THE

ENGLISH CYCLOPÆDIA.

A New Dictionary of Universal Knowledge.

CONDUCTED BY CHARLES KNIGHT.

NATURAL HISTORY.—VOLUME III.

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NATURAL HISTORY.

HABENA'RIA, a genus of Plants belonging to the natural order *Orchidaceæ*. This genus has a ringent hooded perianth, a 3-lobed entire spurred lip. There are three species natives of Great Britain.

H. viridis, the Frog-Orchis, has a very short 2-lobed spur, linear flat 3-pointed lip, the middle point the shortest. The flower is green, and the lip of a brownish colour. It is the *Persistylus* of Lindley, and the *Himantoglossum* of Reichenbach. It grows in pastures.

H. bifolia, the Lesser Butterfly-Orchis, is distinguished by the lip being linear and entire, and the pollen-masses parallel. The flowers are white. It is found in heathy places.

H. chlorantha, the Great Butterfly-Orchis, has the same general characters as the preceding species; but the flowers are larger, and the plant is taller and stouter. The pollen-masses ascend obliquely and converge upwards. It grows in moist woods and thickets.

(Babington, *Manual of British Botany*.)

HABROCOMA, a genus of Mammalian Animals belonging to the order *Rodentia* and the sub-order *Hystricidæ*. Two species were taken by Mr. Darwin near Valparaiso, *H. Cuvieri* and *H. Bennetii*. [HYSTRICIDÆ.]

HABZE'LIA, a genus of Plants belonging to the natural order *Anonaceæ*. It has a 3-lobed calyx; 6 petals, the inner ones smallest; the stamens very numerous; the torus convex; the carpels distinct, indefinite in number, long, cylindrical, obsoletely ventricose or torulose, smooth, striated lengthwise, becoming many-celled by the pericarp growing together; many-seeded, the seeds elliptical, arillate, somewhat erect, numerous, shining, one in each of the cells of the fruit; the arillus formed of two white unequal obcordate membranes.

H. Æthiopica has ovate-acute leaves, 3 inches long, 12 to 14 lines broad, smooth on the upper surface, and downy beneath; the carpels are pod-shaped, 1-2 inches long, knotted, striated, quite smooth, with the taste of pepper. The fruit has a pungent aromatic taste, and is often substituted for other spices. It is the *Piper Æthiopicum* of the shops, and the *Anona Æthiopica* of Duval and other botanists. It is a native of Sierra Leone. *H. aromatica* is another species, yielding a pungent aromatic fruit. It grows in the forests of Guyana, and the fruit is used by the negroes as a condiment.

(Lindley, *Flora Medica*.)

HACKBOLT. [PUFFINUS.]

HADDOCK. [MORRHUA; GADIDÆ.]

HÆMANTHUS. [AMARYLLIDACEÆ.]

HÆMATITE, a name given to certain forms of the native Peroxide of Iron. When of a red colour it is called Red Hæmatite; and when brown, Brown Hæmatite. [IRON.]

HÆMATOCOCCUS (from αἷμα, blood, and κόκκος, a grain), a genus of Plants belonging to the natural order of *Algæ*. It is characterised by being composed of spherical or oval cells of various sizes, each cell being invested with one or more concentric vesicles or membranes, multiplied either by division or by granules formed within the parent cells. Several species of this genus have been described. One of the first observed was the *H. sanguineus*, which, like the Red Snow-Plant (*Protococcus nivalis*), has its cells coloured red; hence the generic name. Several of the species however are of a green colour, and Kützing and others on this account have proposed the name *Microcystis* for this genus of plants.

The species are found upon moist rocks, on the walls of caverns and in damp places. [RED SNOW; PROTOCOCCUS.]

(Hassall, *British Freshwater Algæ; Botanical and Physiological Memoirs of the Ray Society*.)

HÆ'MATOPS, a name given by Mr. Gould to a genus of Birds inhabiting Van Diemen's Land and New South Wales, and thus characterised by him:—

Bill shorter than the head, slightly curved, without any denticle at the apex, rather compressed. Nostrils longitudinal, and covered by an operculum; no bristles at the gape. Wings moderate, first quill short, third and fourth nearly equal and longest. Tail moderate, equal or slightly forked. Tarsi moderate, the rather strong hallux and claw equalling the middle toe and claw; external toes equal in length. Ensanguined spots or marks (nævi sanguinolenti) above the eyes.

Mr. Gould recorded two species, *Hæmatops valdirostris*, 6¾ inches in length (Van Diemen's Land), and *H. gularis*, 6 inches long (New South Wales).

HÆMATOPUS. [CHARADRIADÆ.]

HÆMATORNIS. [FALCONIDÆ.]

HÆMATOXYLON, a genus of Plants belonging to the natural order *Fabaceæ* or *Leguminosæ*. It has 5 sepals united into a permanent tube. The petals, 5 in number, are scarcely longer than the sepals. There are no stamens; the filaments hairy at the base; the anthers without glands; style capillary. The legume is compressed, flat, lanceolate, acuminate at each end, 2-seeded; the sutures indehiscent; the valves bursting longitudinally.

H. Campeachianum, Logwood, a tree common all over the West India Islands. It is a low spreading tree, with a stem generally crooked and deformed, seldom thicker than a man's thigh; the branches somewhat flexuose, terete, covered with whitish dots. In mountain and moist situations it is unarmed, but in the plains, or where the tree is stunted, it is furnished with spines below the leaves; the leaves 2 or 4 from the same point (an irregular tough tubercular prominence), pinnate, sometimes dividing in a bipinnate manner at the lowest pair of leaflets; the leaflets 4-paired, shortly stalked, obovate or obcordate; the racemes at first about the length of the leaf, afterwards, as the pods form, elongating; the flowers on pedicels half an inch in length, yellow, and slightly fragrant; the calyx deeply 5-parted; the lobes unequal, thrice membranous, purplish, deciduous; the tube short, green, and bell-shaped; the petals nearly equal, obovate, wedge-shaped at the base, scarcely longer than the sepals; the stamens alternately short, inserted (as also the petals) on the inside of the margin of the persistent tube of the calyx; anthers ovate; ovary lanceolate, compressed, 3-seeded; style projecting beyond the stamens and petals; stigma capitate, expanded; the pods compressed, flat, lanceolate, acuminate at both ends, 2-seeded, not opening at the sutures, but bursting longitudinally by a division passing down through both the valves. It is chiefly used by dyers. It is a powerful astringent, and may be employed as a substitute for kino, catechu, &c. In diarrhœa and dysentery the decoction is used with benefit.

HÆMOCHARIS. [ANNELIDA.]

HÆMODORA'CEÆ, *Blood-Roots*. Under this name Dr. Robert Brown proposed, in the year 1810, to separate from the natural order *Iridaceæ* the genera *Hæmodorum*, *Conostylis*, *Anigozanthos*, *Phlebocarya*, *Dilatris*, *Lanaria*, *Heritiera*, and *Wachendorfia*. He remarked that they are abundantly different, especially in being hexandrous, or in having the stamens, if only three in number, stationed opposite the petals, and in having the anthers opening on the side next the stigma; the habit was moreover different. This distinguished botanist mentioned in connection with his new order, without actually adding it, *Xiphidium*. The latter genus has more recently been introduced along with *Hagenbachia* as an undoubted member, notwithstanding its having a superior ovary. All the species have equitant leaves, and perennial fascicled fibrous roots or bulb-like corms, and there is also a general appearance of wool upon their flowers, in some cases to such an extent as to bury all the outer surface. The order may be considered a connecting link between *Iridaceæ* and *Liliaceæ*. One species, *Dilatris Heritiera*, yields a dyeing matter in its rhizoma. The species occur in North America sparingly, and at the Cape of Good Hope; several are described from the temperate parts of Australia, and some occur in Brazil and the Mascarene Islands. The natives of Swan River live on the roots of some plants belonging to this order, especially of *Hæmodorum paniculatum* and *H. spicatum*, which are mild and nutritious when roasted, but acrid when raw. One of the most intense bitters known is *Aletris farinosa*. There are 13 genera and 50 species.

Hæmodoraceæ.—Wachendorfia thyrsoidea.

1, a flower spread open to show the position of the three stamens; 2, a ripe capsule; 3, a seed.

HÆMULON, a genus of Fishes of the section *Acanthopterygii* and family *Sciænidæ*. It has the following generic characters:—A single dorsal fin; seven branchiostegous rays; lower jaw compressed, a small oval opening and two small pores under its symphysis; the vertical fins partially covered with scales.

These fishes generally approach to an elongate oval form; the body is moderately compressed; the tail is forked; the dorsal fin, which occupies the greater portion of the distance between the back of the head and the tail, although continuous, has a considerable indentation at that part where the spinous rays join the flexible. The portion of the under jaw which is covered by the upper when the mouth is closed, is invariably of a bright red colour. The species of *Hæmulon* chiefly inhabit the Caribbean Sea, and are eaten by the inhabitants of the West Indian Islands. They are of moderate size, varying from six inches to one foot in length, and generally adorned with longitudinal or oblique dark markings on a pale ground colour.

HAGDOWN. [PUFFINUS.]

HAIDINGERITE. [ANTIMONY.]

HAIL. [SNOW.]

HAIR. The hairy coverings of the *Mammalia* are composed of long delicate processes of a horny substance, which grow from bulbs situated in or beneath the skin. Each hair is contained at its lower part in a delicate sheath, or follicle, which passes obliquely from the surface of the skin on which it opens to a greater or less depth, and at its base dilates into a pouch containing the bulb of the hair. The

bulb of the hair consists of a small cone-shaped body, the pulp soft and delicate, and apparently made up of blood-vessels and nerves, and covered by a reflection of the smooth lining of the sheath of the hair, which is continued from the cuticle covering the surrounding skin. On the whole surface of this bulb the substance of the hair is secreted, and as each layer which is deposited pushes that previously formed onwards, the whole gradually advances along the sheath till it projects beyond the skin, and thence continues to grow free. In the early embryo the sheath or follicle in which the hair is afterwards formed is alone seen, then a delicate vessel may be traced to its base, where a little black spot is soon formed, and this, as all the other parts increase, is gradually developed into a hair. Into each hair-follicle, as Gurlt has shown, there open the ducts of one or two little glands, by which the oily matter is secreted to lubricate the hair and keep it supple and firm, and where these are deficient the same purpose seems to be performed by the follicle itself. The annexed cuts will explain the general mode of formation of hairs, which, it may be observed, is effected in the same manner as that of horn, nail, and many other extra-vascular appendages of animal bodies, namely, by the deposition of successive layers of organic matter on the surface of an abundantly vascular tissue. *Fig.* 1 represents an oblique section of the pulp and lower part of the whisker of a lion, in the Hunterian Museum, in which *a* is the body of the hair, *b* the conical pulp, and *c* a blood-vessel passing into and ramifying in it. *Fig.* 2 is a section of the skin of the upper lip of a lion, with part of a whisker completely formed, and another in progress of growth, from the same collection; *a* is the outer part of the hair-follicle, formed by a deep depression in the skin; *b* is its internal cuticular lining; *c* the contained hair; *d* the sheath containing the vessels and nerves, passing to the base of the follicle and bulb of the hair. *Fig.* 3 is a section of the skin, containing a hair from the human scalp, from the figure by Gurlt, in Müller's 'Archiv für 1835:' here *a* is the thin cuticle, *b* the cutis, *c* the subjacent fat, *d* the cellular tissue, in which the base of the hair-follicle *e* is seen; *f* is the hair itself, enlarged at its base, and *g g* are the two sebaceous glands opening into the sheath.

Fig. 1.

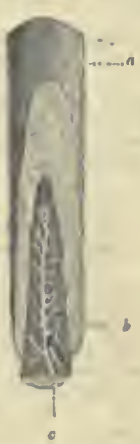


Fig. 3.

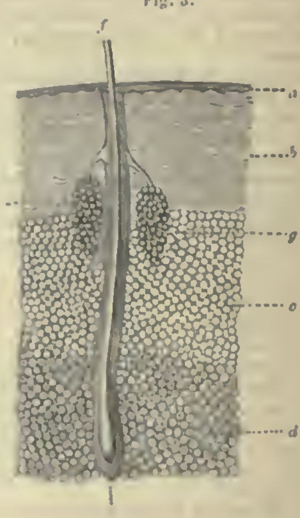
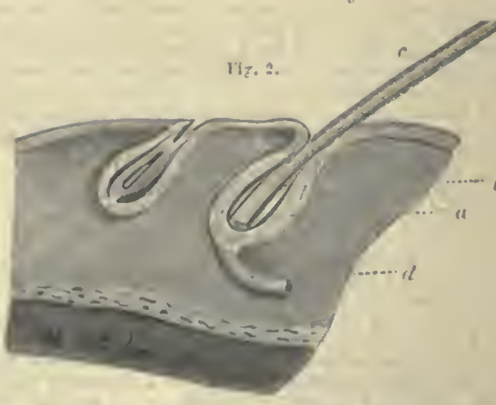


Fig. 2.



In man the hairs are not, as has been generally supposed, perfectly cylindrical. Weber has shown that they are all more or less flattened, so that a transverse section presents an elliptical form, or sometimes, from one side being grooved, has the shape of a bean. The hair of the whiskers, beard, and mustachios, and in general all short curly hair, is most flattened. In most instances flatness and curliness are directly proportionate, and both attain their maximum in the crisp woolly hairs of the negro, which are sometimes as much as two-thirds broader in one direction than in the other. The hair of the negro however, though called woolly, differs considerably from the wool, properly so -named, of sheep and other animals: the latter is not spirally curled, but wavy, all its curves being nearly in the same plane; it is much more delicate, and perfectly round, and hence, from its being equally fitted to curl in any direction, is peculiarly adapted for spinning, while the flattened hairs of men have always a tendency to turn their broadest surfaces towards the middle of the curl.

Except at their base, into which the conical pulp enters to a variable distance, the hairs are perfectly solid, and in most animals their substance is similar throughout. Weber has shown that the appearance of a central canal running along them, and of a softer internal than external material, has resulted from microscopic errors, occasioned by the unequal refraction of light passing through their rounded or grooved surfaces. Only in the lion, zebra, and llama, did Weber find that the internal part seemed rather paler than the outer; in the roebuck and a few other animals he found the cellular structure which has been sometimes erroneously supposed to exist in all hair. The cells are all hexagonal, much like those in the cellular tissue of plants. The average diameter of hairs from the human head are respectively about 1-300th and 1-500th of an inch, and hairs often attain a length of 6 or 7 feet in women. Instances are recorded also of the hair of the beard growing to a length of 9 feet. They are generally of the same thickness throughout their whole length in man, but in the finer kinds of wool they are of unequal size at different parts. This seems to indicate an occasional alteration in the size or activity of the pulp, a supposition which is further supported by the varieties of colour which the same hair sometimes presents, as in those animals which seem to have gray furs, but in which each hair is made up of alternate bands of black and white. In man however nothing of this kind occurs; the colour of each hair is uniform, the appearance of grayness being produced by a mixture of completely white with dark hairs. The colour of the human hair generally varies with the colour of the iris and the general dark or light hue of the skin. Commonly, the darker the hair the more robust the body, and the coarser the skin and other tissues; and this holds still more with animals than in man, for not only are white or gray horses less healthy and vigorous than dark ones, but if one or two of a dark horse's legs be white they are always more liable to injury and to disease.

Hairs are capable of movement, and the standing of the hair on end from alarm is not imaginary. It is found that each bulb of the hair is supplied with a minute muscle, which acts in producing movement of the hair. (Lister, On the Muscular Tissue of the Skin, 'Microscopical Journal,' vol. i. p. 263.)

Hairs are very elastic; they admit of being stretched nearly one-third of their length, and regain their original length almost completely: in proportion to their size they are very tough and firm. In masses they are impenetrable, except to very great violence, and hence one of their uses in the thick coverings of animals; they are also adopted in armour, as for the coverings of helmets. They are extremely bad conductors of heat, and they are generally found most thick and abundant in animals subject to long exposure to cold, in whom moreover an additionally thick coat is provided at each winter after the annual shedding. They are non-conductors of electricity, and when rubbed with almost any other substance so large a quantity of negative electricity is developed that in the dark even sparks may be seen, and the peculiar crepitating sound of rapid little electrical discharges may be heard. This is especially the case with the drier hairs of cats, dogs, &c.; but the weaker electrical phenomena may be observed by rubbing the human scalp. Hair is also remarkably hygrometric, attracting and retaining in its tissue a large quantity of moisture, in consequence of which it becomes flaccid and lengthens, and hence it is used in the construction of the more common hygrometers. It assists also to shield the skin from moisture by its oily surface, and when thick presents almost an impenetrable barrier to water. Thus serving to isolate the animal from the three most powerful external agents, heat, electricity, and moisture, it is scarcely possible to imagine any structure better adapted for the external covering of the whole body, whose motions it is too light to impede, and to whose beauty it so remarkably contributes.

In chemical properties hair resembles horn, nails, &c. It is soluble in water at a very high temperature, as in a Papin's digestor, leaving a large quantity of oil mixed with sulphuret of iron, and some sulphuretted hydrogen. It is this oil, with the sulphuret of iron, which gives the colour to the hair, and by whose absorption grayness is produced. The iron is most abundant in the darkest hair, and the sulphur is the ingredient on which the action of the various black dyes for red or gray hair depends. These are all composed of some salt of silver or lead, which, mixed with some oily or fatty substance in the form of pomatum, insinuates itself into the hair, where it is decomposed and a black sulphuret of silver or lead is formed. Hair is soluble in alkalies and alkaline earths, and for this reason the depilatories in common use are chiefly composed of quick-lime, which however is materially injurious to the skin at the same time that it removes the hair. Hair contains a very small quantity of water, and when burnt leaves a large proportion of ashes, containing iron, manganese, and various salts of lime; it is owing to these properties that hair is peculiarly indestructible, and has been found unaltered on mummies more than twenty centuries old. It has even been supposed to grow after death, but it is probable that, in the few authentic cases in which this is stated, it was owing to the lengthening of the hair by the attraction of moisture from the body or surrounding atmosphere, and to the more rapid drying and contraction of the adjacent tissues.

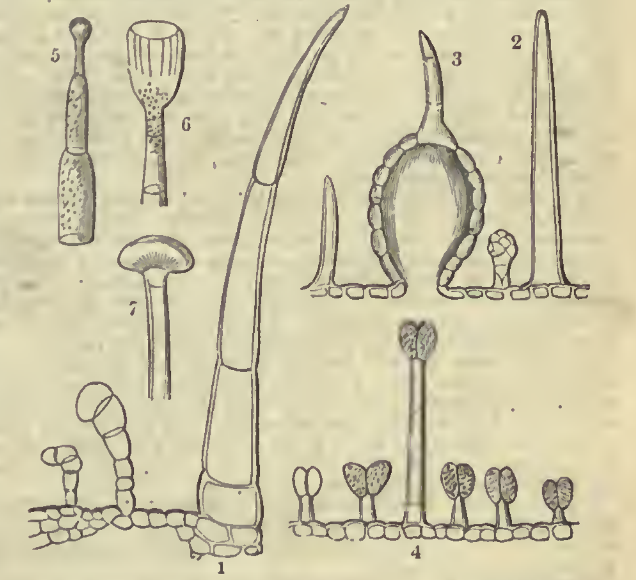
Little need be said of the diseases of hairs. Possessing neither vessels nor nerves, except at their base, they are rarely altered except by the diseases of the skin itself. [ENTOPHYTA.] Their fall, as it is called, is in most animals annual, but in man seems not to occur except by accident, or after particular diseases. The process by which it takes place is unknown, but is probably similar to that of the shooting of the quills of the porcupine, by the gradual approximation of the base of the follicle to the surface. Their loss of colour, which is sometimes exceedingly rapid, is owing to deficient secretion of the colouring oil, and can only very rarely be remedied. When sufficient moisture is not supplied they sometimes split at their points like bristles; at others they break at the middle of the shaft, snapping off, and leaving a little fringed extremity to the stump. The most singular alteration however to which they are subject is that called the 'plica polonica,' from its occurring almost exclusively in some towns in Poland, in which, with so much general disease as sometimes proves fatal, the hair of the head becomes sticky and matted together, when touched gives extreme pain, and is sometimes said even to bleed when cut. This fact cannot however be regarded as evidence of the hair naturally containing vessels, though it indicates an elongation of the pulp to some distance beyond the skin, just as is the case in dogs, whose whiskers will sometimes bleed if cut very close to the surface. [SKIN.]

(Weber, in Hildebrandt's *Anatomie*, vol i.; Gurlt, in Müller's *Archiv für Anatomie und Physiologie*, 1835; Kölliker, *Manual of Human Histology*, translated by Busk and Huxley for Sydenham Society.)

HAIRBELL. [CAMPANULA.]

HAIR-GRASS. [AIRA.]

HAIRS. In plants these are long expansions of the cuticle, chiefly intended to answer the double purpose of collecting moisture from the atmosphere and of protecting the surface of a plant from the too powerful influence of the sun's rays. It is supposed that they are also destined to assist in the conveyance of certain kinds of seeds through the air, and in other cases, as in that of cotton, they are specially adapted for the use of man. That the two first purposes are those for which hairs growing on the surface of plants are intended, seems sufficiently indicated by the following facts:—



1, common hairs of the stem of *Bryonia alba*, becoming glandular at the base or apex; 2, 3, a mixture of hairs (2) and glands (3) from the stem of *Dictamnus*; 4, double glands at the point of the hairs of *Lysimachia vulgaris*; 5, a hair glandular at the apex, from *Primula Sinensis*; 6, gland on the end of the hairs of *Sisymbrium Sophia*; 7, one of the yellow glands found on the head of the hairs of *Scrophularia nodosa*.

In all cases hairs are composed of lengthened cells of cellular tissue, extending from one or more of the cells of the cuticle. Most commonly they are quite simple, and are merely formed of several cells of equally diminishing size, placed end to end, or of a single cell. Of the latter kind are the long entangled hairs that clothe the surface of the cotton-seed, and which are manufactured into thread and linen.

Sometimes several such hairs spring from a common point as in Malvaceous and Euphorbiaceous plants, and *Marrubium creticum* (*fig.* 8); these are technically called stellate. Others branch in various ways, as in *Nicandra anomala* (*fig.* 9), and from such the woolly appearance of the surface of plants often takes its origin. It sometimes happens that the cell, out of which a hair is formed, instead of growing perpendicular to the surface, lengthens in a parallel direction, growing at two opposite sides; cases of this sort are found commonly in Malpighiaceous plants, and in the common hop. (*Fig.* 10.) Finally, in those instances where the terminal cell enlarges and is furnished with an aperture, hairs become glands, and consequently secreting organs. (*Figs.* 1, 2, 3, 4, 5, 6, 7, 10, 11.)

Hairs of Plants.

The mechanism of stinging hairs in *Urtica*, *Wigandia urens*, and the *Loasaceæ* is very interesting. Almost all stinging hairs end in a little knob-shaped swelling, which is exceedingly brittle, and easily knocked off by a touch. The opened point, on being pressed against, exudes the secretions contained in the cells at the base of the hair, and will produce poisonous effects when introduced into animal tissues. Our indigenous nettles are the least injurious. The stings of the *Loasaceæ* are much more so, while the *Urtica crenata* and *U. crenulata* of the East Indies produce wounds in which pain is felt for weeks and months after touching them. The most dangerous of all is the *Urtica urentissima* of Blume, called in Timor, Daonn Setan, and by the English Devil's Leaf. The wounds of this plant give pain for years after, especially in damp weather, and occasionally death from tetanus is the result. Could we separate this poison, it would be the most powerful vegetable poison known.

In the early stages of growth these hairs, all of them, possess an active circulation of the sap. Some hairs have their contents absorbed at a special time, so that the hair is, as it were, absorbed into its own proper cavity. This remarkable phenomenon takes place in the hairs of the style in *Campanulaceæ*. Also in the globular cells of knob-shaped hairs, which then look as if half had been cut through, or as if a cover had been removed. Meyen has published a work on hairs, distinguished by many peculiarities, but will repay perusal.

Aquatic plants are said to have no hairs, but in the case of *Callitriche verna* and *Hippuris vulgaris*, Dr. Lankester has demonstrated the existence of rosette-shaped bodies, which are evidently homologous with hairs. In *Callitriche* they are composed of four or five cells attached to a central cell, which serves as the point of attachment to the epiblema or cellular layer of the leaf and stem. An organ of a similar kind occurs in *Pinguicula vulgaris*.

The hairs of the *Drosera rotundifolia* contain spiral vessels. This would indicate that the bodies thus named belong to the vascular system of the plant, and ought rather to be regarded as segments of the leaf than as true hairs.

In consequence of the hairs of plants being an extension of cellular tissue, which is naturally thin-sided, all hairs are much weaker than the tough thick-sided tubes of which woody tissue is composed. This accounts for the well-known fact that all goods manufactured from cotton, which is vegetable, are far less tough and durable than those which, like linen, are prepared from the tissue of bark or wood. When the two forms of matter are submitted to microscopical examination, the thin sides and transverse partitions of the former will usually distinguish it from the thick-sided tubes of the latter, in which no partitions are discoverable.

(Schleiden, *Principles of Scientific Botany*, tanslated by Lankester; *Report of Twentieth Meeting of British Association*.)

HAIR-SALT. The efflorescence of native Sulphate of Magnesia is thus called.

HAIR-TAIL. [TRICHIURUS.]

HAJE, a name of a venomous Serpent, *Coluber Haje* of Linnæus. [NAIA.]

HAKE. [MERLUCIUS.]

HALCYONIDÆ, a family of Birds belonging to the Fissirostral Tribe, of the order *Insessores*, or Perching Birds, according to the system of Mr. Vigors. [INSESSORES.] This family includes the beautiful birds known by the name of Kingfishers.

In Willughby's 'Ornithology,' edited by John Ray, the "Kingfisher —*Ispida* an veterum *Alcyon*?" is placed at the head of "Land-Birds that feed upon Fish."

Ray, in his 'Synopsis,' gives the bird the same title and position; but the heading varies a little from that of Willughby; for Ray makes the Kingfisher the first of his "Aves terrestres, aquas frequentantes, rostris longis, piscivoræ."

Brisson arranged the Kingfishers (Martin-Pêcheurs) in company with the Todies, as the two genera forming the third section of his fourteenth order, consisting of those birds which have the middle of the three anterior toes united to the external one up to the third joint, and to the internal one up to the first.

Linnæus placed the Kingfishers under his order *Picæ*, between *Todus* and *Merops*, with the generic appellation of *Alcedo*, and the following definition:—" Bill trigonal, thick, straight, and long. Tongue fleshy, very short, flat, and acute. Feet gressorial in most."

Latham's second order, *Picæ*, is divided into three sections. The third of these consists of birds with gressorial feet, and consists of the Motmots, the Hornbills, the Kingfishers, the Todies, and the Bee-Eaters.

Lacépède's thirteenth subdivision consists of birds whose external toes are united almost throughout their length (Platypodes): his seventeenth order (which, with the sixteenth, eighteenth, nineteenth, and twentieth, comes under this subdivision) consists of the genera *Alcedo* and *Ceyx*.

The tenth and last family of M. Duméril's second order (Passereaux) consists of the *Tenuirostres*, or *Leptorhamphes*. It contains many genera, the Kingfishers, the Todies, the Bee-Eaters, the Humming-Birds, the Creepers, the Hoopoes, &c.

The fourth order in the method of M. Meyer comprises the genera *Merops* and *Alcedo* only.

Illiger's *Ambulatores* form his second order, the first division of which, the sixth in relation to the consecutive numbers, is termed *Angulirostres*. This division comprehends the genera *Alcedo* and *Merops* only. It is preceded by the *Syndactyli*, the last division of his first order, *Scansores*; and the *Syndactyli* consist but of one genus, *Galbula*. It is immediately succeeded by the *Suspensi*; and *Trochilus* is the only genus of this division.

Cuvier's *Syndactyles*, the fifth division of his second order, Passereaux, comprise the genera *Merops*, *Prionites* (Motmots), *Alcedo*, *Ceyx*, *Todus*, and *Buceros*.

M. Vieillot makes the *Sylvicolæ* the second order in his arrangement. The second tribe of this order (*Anisodactyli*) is made up of numerous families. The twenty-fourth consists of the Bee-Eaters and Kingfishers. It is immediately preceded by the *Epopsides*, and immediately succeeded by the *Antriades* (*Rupicola*), the twenty-sixth (*Prionotes*) consisting of the Motmots and *Calao* (Hornbills).

The Alcyons, the seventh order of M. Temminck, consist of the Bee-Eaters, the Kingfishers (Martin-Pêcheurs), and the Kinghunters (Martin-Chasseurs).

In the method of M. De Blainville h's *Scansores* are divided into the Hétérodactyles, the Zygodactyles, and the Syndactyles. *Alcedo* (Linn.) is the representative of the latter. In the method of the same zoologist, as developed by M. Lherminier, the Kingfishers (Martin-Pêcheurs—*Alcedo*, Linn.) are placed in the first or normal subclass, and form the thirteenth family, coming between *Merops* and *Buceros*.

Mr. Vigors, in his paper 'On the Natural Affinities that Connect the Orders and Families of Birds,' observes, that if the genus *Todus* of authors be examined with reference to its general affinities, an intimate resemblance will be found between it and the succeeding group of *Halcyonidæ*; since the only species known when he wrote exhibits the exact representation of a Kingfisher, with the exception of a shorter and more depressed bill. He is of opinion that we are thus conducted to the Halcyon of Mr. Swainson, a genus which he thinks extremely distinct and well-defined (regretting however—and with justice—that the name had not been retained for that group of the family which includes the European Kingfisher, the bird known to the ancients under that name), and from that genus to the *Dacelo* of Dr. Leach, until, in the more slender bill of *Alcedo*, is found an approaching conformity to the more delicately-shaped bills of the succeeding family of *Meropidæ*. In the group of *Halcyonidæ* he places the *Galbula* of Brisson, which, though distinguished from the groups of which Mr. Vigors is treating by its zygodactyle feet, and as such arranged by modern writers among the true *Scansores*, was, Mr. Vigors observes in continuation, originally included in the genus *Alcedo* by that great master of natural affinities, Linnæus, on account of the identity of the general structure and economy of both groups. Here

Mr. Vigors thinks that it must necessarily be placed, if we look to natural affinity rather than the strict dictates of artificial arrangement; and with it he fancies may be placed some apparently conterminous groups, *Capito* of Vieillot, and some of its affinities, &c., of which the toes are equally disposed in pairs. The relationship of all to the true *Scansores* may, he says, be accounted for by the consideration of that tendency which opposite sides of a circle of affinity generally evince to approach each other. The very difference however between the feet of *Alcedo* and *Galbula* (which two groups, at the same time, he adds, it must be remarked, agree more intimately in every particular of the leg and foot, except the scansorial disposition of the toes, than *Galbula* accords with any of the *Scansores* in the same characters), is lost in a species of *Galbula* which Mr. Vigors had lately inspected from Brazil, where one of the hind toes is wanting, and where the foot thus exactly corresponds with that of the three-toed *Halcyonidæ*, or the genus *Ceyx* of M. Lacépède. The singular and beautiful species of the Linnæan *Alcedo*, the Ternate Kingfisher, which Mr. Vigors characterises as a genus under the name of *Tanysiptera*, shows, in his opinion, the equal approximation of that genus to *Galbula*, and a deviation from its own type, its tail deserting the shortened character of that of the true Kingfisher, and assuming the lengthened and graduated conformation of the same member in the Paradise Jacamar and the other long-tailed *Galbulæ*. Having now arrived at the last family of the tribe, Mr. Vigors directs us to look for that connecting affinity which will lead us back to that other family of it with which he commenced his observations. Here again, he remarks, the universally-acknowledged relationship between the *Halcyonidæ* and the *Meropidæ* leaves him nothing to observe. He refers to the gradually-attenuated bills of *Alcedo* and *Galbula*, and the increasing length of the tail in the latter genus, as softening down the differences by which those families, united by general habits and economy, alone appear to be separated. Thus the circular succession of affinities by which the tribe of *Fissirostres* returns into itself appears to Mr. Vigors to be complete.

The fifth and last family of M. Latreille's second order (Passereaux) consists of the Bee-Eaters, Motmots, Todies, Kingfishers, the genus *Ceyx*, and the Hornbills. The fourth family comprises the *Tenuirostres*, and the *Scansores* (Grimpeurs) form the order which immediately follows the Passereaux.

Prince Bonaparte, in his 'Tabella Analitica de' Generi' ('Specchio Comparativo,' 1827), makes the tribe *Ambulatores* immediately follow the tribe *Scansores*. The first family of the *Ambulatores* consists of the genera *Alcedo* and *Merops*.

In M. Lesson's 'Projet' the third tribe (Syndactyles) of the first order, *Insessores* or *Scansores* (Grimpeurs), includes four families, in the following order:—*Meropidæ*, *Halcyonidæ* (Alcyonées), *Rupicolidæ* (Rupicolées), and *Buceridæ*.

In the 'Table Méthodique,' at the end of his 'Manuel,' Lesson makes the family *Meropidæ* comprise the genera *Merops*, *Alcedo*, *Dacelo*, *Ceyx*, *Syma*, *Todiramphus*, *Momotus*, and *Buceros*.

Mr. Eyton, in his arrangement, published in his 'History of the Rarer Species of British Birds' (1836), makes his fourth family (*Tenuirostres*, Cuv.) of his second order (*Passeres*, Linn.) consist of three divisions:—1st, the *Anisodactyli*, Temm.; 2nd, the *Syndactyli*, Cuv.; and 3rd, the *Alcyones*, Temm. The latter division contains the genus *Alcedo*, Ray, whilst *Merops* is arranged under the *Syndactyli*.

Mr. Swainson, in the first volume of his 'Classification of Birds' (1836), when treating of the Syndactyle foot, allows the term to be good, if limited to such feet, with united toes, as are of a different formation to all others; and would not, even if the toes were free, come under any of the definitions which he had previously given. Such a form of foot, he says, will be found in the genera *Merops* and *Alcedo*, containing the Bee-Eaters and Kingfishers, to whose feet, 'par excellence,' he limits the term Syndactyle. "The habits of these two groups," continues Mr. Swainson, "as far as concerns the use of their feet, are nearly the same, for in neither are these members ever employed but to rest the body. The Kingfisher watches patiently from a fixed station, generally a naked twig overhanging the water, for such fish as come within its reach; and then, after a time, flies to another station, where it alights and remains. The feet, from not being used for walking or standing, are consequently very small, and the toes imperfectly developed: there are three in front and one behind, but two of the former might almost be reckoned as only one, since they are united together even to the commencement of their respective claws; the inner toe is not half the length of the others, and seems rudimentary; it has a claw, and is rather more detached at its tip than the other two; in some, as in the three-toed Kingfishers, this inner toe disappears. The hinder toe is very short, and scarcely longer than the inner one; the scales of the whole foot are so thin and transparent that they can scarcely be seen in the small species by the naked eye. Those who have seen so much of the true Kingfishers, so scarce in England but so common in Tropical America, know that they never perch upon any other than small or slender branches; and this we may infer from the shape of the foot. The two outer anterior toes are very long, so that they would completely clasp two-thirds of the circumference of a small branch, the other third being embraced by the hinder toe. This fact is further confirmed by the unusual flatness of the soles of all, and by the acuteness of the claws, which from being but slightly curved would not upon a small branch come into contact with the wood; the union of the three anterior toes, by producing considerable breadth of sole, gives an unusual degree of steadiness to the bird, highly conducive to its remaining very long in one position. Thus we see that the foot of the Kingfisher, which at first appears so very imperfect, and so totally useless for ordinary purposes, is that which is most of all suited to the habits and the wants of the bird. The Bee-Eaters, like the Swallows, feed upon the wing, yet, unlike those birds, they never perch upon the ground; at least we can affirm this of the European species (*Merops Apiaster*), which visits the island of Sicily every year in great numbers, and remains for near a month, on its passage from Africa to middle and southern Europe. During this period we have sought for many years every opportunity of detecting these birds in their resting position, but never were successful in finding them otherwise than on the tops of the olive-trees, where they rest immoveable until they again dart off for another long excursion. It is indeed obvious that they could not walk, for their feet are much the same as the Wood Kingfishers (*Dacelo*), with this only difference, that the three anterior toes are divided the whole length of their last joint, the scales being rather more conspicuous."

In the second volume of the same work Mr. Swainson speaks of the *Halcyonidæ*, or Kingfishers, as obviously connected with the *Meropidæ*, next to which he arranges them. These comprise, he observes, several well-marked genera, agreeing among themselves in the great length of their bill and in the extreme shortness of their feet. These characters, he adds, it is true, belong also to the true Bee-Eater; but a remarkable difference in economy is developed in the Kingfisher. "We have seen," continues Mr. Swainson, "that the Goat Suckers, Swallows, and Bee-Eaters trsverse the air to search after and pursue their prey; their wings are consequently adapted for long and continued flight; but the family before us have a different economy, and therefore a different organisation. The whole of the genera are sedentary, watching for their food from a fixed station, which they only quit as soon as their prey approaches sufficiently near to come within the sweep of their wings; if unsuccessful in their first attack they do not pursue their game, but return again to their post, and patiently wait for another luckless straggler; if their first attack is successful they return with their victim to the same station, and then proceed to swallow it. Every one knows that these are the habits of the European Kingfisher (*Alcedo ispida*), and travellers affirm that the Kinghunters (*Halcyon*) pursue the same method in the forests of the Old World. But it has unfortunately happened that systematic naturalists, totally unacquainted with the natural habits of the other genera (nearly all of which are confined to Tropical America), have fancied they were climbing-birds, and have consequently placed them in other orders whose organisation and economy are widely different. Thus the Jacamars in the 'Règne Animal' are placed after the Hornbills, and the Puff-Birds (*Tamatia*) are associated with the Cuckoos."

The following characters are assigned by Mr. Swainson to the *Halcyonidæ*:—Wings rounded, not formed for rapid flight. Feet very feeble. Toes in pairs. He makes the family consist of the following genera and sub-genera:—Genus *Tamatia*, comprising *Tamatia*, Cuvier; *Capito*, Vieillot; *Lypornix*, Wagler; *Monassa*, Vieillot; and *Brachypetes*, Swainson.—Genus *Halcyon*, Swainson, including *Dacelo*, Leach; *Halcyon*, Swainson; *Syma*, Lesson; *Todiramphus*, Lesson; and *Ceyx*, Lacépède.—Genus *Alcedo*, Linnæus, comprehending *Alcedo*; *Ispida*, Swainson; *Tanysiptera*, Vigors; and *Alcyone*, Swainson.—Genus *Lamprotila*, Swainson.—Genus *Galbula*, Linnæus (Brisson, we suppose, is meant; Linnæus has no such genus).

Tamatia (Puff-Birds).—Bill straight, compressed. Nostrils defended by long stiff incurved feathers and bristles. Rictus strongly bristled. Toes versatile, as in *Cuculus*. (Swainson.)

Under the article BARBETS is a figure of *Tamatia macrorhynchos*, with Mr. Swainson's description of the habits of the Puff-Birds in general. In his 'Classification of Birds,' vol. ii., the same author states that the Hermit-Birds (*Monassa*) have similar habits, and frequently rise up perpendicularly in the air, make a swoop, and return again to their former station.

The sub-genera he characterises as follows:—

Tamatia.—Bill moderate, thick, conic; the tip but slightly bent. Tail narrow. Conirostral. *T. maculata*, 'Brazil. Birds,' pl. 11.

Capito.—Bill long; the tip abruptly bent, so as to form a hook. Tail narrow. Dentirostral. *C. leucotis*, 'Brazil. Birds,' pl. 11; *C. somnolentus*, *ib.*, pl. 9.

Lypornix.—Bill moderate, defended by very long bristles. Both mandibles nearly equal. Wings very short, rounded. Tail narrow. Tenuirostral. *L. striata*, 'Brazil. Birds,' pl. 34; *L. rubicula*, *ib.*, pl. 25.

Monassa.—Bill as in *Lypornix*, without the basal bristles, but with short setaceous feathers. Wings short. Tail lengthened, and very broad. Scansorial. *M. leucops*, 'Brazil. Birds,' pl. 12.

Brachypetes.—Bill as in *Lypornix*, but shorter, higher, and more curved; the margins greatly inflexed. Wings long. Tail short and even. Fissirostral. *B. tenebrosa*, 'Brazil. Birds,' pl. 35.

All these are inhabitants of the New World.

Halcyon.—Bill long, very straight, cylindrical; the sides widened;

the base more or less depressed; gonys ascending. Feet syndactyle. (Swainson.)

The following sub-genera are thus characterised:—

Dacelo.—Margin of the upper mandible considerably sinuated near the tip. Wings lengthened; the quills slightly mucronate. Tarsus [illegible] with rough scales. Australian range. (Swainson.)

D. gigantea, the Gigantic Dacelo, *Alcedo gigantea* of Latham; *Alcedo fusca* of Gmelin.—Body olive-brown, beneath whitish; tail banded with black and ferruginous, the tip white; upper mandible blackish, under one whitish with a blackish base. Male, with its head slightly crested, the crest fuscous; legs yellow; belly banded with blackish. Female with the crown of the head brown, without a crest; legs [illegible]. ('Zoological Miscellany,' vol. ii.)

Gigantic or Great Brown Kingfisher (*Dacelo gigantea*).

Dr. Leach gives Australia as the habitat of this bird, where, he adds, it is a very common bird, and he says that it is known by the appellation of Gigantic or Great Brown Kingfisher. In Governor Phillip's 'Voyage to Botany Bay' (London, 4to, 1789), the Great Brown Kingfisher is described at length, with the observation that these birds vary much, the colours being more or less brilliant, and in some of them the tail is marked as to be wholly barred with white and black, and the legs brown or blackish. The species is there said to inhabit various places in the south seas, being pretty common in New Guinea; but the specimen from which the figure given in the work was taken was sent from Port Jackson, where it is said to be not unfrequently met with. It is the Laughing Jackass of the colonists of Sydney, and Cuck'unda of the natives, according to Lesson, who says it is very common on the banks of Fish River, where he killed a great number.

Halcyon.—Bill long, straight, broad, nearly quadrangular; culmen slightly inclining towards the tip, near which the margin is slightly sinuated; gonys smooth. Wings broad, short, rounded. Tail very short. Feet syndactyle, scales of the tarsus obsolete. (Sw.)

The generic character above given appears in Mr. Swainson's 'Classification of Birds.' In his 'Zoological Illustrations' (1st series), he states that the two extreme points of difference in the Linnæan Kingfishers are seen in *Alcedo ispida* and *A. gigantea*, "the last of which has been made into the genus *Dacelo*. It will nevertheless be found that [illegible] among the birds left in the old genus there are a great number (of which indeed this bird, *Halcyon cinnamomina*, as it is there named, is a striking example), which are much nearer allied to *Dacelo* than to *Alcedo*, where they now stand. It will appear therefore more natural to consider *Halcyon* and *Dacelo* as one genus, which may be called by either name, but which must be distinguished by the characters herein given to *Halcyon*, inasmuch as the generic definition of *Dacelo* (founded on one bird) will be found too restricted to comprehend all."

Mr. Swainson then proceeds to give the following description of "*Halcyon cinnamomina*, the Cinnamon Crab-Eater," from a bird in the possession of Mr. Leadbeater, by whom it was received from New Zealand, and who gave Mr. Swainson the opportunity of publishing his figure and description.

Total length ten inches; bill two and a half inches from the gape, and one and a half inches from the nostrils; the tip of the upper mandible with a slight inclination downwards, and with an appearance of a notch; the whole head, neck, and under plumage of a delicate fawn colour; under wing-coverts the same; the remaining upper plumage with the wings and tail changeable blue green; ears sea-green and dusky united to a narrow black nuchal collar; wings four inches long, and the tail, which is even, three and a quarter inches; the hind head is slightly crested, and the feet pale-brown. (Swainson.)

Cinnamon Crab-Eater (*Halcyon cinnamomina*). Swainson.

Syna.—Bill long, enlarged at the base, compressed and thin on the sides towards its extremity, upper mandible slightly curved from the base to the point (which is very sharp), and longer than the lower mandible, which is carinated below and convex, and very sharp at its point, which is lodged in the groove (rainure) of the upper mandible; edges of both mandibles furnished for two-thirds of their length with sharp serrated teeth, strong and numerous, and directed from before backwards. Lower space around the eye naked. Third and fourth quills equal, long, the first short. Tarsi moderate, the three anterior toes united, the external toe shortest. Wings short. Tail moderate with unequal feathers to the number of ten great ones, and two external small ones. (Lesson.)

S. Torotoro, Less. (*Alcedo ruficeps*, Cuv.). Length 7 inches from the tip of the bill to the extremity of the tail. The bill 2 inches from the commissure to the point, and the tail 17 lines. Bill entirely of a brilliant golden yellow; head and cheeks of a bright uniform cinnamon yellow separated by a brighter tint in the form of a collar from the mantle (manteau) by two spots of a deep black, which do not entirely unite upon the neck. Around the eye a black circle; feathers of the mantle velvet-black, those of the wing-coverts uniform blue-green, rump bright green; quills brown within and bordered with metallic greenish externally; tail-feathers equal, of a rather deep-blue above and brown below. Throat of a light but very clear yellowish, which becomes deeper on the sides of the belly and breast, to become lighter and pass into whitish on the abdomen (bas-ventre). Feet rather strong, of a bright yellow; nails black. (Lesson.)

M. Lesson, who established this genus, states that it haunts the banks of the sea, among the Mangroves—palétuviers—(*Bruguiera*). He says that it skims the shores (grèves) for the purpose of seizing as it flies the small fishes which its strongly dentilated bill secures. He also observed many individuals skimming in their flight the waters of the small streams which are discharged into the harbour of Dorery at New Guinea, and he says that the Papuans name the bird Torotoro, doubtless from its cry.

Todiramphus.—Bill straight (the lower mandible very slightly swollen or convex), very much depressed, wider than it is high, without any arête, the mandibles equal, obtuse at the end and flattened, the edges being entirely smooth. Nostrils basal, the fissure oblique and hardly apparent, bordered by the frontal feathers. Wings short, rounded; first quill shortest, and the fourth longest. Tail long, the feathers equal, and twelve in number. Tarsi elongated, moderate, and reticulated. (Lesson.)

M. Lesson, who established this natural group, states that they live in the islands of the South Seas. They inhabit the woods, and perch almost constantly on the cocoa-palms (cocotiers). Their nourishment is only composed of small flies (moucherons), which they seize when the insects come to pitch on the spathes charged with the flowers of the palm. The islanders name them O-tataré. They were sacred birds, and it was forbidden to kill them under severe penalties. Their skins were offered to the great god Oro.

T. sacer; Alcedo tuta, Gm. and Lath.; *Alcedo sacra*, Gm. and Lath.; Sacred King's-Fisher, Lath. Total length, 8 inches 6 lines; bill, 21 lines from the commissure to the point; tail, 3 inches. Bill black, white at the origin of the lower mandible; summit of the head covered with brownish-green feathers, which form a sort of hood (calotte), separated by a large white streak which rises on the front, passes above the eyes, and continues behind the occiput. A large black line (trait) springs from the eye, and taking a tinge of green and then of brown, forms a border to the white line and circumscribes it. Throat, breast, and all the upper part of the body pure white; a very large, whitish, demicollar, waved (sinuolé) with light brown and very light chestnut, occupies the upper part of the mantle, and is bordered with black; the back, coverts of the wings, rump, upper part of the tail and wings, are uniform bluish-green; the greater quills are brown and blue on their external border; the other quills (remiges moyennes) terminated with brown. Tail brown below. Tarsi black. The wings extend to the upper third of the tail.

Sacred King's-Fisher (*Todiramphus sacer*).

M. Lesson, whose description we have selected, says that the species is very common in the Islands of Otaheite, or Taheite, and Borabora. It perches on the cocoa-palms, and the natives call it O-tataré. Its flight is short, and it is not timid. It lives on the insects which the honied exudations of the cocoa-flowers attract. This species and *Psittacus Tahitensis* remain constantly on the cocoa-nut trees, which form girdles on the shores of all those islands.

Dr. Latham remarks that his Sacred King's-Fisher has been found in Dusky Bay, New Zealand, where it is called Ghotaré.

Ceyx.—Bill entirely straight, long, a little flattened vertically, the mandibles of equal height, smooth on their edges, having each a rounded arête on their middle and the points equal and blunt; nostrils basal, oblique, and small. Third quill the longest. Tail very short, the feathers slightly unequal. Tarsi short, delicate, with only three slender toes, of which the two anterior are strongly united, and the hind toe free. (Lesson.)

M. Lesson remarks that the genus is founded on the *Alcedo tridactyla* of Latham, of which the Martin-Pêcheur de l'Île de Luçon of Sonnerat is only regarded as a variety. He also notices the *Ceyx azurea*, *Alcedo azurea* of Latham, and the *Ceyx Meninting* (*Alcedo Biru* of Horsfield?). He remarks that *C. azurea* was killed on the edge of the harbour of Doréry, in New Guinea, and that Latham indicates Norfolk Island, and Lewin, Port Jackson, as its habitats. The *C. Meninting* (Meninting-Watu, or Burung-Biru of the Javanese), which he considers identical with *Alcedo Bengalensis* of Edwards, inhabits, he says, the banks of the small streams round the harbour of Doréry, at New Guinea.

Dr. Horsefield describes the Burung-Biru as by no means uncommon in Java. He observed it chiefly in the interior, in low situations; but it was also found in the maritime districts. Its habits and manners were those of the European Kingfisher. It darts in short rapid flights along the surface among rivulets and lakes, emitting as it moves shrill sounds in a high key. These sounds are so strong and acute, that when the bird is near they strike the ear in an unpleasant manner. It is not unfrequently observed perched on trees on the banks of rivulets, and its food consists of small fishes and of aquatic insects. ('Zool. Researches in Java.')

Sonnerat describes his second species of Kingfisher, from the Isle of Luçon, as about one-third less than the Kingfisher of Europe, and as one of the most brilliant of birds. The whole head, the neck behind, the sides of the neck, the back, the rump, and tail, are of a deep lilac; the wings indigo-blue, approaching to black, but a bright and shining border of blue surrounds each feather; the throat, the neck, the belly, and the under part of the tail are white; the bill is very long, of a carmine-red, "dont la nuance est foible," the feet are red; "that," adds Sonnerat, "which especially characterises it, is that it has but three toes upon each foot, two before and one behind." ('Voyage à la Nouvelle Guinée.')

Meninting-Watu, or Burung-Biru (*Ceyx Meninting*). Horsfield.

Le Martin-Pêcheur de l'Île de Luçon, 2nd species (copied from Sonnerat's plate, which was apparently taken from an ill-stuffed specimen).

Mr. Swainson refers to this plate, only under the name of *Ceyx tridactyla* as an example of the genus.

Alcedo.—Bill very straight, compressed its whole length; the tip of both mandibles acute, and the upper one not inclined, commissure perfectly straight; feet syndactyle, all the tarsal scales obsolete; tail very short; feet with three toes before and one behind, claws simple; culmen of the bill sharp, carinated, and simple; inner and hinder toes of equal length. The species inhabit only the Old World. (Sw.)

A. ispida, Linn. This is the Martin-Pêcheur of the French; and also Pescheur, Martinet Pescheur, Tartarin, Artre, and Mounier, according to Belon; Piombino, Uccello del Paradiso, Pescatore, Pescatore del Re, Martino Pescatore, Uccello di Saucta Maria, and Vitriolo, of the Italians, according to Belon; Uccello della Madonna, Uccello Santa Maria, Piombino, and Alcione, of the same, according to Prince C. L. Bonaparte; Gemeine Eisvogel (Bechstein), and Grosser, Kleiner and Fremder Eisvogel (Brehm), of the Germans; Glâs y dorlan of the Welsh, and Common Kingfisher of the English.

Whether this species is one of the birds named 'Αλκυών (Halcyon) or 'Αλκυὼν (Alcyon)—for some of the learned doubt whether the word should be aspirated or not—by Aristotle and the Greeks, is by no means satisfactorily made out, though the better opinion seems to be that it is the 'Αλκυὼν ἄφωνος of the Greek zoologist. Belon and Pennant think that it is; Klein and M. De Bomare, on the contrary (and Camus seems to agree with them), consider it as doubtful which of our birds was meant by the Halcyon of the ancients, whose seven placid days while brooding over its poetical floating nest have become proverbial.

It has the following characters:—Bill blackish-brown, reddish at the base. Behind each eye is a patch of light orange-brown, succeeded by a white one; from each corner of the under mandible proceeds a streak of verditer-blue, tinged with verdigris-green; crown of the head deep olive-green, the feathers tipped with verdigris-green; from the nape of the neck to the tail is a strip of verditer-blue feathers, tinged in some shades with verdigris-green; chin and throat yellowish-white; breast, belly, and vent orange-brown, palest towards the under tail-coverts; tail greenish-blue; the shafts of the feathers black; legs pale tile-red. (Selby.)

The irides are hazel; the bill of the female is not so long as in the other sex; the colours also are deeper and more of a green shade.

Kingfisher (*Alcedo ispida*).

Setting aside the fable of the floating cradle in which during the Halcyon days the bird was said to rear its young, we shall find that ornithologists have differed not a little as to the actual nest of this brilliant bird. Pennant says that it makes its nest in holes in the sides of cliffs, which it scoopes to the depth of 3 feet, and in holes in the banks of rivers, chiefly those which before belonged to the water-rat; and he states the number of the eggs to be from five to nine, of a most beautiful trasparent white. The nest, he adds, is very fetid. Pennant then refers to Aristotle's description of the nest of the 'Αλκυὼν ἄφωνος, or Mute Halcyon, in which the latter states that it resembled those spherical concretions that are formed by the sea-water (ἁλοσάχνη), that it was hollow within, that the entrance was very narrow, so that if it should upset, the sea would not enter; that it resisted any violence from iron, but yielded to a blow of the hand, and when thus broken was soon reduced to powder, and that it was composed of the bones of the βελόνη (Belone), a sea-fish so named—for the bird lives on fish. Aristotle then states the number of eggs at five or thereabouts ('Hist. Anim.' ix. 14). Pennant, who, as we have observed, considers the Mute Halcyon of Aristotle to be our Common Kingfisher, observes that much of the description above quoted seems to be founded on truth. The form of the nest, he remarks, agrees almost exactly with the curious account of it by Count Zinnani. "The materials, which Aristotle says it (the nest) was composed of, are not entirely of his own invention. Whoever has seen the nest of the kingfisher will observe it strewed with the bones and scales of fish, the fragments of the food of the owner and its young; and those who deny that it is a bird which frequents the sea must not confine their ideas to our northern shores, but reflect, that birds inhabiting a sheltered place in the more rigorous latitudes may endure exposed ones in a milder climate. Aristotle made his observations in the east, and allows that the Halcyon sometimes ascended rivers, possibly to breed, for we learn from Zinnani, that in his soft climate, Italy, it breeds in May, in banks of streams that are near the sea; and having brought up the first hatch, returns to the same place to lay a second time." Now, it will be observed that Pennant, in his own description of the nest, speaks of nothing but the hole and the fetid remains, and though Zinnani gives a very good description of the excavated hole, he speaks with caution of the collection of fish-remains therein; for though, he says, of the "scaglie di pesci" with which the nest was covered, "restrano vagamente intrecciate," he adds, "ma forse non sono cosi disposte ad arte, bensì per accidente," showing that he thought their disposition about the nest was probably more the result of accident than design.

Montagu, in his 'Ornithological Dictionary,' says that the bird generally takes possession of a rat's hole to deposit its eggs; he then proceeds as follows:—"The many curious accounts which have been given of the nest of this bird induced us to take some pains to discover the fact. The result of our researches are (is), that the hole chosen to breed in is always ascending, and generally 2 or 3 feet in the bank; at the end is scooped a hollow, at the bottom of which is a quantity of small fish-bones, nearly half an inch thick, mixed in with the earth. This is undoubtedly the castings of the parent birds, and not the young, for we have found it even before they have eggs, and have every reason to believe that both male and female go to that spot, for no other purpose than to eject this matter, for some time before the female begins to lay, and that they dry it by the heat of their bodies, as they are frequently known to continue in the hole for hours, long before they have eggs. On this disgorged matter the female lays to the number of seven eggs, which are perfectly white and transparent, of a short oval form, weighing about one dram. The hole in which they breed is by no means fouled by the castings; but before the young are able to fly it becomes extremely fetid by the fæces of the brood, which is (are) of a watery nature, and cannot be carried away by the parent birds, as is common with most of the smaller species. In defect of which, instinct has taught them to have the entrance of their habitation ascending, by which means the filthy matter runs off, and may frequently be seen on the outside. We never could observe the old birds with anything in their bills when they went to feed their young; from which it may be concluded they eject from their stomach for that purpose."

Mr. Selby, after noticing the ejection of bones and other indigestible parts, in pellets, by the mouth of these birds, goes on to state that they breed in the banks of the streams they haunt, either digging a hole themselves, or taking possession of that of a water-rat, which they afterwards enlarge to suit their convenience. He then proceeds as follows:—"The bearing of the hole is always diagonally upwards, and it pierces two or three feet into the bank. The nest is composed of the above mentioned pellets of fish-bones, ejected into a small cavity at the farther end of this retreat, and upon which the eggs are laid, to the number of six or seven, of a transparent pinkish-white." He then quotes the remarks of Montagu on the sloping direction of the hole, and the use of that direction in carrying away offensive matter. ('Illustrations of British Ornithology,' vol. i.)

Mr. Rennie, in his edition of Montagu's 'Dictionary,' observes, that from the high authority of Montagu, the description above given has been copied by every recent writer, with the exception of Temminck,* who says nothing on the subject, and Wilson, who says ('Am. Orn.,' iii. 60), of his Belted Kingfisher (*Alcedo Alcyon*), that "its nest is neither constructed of glue nor fish-bones." Mr. Rennie then proceeds thus:—"We are certain of the fact that this will apply equally to our own kingfisher. In the bank of a stream at Lee in Kent, we have been acquainted with one of these nests in the same hole for several successive summers, but so far from the exuviæ of fish-bones ejected, as is done by all birds of prey, being dried on purpose to form the nest, they are scattered about the floor of the hole in all directions, from its entrance to its termination, without the least order or working up with the earth, and all moist and fetid. That the eggs may by accident be laid upon portions of these fish-bones is highly probable, as the floor is so thickly strewed with them that no vacant spot might be found, but they assuredly are not by design built up into a nest. The hole is from 2 to 4 feet long, sloping upwards, narrow at the entrance, but widening in the interior, in order perhaps to give the birds room to turn, and for the same apparent reason the eggs are not placed at the extremity. I am not a little sceptical as to its sometimes selecting the old hole of a water-rat, which is the deadly enemy to its eggs and young; but it seems to indicate a dislike to the labour of digging. It frequents the same hole for a series of years, and will not abandon it, though the nest be repeatedly plundered of the eggs or young. The accumulation of cast-bones in one of these old holes has perhaps give origin to the notion of the nest being formed of them."

Mr. Gould, in his 'Birds of Europe,' states that the eggs are deposited in a hole, such as those above alluded to, by the female, without making any nest.

Small fish, such as Sticklebacks and Minnows, form the food of the Kingfisher principally, but M. Temminck and Mr. Rennie say that the bird will also eat fry or spawn (frai), slugs, worms, and leeches.

It sits immoveable on some overhanging twig, watching for its

* But Temminck ('Manuel,' 1820) says that the bird nestles in holes in the earth, most frequently in those abandoned by the water-rats, along the abrupt banks of rivers, often under the roots of trees, in the hollows of trees, and sometimes in the holes of rocks, and that it lays from six to eight eggs of a lustrous white.

prey, and when it has secured a passing fish by a sudden dash, beats it to death against a stone on the ground, and then swallows it. At other times it will hover suspended over the water, and dart on its prey, but the bird usually makes its attack from a station. The editor of the last edition of Pennant states that it has been seen balancing itself over the water in which a great many of the small, round, shining beetles were swimming swiftly in circles (*Gyrinus natator?*), and which it makes its prey.

This species, when adult, appears to be mute except at the season of pairing; but the young are very clamorous, and frequently betray their retreat before they leave the nest—which they do not quit till they are fully fledged—by their cries. Before they provide for themselves, which they soon do, they sit on some branch while the parents fish for them, and on their approach with food are very noisy.

The flight of this bird is most rapid; it darts by like an iridescent gleam.

Temminck states that *Alcedo ispida* occurs more in the south of Europe than in the north. In Holland, he says that it is not widely spread. Mr. Selby says that it is generally dispersed through Europe, and that our birds differ in no respect from those of the same species in Asia and Africa, as he has had an opportunity of examining specimens from both continents. M. Temminck observes that the most common of the three species of Kingfisher must not be confounded with our *A. ispida*, though it differs but little from it. The Common Kingfisher is a resident with us, as it is in Italy and other European countries. Mr. Gould says that the young in the British Islands appear to have habits of partial migration, as they wander from the interior along the rivers to the coasts, frequenting in the autumnal and winter months the mouths of small rivulets and dykes near the sea; but more particularly along the line of the southern coast and the shores of adjacent inlets. We may here remark, that in the 'Portraits d'Oyseaux' of Belon, the following quatrain is printed under the cut of the Common Kingfisher:—

"Le Martinet-Pescheur fait sa demeure
En temps d'hyver au bord de l'ocean :
Et en esté sur rivière ou estan :
Et de poisson se repaist à toute heure."

It may be imagined that a bird of which so many marvellous stories have been told, under the idea of its being the Halcyon of the ancients, whose so-called nest, the *Halcyoneum*, was supposed to be endowed with medical properties, did not entirely escape the attention of the superstitious moderns. Thus its dried body was said to preserve woollen cloth from the moth, and if suspended by a thread from the ceiling of a room with doors and windows closed, to turn its bill towards the quarter whence the wind blew.

Barabas, in Marlowe's 'Jew of Malta,' says—

"But now how stands the wind?
Into what corner peers my Halcyon's bill?
Ha! to the east? yes."

Kent ('King Lear,') when, in his answer to Cornwall, he is rebuking such 'slaves' as the 'Steward,' declares that they—

"Renege, affirm, and turn their Halcyon beaks
With every gale and vary of their masters."

Mrs. Charlotte Smith states that she once or twice saw a stuffed bird of this species hanging from the beam of a cottage-room as a weather-vane to show the way of the wind. It has lately been seen in a similar position at Botley near Southampton. In the same part of the country some of the common people fancy that if a dead Kingfisher be suspended by the bill it will turn its breast according to the ebb and flow of the tide. The bird was also supposed to be a protection against thunder, to increase hidden treasure, to bestow grace and beauty on the person who carried it, and to renew its plumage, dead as it was, every season by moulting.

With reference to the question as to what species was meant by Aristotle, the reader should be aware that another Kingfisher, *Alcedo rudis* of Linnæus (*Ispida* (?) Swainson), occurs in the islands of the Grecian Archipelago, though Africa and Asia appear to be its more particular localities. The species is figured in Mr. Gould's beautiful work on the 'Birds of Europe.'

Ispida.—Habit of *Alcedo*. Culmen obtuse, somewhat flattened, and margined on each side by an indented groove. Tail lengthened, rounded. Inner toe much longer than the hinder. Claws either deeply notched, or cleft, so as to present two acute unequal points. (Swainson.)

Geographical Distribution.—Chiefly the New World. (Swainson.)

Mr. Swainson, who, in his 'Classification of Birds,' gives the habitat above stated, describes two species, *Ispida gigantea* and *I. bicincta*, in his birds of Western Africa. He states, and with reason, that among the largest-sized Kingfishers that have long been imperfectly known and incorporated in our systems, there is the greatest confusion, not only as to the characters of the birds themselves, but likewise in regard to their native countries. We have therefore, knowing the accuracy of Mr. Swainson's pencil, copied his figures of *Halcyon cinnamomina*, *Ispida gigantea*, and *Alcyone Australis* (the latter from Mr. Swainson's figure in the 'Zoological Illustrations,' with the aid of a specimen in the Museum of the Zoological Society of London),

as the best, if not the only mode of conveying to the reader the forms that he would designate under the names of *Halcyon*, *Ispida*, and *Alcyone*.

Above, cinereous, spotted with white; chin and cheeks white, immaculate; breast with a broad rufous collar; head above black, crested behind.

It is a native of Senegal.

Ispida gigantea. Swainson.

Tanysiptera.—Bill rather short, somewhat thick, straight, acute; nostrils oval. Tail graduated; two middle tail-feathers longest. (Vigors.) Mr. Swainson gives India as its habitat.

T. Dea; Alcedo Dea, Linn.; *Ispida Ternatana*, Briss. Above, intense black azure, white beneath; head and wing-coverts cærulean; tail-feathers white margined with cærulean, the two middle ones cærulean, with their apices club-shaped and white. (Vigors.)

Tanysiptera Dea.

Alcyone.—Bill as in *Alcedo*; but the feet with only three toes. Australia. (Swainson.)

A. Azurea. Body above, sides of the head and neck, shining ultramarine blue; beneath rufous; chin and throat whitish; wings blackish, inner fore toe wanting. (Swainson, 'Zool. Ill.,' 1st series, where it is figured and described as *Alcedo azurea.*)

Alcyone Australis.

It is found in Australia.

Habits.—Lewin, who has figured this Kingfisher in his 'Birds of New Holland,' states that it inhabits heads of rivers, visiting dead trees, from the branches of which it darts on its prey in the water beneath, and is sometimes completely immersed by the velocity of its descent.

Lamprotila.—Plumage metallic-green and gold. Bill very broad, dilated; the commissure and culmen curved; the upper margins folding over the lower. Nostrils membranaceous; the aperture round, protected by feathers. Wings as in *Galbula*, but longer; the third and fifth quills equal. (Sowerby.)

L. platyrhyncha.

Lamprotila platyrhyncha.

Galbula.—Plumage metallic. Bill very long, perfectly straight, greatly compressed; the culmen sharp; the tip not bent. Wings short. Tail lengthened, graduated. Toes in pairs, or with the hallux wanting. Nostrils with a few strong bristles. (Sw.)

Mr. Swainson remarks ('Classification of Birds,' vol. ii.) that the habits of the Jacamars and those of the Puff-Birds and Hermit-Birds are similar, although the flight of the latter is weaker. "The Jacamars," he says, "generally sit on low naked branches in the forest paths, from whence they dart upon butterflies, spearing them with their long bill: their haunts indeed may frequently be known by the ground being strewed with the beautiful wings of their victims, the body alone of which they devour."

Mr. Swainson further observes that in all the groups of this family previously noticed the bill is invariably compressed on the sides, and generally of considerable length; but in *Galbula grandis* a change from this structure is first discovered, and we see a bill considerably broad and depressed; that character, in short, which is in unison with the next family, according to Mr. Swainson's arrangement, namely, the *Trogonidæ*.

G. paradisea, Swallow-Tailed Kingfisher, Edw.; Paradise Jacamar, Lath. Size of a lark; colour golden-green; throat, neck, and lesser wing-coverts white; head violaceous-brown; bill and feet, the latter of which are feathered to the toes, black; two intermediate tail-feathers longest.

It is a native of Surinam.

Swallow-Tailed Kingfisher (*Galbula paradisea*).

HALE'SIA (named in honour of Stephen Hales, D.D., author of 'Vegetable Statics,' &c.), a genus of Plants belonging to the natural order *Styraceæ*. It has a monopetalous corolla ventricosely campanulate, with a 4-lobed erect border; the stamens 12 to 16; filaments combined into a tube at the base, and adnate to the corolla; the anthers oblong, erect, 2-celled, dehiscing lengthwise; the ovary inferior; the style single; the stigma simple; the fruit a drupe, which is dry, oblong, with 2-4 winged angles, terminated by the permanent style; the cells 1-seeded, with the seeds at the bottom of the cells. The species are trees with alternate serrated leaves, and lateral fascicles of pedicellate drooping white flowers. This genus has been made the type of an order *Halesiaceæ* by D. Don, who is followed by Link and others.

H. tetraptera, Common Snowdrop-Tree, has ovate, lanceolate, acuminated, sharply serrated leaves; the fruit with four wings. This plant is a tree, growing from 15 to 20 feet high, and is a native of South Carolina. It has fine white flowers, from 9 to 10 in a fascicle, drooping and resembling those of a snowdrop. The wood is hard and veined. It is one of the hardest and also one of the handsomest of the American deciduous trees. The rate of growth for the first five or six years is from 12 to 18 inches a year. It ripens its seeds freely in this country, and it may be propagated from these or imported seeds. There is another species, *G. diptera*, which is also an American plant, but does not attain so great a height as the last. *H. parviflora* is a native of Florida, and is supposed by some botanists to be merely a small flowered variety of the first. They will grow in any common garden soil, and may be propagated by slips from the root, as well as from seeds.

(Don, *Dichlamydeous Plants*; London, *Encyclopædia of Trees and Shrubs.*)

HALF-BEAK. [Esox.]

HALIÆETUS. [Falconidæ.]

HALIBUT. [Hippoglossus.]

HALICHŒRUS. Professor Nilsson's name for a genus of Seals. [Phocidæ.]

HALI'CORE, or HALI'CORA. [Cetacea.]

HALI'DRACON. [Plesiosaurus.]

HALIDRYS. [FUCACEÆ.]

HA'LIEUS. [PELECANIDÆ.]

HALIME'DA, a portiou of the genus *Corallina*, Linn., for which Lamarck had used the name *Flabellaria*, is thus styled by Lamouroux. ('Exposition Méthodique des Genres.') The articulatious are flat or compressed, rarely cylindrical, almost always flabelliform; the axis fibrous, surrounded by a thin cretaceous substance.

HALIMUS. [MAIADÆ.]

HALIO'TIDÆ, a family of Gasteropodous *Mollusca*, to which the shells commonly called Ear-Shells, or Sea-Ears, belong. Mr. Swainson, in his first series of 'Zoological Illustrations,' observes, when writing on the Small-Holed Californian Ear-Shell (*Haliotis Californiensis*, 1820-21), that "the definitions given by conchologists up to that time were so imperfect that they had left our knowledge of these shells nearly the same as in the time of Linnæus. Seventeen species only are enumerated in Mr. Dillwyn's work; although thirty-four have fallen within my own observation during the last few months."

Linnæus, who records the seven species known to him under the generic appellation of *Haliotis* (Sea-Ear), describes the animal as a Slug (*Limax*), and the Shell as ear-shaped and open (patens), with a lateral hidden spire, and the disc longitudinally pierced with holes (poris). He places the genus between *Nerita* and *Patella*.

Cuvier, in the first edition of his 'Règne Animal' (1817), makes the Ormiers (*Haliotis* of Linnæus) the first genus of his sixth order of Gastropods, *Scutibranchiata*. [GASTEROPODA.] He observes that it is the only genus of the order which has its shell turbinated, and that among these sort of shells that of the Ormiers is remarkable for the excessive amplitude of its aperture, its flatness, and the smallness of the spire, which is seen from within. This form, he adds, has caused it to be compared to the ear of a quadruped. Cuvier divides the genus into the following sub-genera:—1, the Haliotids, properly so called (*Haliotis* of Lamarck); 2, the Padolli of De Montfort; 3, the *Stomatiæ* of Lamarck. The Ormiers are immediately followed by the Cabochons (*Capulus* of De Montfort—*Patella Hungarica*).

Lamarck ('Animaux sans Vertèbres,' 1817) arranges the genus *Haliotis*, which is immediately preceded by *Stomatia*, as the last genus of his Macrostomes. The following is his definition of *Haliotis*:—

"Shell ear-shaped, most frequently flattened; with a very short spire, sometimes depressed, nearly lateral. Aperture very ample, longer than it is wide, entire in its perfect state. Disc pierced with holes disposed on a parallel line near the left-hand border, the last commencing with a notch."

The same zoologist makes the following observations on the genus as restricted by him:—"The Haliotids constitute a very beautiful genus, rather numerous in species and remarkable for the singular form and the brilliant nacre of their shell. They have received the name of Sea-Ears, because they in fact represent sufficiently well the form of the cartilage of the ear in man. Their shell is an oval-oblong, flattened in general, slightly spiral near one of its extremities, and furnished with a row of holes disposed on a curved line near the left-hand border and parallel to it. As the animal increases in growth, it forms for itself a new holo on the edge of the anterior part of the shell; this hole commences with a notch which serves to give a passage to the siphon of the animal, and is afterwards completed; when another is formed posteriorly. In its natural situation, and when the animal crawls, this shell may be considered as a reversed basin with its convexity upwards. Its circumference is then considerably exceeded by the very large foot of the animal, and the spire is found on the postorior part of its body. Following the description of the Ormier (tho animal of the *Haliotis*) giveu by Adanson, I had supposed that the branchiæ of this animal were exterior, like those of the Phyllidians: but M. Cuvier has undeceived me by showing me that they are hidden in a particular cavity. *Haliotis* therefore belongs to the family of Macrostomes. With regard to the tentacula, it has not perhaps really more than two. But as it is not uncommou (assez fréqnent) among the marino Trachelipods to find the eyes carried each upou a tubercle which springs at the external or posterior base of the tentacula, these tubercles are apparently more elongated hore than elsewhere: in this case the two larger tentacles are the anterior ones." Lamarck records fifteen species, iucluding *Haliotis dubia*.

Mr. Swainson ('Zool. Illustr.,' 1st series) remarks that "the genus *Padollus* of Montford (De Montfort ?) restiug entirely on the unevenness of the outer lip, without any knowledge of the auimal," appears to him an unnecessary distinction, for such, he observes, is the character of all young shells, and also of mature ones, whose outer surface is rugged or uneven.

De Montfort (1810) gives the following generic characters for *Padollus*:—Shell free, univalve, in the form of an ear, pierced with one or two holes; summit spiral, flattened, dorsal; aperture oval, wide open (évasée), entire, perpendicular; left lip reflected and trenchant; back covered with an epidermis, having a gutter in the middle and in the direction of the spire. He gives as the type of tho genus *Padollus rubicundus*, and proceeds nearly as follows:—"In arranging this shell as intermediate between the *Sigareti* the *Stomatiæ* and the *Haliotides*, we consider that wo have been ablo to establish upon it a new genus. Sufficiently similar to the *Haliotides* by its general contour (l'ensemble de ses formes), it is in some manner uevertheless approximated to tho *Stomatiæ*, iuasmuch as it has very few holes; but it presents, more than almost any of these shells, a spiral gutter, hollow in the interior, elevated on the back, placed in the middle and curved in the direction of the spire. This hollow, or gutter, is independent of the curved and serial liue of holes, which are nearly all obliterated. The right-lip is also more opened out (s'épanouit aussi d'avantage), it juts out and festoons (festonne) over the left lip towards the summit, and to the height of the spire: the interior offers an iridescent and undulated uacre. Externally it is of a brick-red, and the summit, in consequence of losing its exterior calcareous and coloured coat, is nacreous. The back is finely striated and reticulated, and the successive periods of growth are very strongly marked there. There is no doubt that the obliteratiou of the holes of the *Padolli* are a consequeuce of the absence of some organs, with which the *Haliotides* must be emiuently provided, and it is even probable that the single hole which notches their border serves during the life of these mollusks to lodge a fold of the border of the mantle, rolled into a tube and serving for respiration; a tube which we shall find among many of the spirivalve mollusks."

Considering the time at which De Montfort wrote, there is much good reasoning iu this passage; it must be recollected that he evidently gave his description from a young shell; for he says iu the course of it that the shell sometimes reaches more than an inch in its greatest diameter.

Dr. Leach (1814) adopted De Montfort's distinction and name. The doctor says that this genus is readily distiuguished from *Haliotis* (Ear-Shell) by the irregular form of the outer edge or lip; the disc, he adds, has fewer perforations and the spire is placed farther on the back. He states iu conclusion that the animal is unknowu, but is probably not very unlike that of the Ear-Shell.

Mr. G. B. Sowerby ('Genera of Recent and Fossil Shells'), observes, that with the exception of a few that are commonly kuown by collectors and Liunæans as Imperforate Ear-Shells, the genus *Haliotis* has not suffered any dismemberments. "An attempt," continues Mr. Sowerby, "has iudeed been made by Montfort to separate from the genuine *Haliotides* two or three species under the name of *Padollus*, in which he has been followed by Leach, but as far as respects general adoption this attempt appears to have been as unsuccessful as it was unnecessary. Not so the separatiou of the Imperforate *Haliotides*, which are easily distinguished by wanting the row of perforations so very characteristic of the true *Haliotis*."

The *Otidea* form the first family of *Scutibranchiata*, the third order of *Paracephalophora Hermaphrodita* iu M. De Blainville's arrangement ('Manuel de Malacologie,' 1825.) The first geuus of this family is *Haliotis*, divided into four sectious, aud iucluding the genera *Padollus* and *Stomatia*.

M. Rang ('Manuel,' 1829) continues the Ormiers (Macrostomes of Lamarck, *Otidea* of De Blainville, Auriformes of Latreille) as the first family of *Scutibranchiata* (Cuvier); but he makes it consist but of ouo genus, *Haliotis* (Liunæus). The genus *Stomatia* of Lamarck he places under the Sigarets of De Férussac, as well as the genus *Stomatella* of Lamarck, which he seems to consider as includiug the *Padollus* of De Montfort. The Sigarets in this arrangement are made to form the ninth family of the *Pectinibranchiata* of Cuvier.

In Cuvier's last edition of the 'Règne Animal' (1830), the position and arrangement of the Ormiers remains as iu the first editiou, with the exception that in the last edition tho *Scutibranchiata* form the eighth order of his Gastropods.

In the present state of our information it will perhaps be as well to select the arrangement proposed by Cuvier, and in great measure adopted by M. De Blainville. M. Rang, in his description both of *Stomatella* (iucluding *Padollus*) aud *Stomatia*, says, "Animal unknown."

Haliotis (properly so called; *Haliotis*, Lamarck).—Animal.—One of the most oruamented of Gastropods. All round its foot to its mouth there is, at least in the more common species, a double membrane cut out iuto leaflets (feuillages), and furnished with a double row of filaments. On the outside of its long tentacles are two cylindrical pedicles for carrying the eyes. The mantle is deeply divided on the right side, and the water, which passes by means of the holes in the shell, can, through this slit, penetrate into the branchial cavity; along its edges again are also three or four filaments, which the animal can also cause to come out through these holes. The mouth is a short proboscis. (Cuvier's description for all Gmelin's *Haliotides*, except *H. imperforata* and *H. perversa*.) Body oval, very much depressed, hardly spiral behind, provided with a large foot doubly fringed ou its circumference. Head depressed; teutacles a little flattened, joined (connés) at the base; eyes carried on the summit of prismatic peduncles, situated on the external side of the tentacles. Mantle very delicate, deeply divided on the left side; tho two lobes poiuted, forming by their junction a sort of canal for conducting tho water into the branchial cavity situated on the left, and inclosing two very long, unequal, pectinated branchiæ (peignes branchiaux). (De Blainville.)

Animal oblong, depressed, furnished with a large head and a short proboscis, at the extremity of which is the mouth, containing a tougue armed with points (aiguillons); tentacles two, long and cylindrical; eyes on pedicles, implanted at their external base, a little backwards. Mantle short, delicate; foot very large, oblong, furnished all round with a double row of festoons agreeably cut out or pinked (decoupés).

Organs of respiration composed of two unequal pectinated branchiæ, in a cavity open to the left, the muscle of attachment occupying the middle of the animal; vent (anus) opening into this cavity opposite the slit which forms its aperture. (Rang.)

In addition to the general account of the organisation given by Cuvier, we refer the reader to No. 489 (Gallery) of the Physiological Series of preparations in the Museum of the College of Surgeons. A small specimen is there prepared to show the stomach. The floor of the branchial cavity, the gills, and anus are turned back, and the integument is removed from above the œsophagus and first stomach. A bristle is passed through the mouth into the œsophagus, and another from the first to the second stomach. The latter cavity is imbedded in the liver, and receives the secretion of that gland by such wide orifices that portions of the alimentary substances have entered the biliary ducts, which thus appear to be ramifications of the alimentary canal. ('Catalogue,'—Gallery, vol. i.)

Shell nacreous, very much depressed, more or less oval, with a very small spire, very low, nearly posterior, and lateral; aperture as large as the shell, with continuous borders, the right border delicate and trenchant, the left flattened, enlarged, and trenchant; a series of complete or incomplete holes, parallel to the left side, serving for the passage of the two pointed lobes of the mantle; a single large muscular impression, median, and oval. (De Blainville.)

These, the true *Haliotides*, forming M. De Blainville's section

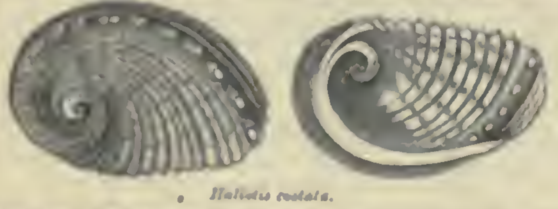
A. consisting of species whose disc is rounded forwards and pierced with a series of holes, vary much in size and shape.

The general form may be imagined from that of *Haliotis tuberculata*,

Haliotis tuberculata.

a, animal and shell; *b*, interior of shell.

the most common species, the size, shape, &c. of which is too well known to require description, and from *H. costata*; but there are some of the species from the warmer climates that are as large or larger than the crown of a hat, and are absolutely dazzling from the splendid



Haliotis costata.

iridescence of their nacre. The shape too varies considerably. Thus we have among the comparatively small species a form very nearly round (*H. excavata*), whilst *H. Asinina* is very much elongated.

There are about 75 recent species of *Haliotis* known, and 4 fossil species.

Both M. De Blainville and M. Rang state that species of *Haliotis* exist in all the seas; the latter uses the expression, "elles sont très répandues dans toutes les mers," but their limits seem not to go far beyond temperate climates. They are found in the Canaries, at the Cape, in India, China, Australia, New Zealand, the Pacific, and California. None appear to have been seen by our northern voyagers; and though *H. tuberculata* (which there can be little dout is the ἀγρία λεπάς, ἣν τινες καλοῦσι θαλάττιον οὖς—"the wild lepas, which some call the Sea-Ear"—of Aristotle, 'Hist. An.,' lib. iv. c. 4), is common at Guernsey and Jersey, and has been found (that is, the shell) on the south coast of Devonshire, we agree with Mr. Sowerby in thinking that, on the present evidence, this species cannot with propriety be considered a native of our own coasts, though the dead shells are sometimes thrown up on our southern shores after violent storms.

The *Haliotides*, which are all marine and littoral, being without opercula, adhere, like the *Patellæ*, by applying their under parts to the surface of the rocks. They are generally found near the water's edge, and, according to Lamarck, go during the fine summer nights to feed on the herbage which grows near the shore.

As an article of food this genus is by no means to be despised. We have eaten *Haliotis tuberculata*, and when served by a good cook it is tender and sapid. The large fleshy foot, if not properly managed, is apt to be tough. The people of Guernsey and Jersey ornament their houses with the shells of this species, disposing them frequently in quincunx order, and placing them so that their bright interior may catch the rays of the sun. We have often thought that some of the large and splendid intertropical species, whose exterior, after removing the outer coat, take a polish almost equalling the natural brilliancy of the inside, might be converted into dishes for holding fruit: if mounted with good taste, their indescribable iridescence would materially add to the richness of an elegant table. As it is, the shells of *H. tuberculata* are extensively used for making mother-of-pearl ornaments, especially in ornamenting papier maché articles. For this purpose great quantities are taken to Birmingham.

B. Species whose disc, besides the series of holes, is raised by a large parallel rib, hollowed interiorly, and whose anterior border is more or less irregular.

Padollus (De Montfort).—M. De Blainville refers to *Haliotis canaliculata* (Lamarck), as the example. The figure in Knorr, referred to by Lamarck, is red externally, and has the elevated rib; but the shape of the shell is longer than that of *Padollus scalaris* (Leach), and of other *Padolli* which we have seen. The specimen recorded by Dr. Gray in the Appendix to the 'Narrative of a Survey of the Intertropical and Western Coasts of Australia, performed between the years 1818 and 1822, by Captain Philip Parker King, R.N., F.R.S., &c.,' vol. ii., and which Mr. Gray notices as the largest he ever saw, measured 3¼ by 2½ inches. We have seen the shell, and never saw so large a specimen. Dr. Gray records it as *Padollus rubicundus* of De Montfort, with the synonyms of *Padollus scalaris*, Leach, and *Haliotis tricostalis*, Lamarck.

Padollus rubicundus (?).

Lamarck, on the authority of M. Leschenault, says that his *Haliotis tricostalis* inhabits the seas of Java. The fine specimen brought to England by Captain King was found upon Rottnest Island, on the west coast of Australia, and is now in his cabinet. It has only three holes, the anterior ones, open. All, both those which are closed and those which are open, are very highly elevated, and so is the curved longitudinal rib. The left border externally is very much raised and nodulous, looking at first sight as if it had another row of holes which had been closed; but it was evidently always imperforate.

C. Species whose disc is not pierced, but hollowed longitudinally by a decurrent canal.

M. De Blainville gives as an example of his section C. *Haliotis dubia* of Lamarck. It will be clear to the observer that the animal protected by such shells as the two next, must exhibit some differences from that of a true *Haliotis*.

D. Species whose disc is not pierced, and which offer the two gutters together, but approximated, so as to leave externally a decurrent rib between them.

Stomatia (Lamarck).—Cuvier, who says that the animal of *Stomatia* is much less ornamented than that of *Haliotis*, is of opinion that this form connects the *Haliotides* with certain *Turbines*.

Mr. G. Sowerby ('Genera of Recent and Fossil Shells,' No. xix.) observes that Lamarck, in his observations upon *Stomatella*, tells us that in respect to their general form those shells appear to be nearly related to the *Stomatiæ*; and that they are principally distinguished by the transverse ridge and the elevated outer lip of the *Stomatiæ*. Upon a careful examination however of ten species, Mr. Sowerby was unable to discover any difference in the outer lip; and he remarks that Lamarck places among his *Stomatellæ* one species, *S. rubra*, which has a nodular keel placed exactly in the same position as the transverse ridge, by which the latter characterises *Stomatia*; so that Mr. Sowerby does not find any generic difference whatever, and has therefore united the two Lamarckian genera under the appellation *Stomatia*. He thus characterises the genus thus reformed :—Shell pearly within, mostly coloured externally; suborbicular or long, generally ear-shaped and depressed. The spire, in most species, prominent, but not produced nor elongated ; sometimes very small, marginal and inconspicuous. Aperture mostly longitudinal, in some species nearly orbicular, in others much elongated, always very large ; its edges entire, united at the upper part, and scarcely modified or altered in form by any portion of the last volution. Volutions from two to four. Muscular impressions two, seldom distinct, nearly marginal, and in the open part of the shell.

Mr. Sowerby goes on to state that *Stomatia* appears to be related to *Haliotis*, and is therefore rightly placed by Lamarck among his Macrostomes. One of its species is arranged by Linnæus, he adds, as a *Haliotis*, under the name of *H. imperforata* (Gmel.). Mr. Sowerby does not pretend to discuss the question of their resemblance to Lamarck's Turbinacées ; but only observes that in general form some of them approach very nearly to some of Lamarck's Monodontes. The *Stomatiæ*, he states in conclusion, are marine, and he says that all the species he has seen wero brought from tho East Indies aud Australia.

Stomatia has been found at a depth of seven fathoms, adhering to *Meleagrinæ* and corals.

The following genera are referred by some writers to *Haliotidæ*, *Broderipia*, *Scissurella*, *Pleurotomaria*, *Murchisonia*, *Trochotoma*, *Janthina*. [TURBINIDÆ ; JANTHINIDÆ.]

HALISPO'NGIA. According to the structure and composition of the numerous species of Sponges, they may be divided into genera. If, in accordance with the observations of Dr. R. Grant, we consider sponges in three groups, one having a horny tubular structure, another containiug calcareous spiculæ, a third contaiuing siliceous spiculæ, we may adopt the three generic types, *Spongia*, *Calcispongia*, and *Halispongia*, of De Blainville.

Halispongia is thus characterised :—Mass more or less rigid or friable, of irregular figure, porous, traversed by winding canals, which eud in openings scattered over the surface; substance subcartilaginous, supported by simple siliceous spiculæ.

The species exhibit various external forms, encrusting, branching, or foliaceous. Dr. Fleming includes them under the titlo *Halichondria*. [SPONGIADÆ.]

HALITHE'A, a genus of marine Dorsibranchiate Annelids belonging to the family *Aphroditidæ*. [ANNELIDA.]

HALKET, a kind of Seal. [PHOCIDÆ.]

HALLI'RHOA, the name proposed by Lamouroux for a group of Fossil *Polyparia*, referred by many writers to *Alcyonia*. The spheroidal figure, contracted base, deep central pit, and pores on the surface, appear the characters most relied on by Lamouronx. Goldfuss gives characters for the genus *Siphonia* of Parkinson, which may include the two species meutioned by Lamouroux from the vicinity of Caen and the Vaches Noires. *Hallirhoa costata* of Lamouroux is found in the Greensand of Normandy and England.

HALLOYLITE, a Mineral named after Dr. Omalius d' Holly, a French geologist. It is a hydrous silicate of alumina. It occurs massive and earthy, resembling a compact steatite. It yields to the nail aud may be polished by it. It has a whito or bluish colour. Adheres to the tongue, and small pieces becomo transparent in water. It is found at Liègo aud at Bayonno in France. It has the following composition :—

Silica	39·5
Alumina	34·0
Water	26·5
	100·0

HALLOYSITE. [HALLOYLITE.]

HALMATURUS. [KANGAROO.]

HALO'DROMA, Illiger's name for a genus of Sea-Birds allied to the Petrels and Albatrosses. [LARIDÆ.]

HALO'NIA, a genus of Fossil Plants, allied to *Lepidodendron*, and occurring in the Coal Formation. [COAL PLANTS.]

HALORAGA'CEÆ, *Hippurids*. a small group of Exogenous Plants, many of which inhabit watery places, and all of which have minute inconspicuous flowers. In consequence of the calyx being superior, the embryo without much albumen, and some of them having four petals, they are often considered to form a peculiar section of *Onagraceæ*, or if separated from that order, are at least stationed in the immediate vicinity of it. Upon this supposition, they are looked upon as an imperfect coudition of the Onagraceous type, bearing the same relation to it as *Sanguisorbeæ* to *Rosaceæ*, *Chamælaucieæ* to *Myrtaceæ*, or *Mimoseæ* to other *Fabaceæ*. But in the present uncertainty regarding the true affiuity of many natural orders of plants, we must not consider this a settled point. On the coutrary, it is not improbable that *Haloragaceæ* constitute an imperfect form of the great Epigynous group of Exogens, of which *Onagraceæ* are only one of the members. What renders it peculiarly difficult to determine the real affinity of this little gronp is, that as it is now constituted, it offers striking modifications of development both in the organs of vegetation and those of fructification. While *Haloragis* has a stem with a complete vascular organisation, and regularly constructed leaves, *Myriophyllum* has its vascular system reduced to a rudimentary condition, and iu some of the species the leaves themselves appear only in the form of filiform ramifications ; and in *Hippuris*, the development of the vascular system of both stem and leaves is still further reduced. In like mauner in the flowers, *Haloragis* has four petals, eight stamens, four stigmas, aud four cells to the ovary ; *Proserpinaca* has no petals, three stamens, three stigmas, and three cells to the ovary; and *Hippuris* has no petals, one stamen, one stigma, and but one cell to the ovary. This latter genus is a common plant in the marshes and meadows of this country, where it is vulgarly called Mare's-Tail.

Common Mare's Tail (*Hippuris vulgaris*).

1, a single flower, with its bract, much magnified ; 2, a vertical section of the ovary, showing a single ovule hanging from the apex of a single cell ; 3, a vertical section of a ripe fruit, showing the seed suspended in the interior, and the dicotyledonous embryo.

Damp places, ditches, and slow streams in Europe, North America, Southern Africa, Japan, China, Australia, and the South Sea Islands are the resort of this order.

HALOSCIAS (Fries), a genus of Plauts belonging to the natural order *Umbelliferæ*, aud the tribe *Seselineæ*. It has a calyx of 5 small persistent teeth ; the petals ovate with an inflexed lobe aud short claw; the fruit elliptical, terete, or slightly dorsally compressed ; carpels with five sharp somewhat winged ridges; interstices and commissure with many vittæ; seed not cohering to the carpel, without vittæ. One species of this genus is a native of Great Britain.

H. Scoticum, Scottish Lovage, is found on rocks on the sea-coast of Scotland aud Northumberland. It has an herbaceous stem, tiuged with red, from 12 to 18 inches high.

(Babington, *Manual.*)

HALTICA, a genus of Insects belouging to the order *Coleoptera*, and to the tribe *Galerucitæ* of the family *Cyclica*. It includes the insects called Black Fleas, Turnip-Flea, or Turnip-Fly. The species of the genus *Haltica* are remarkable for their power of leaping, which is effected by means of the peculiar formation of their very thick hind legs. They are among the smallest of beetles, and are varionsly coloured with green, brown, or yellow, often brightly shining. Some destroy the cabbage, others flax, others tobacco, or hops ; but the turnip is the greatest sufferer from the ravages of these little creatures, which, though small in size, are many in number.

The species found on the turnips is the *H. Nemorum*. It is about one-eighth of an inch long, is rather flattened, and of a brassy-black colour, thickly dotted ; the wing-cases are grecuish-black, with a palo yellow broad line on each, the base of the autennæ and legs of a paler colour. The eggs are deposited on tho under side of a rough leaf from April to September. They hatch in two days, and the larva attain perfection in sixteen days. Tho chrysalis is fixed in the earth a fortnight. They lovo sunshine, warmth, aud fine weather, and eat away tho surface of the youug leaves of the plant with voracity. Tho larva feeds withiu the full-grown leaf, iu which tho egg has been laid and attached hy its parent, but does little or no mischief to the growth of the plant. It is the beetle which destroys the first smooth leaves or cotyledons of the turnip. It scents out the turnip crop from a great distance, and flies towards it even against the wind. It feeds by night, and during the day retires under the cotyledon. The parent insects are to be seen in the earliest fine days of February, and do not disappear before the end of October, but they do not feed much after the latter end of September. There are five or six broods of these in a summer. Besides the *H. Nemorum*, the *H. similis* and *H. flava* are also destructive to turnips.

The destruction caused by these insects may be conceived, when, so long ago as 1786, Mr. Young stated that the turnip crop destroyed in Devonshire alone was valued at 100,000*l.*; consequently, many entomologists have directed their attention both to the inquiry into the habits of the animal and the finding a remedy for the mischief it causes. Admirable essays on the subject have been published in the 'Entomological Transactions' by Mr. Le Keux, and in the 'Journal of the Agricultural Society of England,' by Mr. J. Curtis, which may be consulted with advantage by the farmer.

Among the remedies which have been proposed are fumigation, watering with weak brine, steeping the seed in brine, applying lime and soot to the land, and the application of wormwood decoction and road-dust. The last has been greatly recommended in Germany, and there is an essay on the subject, by M. Wundram of Dorste, Hanover, in the 'Transactions of the Royal Agricultural Society of Vienna.'

The rapid growth of the turnip plant is the best remedy, and in order to secure this, plenty of seed of the same age should be sown. Deep digging and burning the land when the chrysalides are in it are good practices. Sowing the surface of the soil with gas-lime two or three mornings after the seed has been sown has been recommended as the most effectual remedy.

HALYMENITES. Under this generic name Sternberg ('Flora der Vorwelt') and Bronn ('Lethæa Geognostica') include several species of Fossil Fucoid Plants, found in the slaty Oolitic rocks of Stonesfield and Solenhofen.

HALYSITES, the name given by Fischer to a genus of Fossil Corals, synonymous with *Catenipora* of Goldfuss. As having priority, it is adopted by Bronn in his 'Lethæa Geognostica.'

HAMAMELIDA'CEÆ, *Witch-Hazels*, a very small group of woody Exogenous Plants, characterised by having a superior calyx, a definite number of stamens half of which are usually sterile, a 2-celled ovary, and an embryo in the midst of horny albumen. There are only three genera in the gardens of this country, *Hamamelis*, *Trichocladus*, and *Fothergilla*. Some of the species are large forest-trees, affording good timber, but nothing is known of any other useful property in the order. The order is related to *Bruniaceæ*, *Cornaceæ*, and *Saxifragaceæ*. The species come from North America, Japan, China, and the central parts of Madagascar and South Africa. The kernels of *Hamamelis Virginica* are oily and eatable. The leaves and bark are very astringent, and also contain a peculiar acrid essential oil.

HAMBURGH WHITE. [BARYTES.]

HAMITES, a genus of Cephalopodous *Mollusca* proposed by Mr. James Sowerby. ('Mineral Conchology of Great Britain.') It includes only fossil species. According to the original views of Mr. Sowerby, only those chambered shells belong to *Hamites* which have the form of a hook or siphon bent in one plane, with parallel but unequal limbs, and sinuous septa. But the specimens having these characters appear always imperfect; and when Professor Phillips found in Yorkshire many fossils, in other respects perfectly resembling *Hamites* described by Mr. Sowerby, rolled in a plane spiral, the volutions in some species touching, in others free, and in a few terminating in a straight elongation (like *Spirula*), he extended the use of the term. Dr. Buckland has adopted this view in his 'Bridgewater Treatise.'

In the 'Transactions of the Geographical Society of France,' June, 11, 1837, M. Léveillé gives descriptions and figures of species of fossil *Cephalopoda*, which might be considered as the spiral part of *Hamites* (Phillips), and names them *Crioceratites*. Bronn adopts this genus. Mr. Sowerby has recently been led to very similar results, and has proposed to call the same group *Tropæum*. Now, as certain forms of ammonites in the Lias and Oolitic rocks (*A. fimbriatus*) have no very obvious difference from *Tropæum*, *Crioceratites*, or the spiral parts of *Scaphites* (e.g. *Scaphites Yvanii* in the British Museum), it is evident that the whole question of the true relations of these remarkable fossil genera to ammonites remains to be further examined.

Hamites of the typical forms occur at Folkstone, Hamsey, and other situations in the Gault, Greensand, and other cretaceous beds. *Crioceratites* and *Tropæum* belong chiefly to the same groups of rocks in England, France, Switzerland, &c. Fifty-eight species of *Hamites* have been described. D'Orbigny proposes the name *Hamulina* for the twenty species found in the Neocomian beds of France. [TROPÆUM.]

HAMSTER. [CRICETUS.]

HAND. [SKELETON; MAN.]

HAND-TREE. [CHEIROSTEMON.]

HA'PALE. [JACCHUS.]

HARBIN. [MERLANGUS.]

HARDNESS (in Mineralogy). The different degrees of hardness possessed by minerals of similar external characters will often serve to distinguish them from each other. Mohs has formed a scale which affords an approximation in estimating the hardness of minerals, and according to which it is expressed in numbers. The substances which he uses are such as are easily obtained in a state of purity. They are:—

1. Talc, white or greenish.
2. Rock-salt, pure and cleaveable; and gypsum, uncrystallised and semi-translucent.
3. Calcareous spar, cleaveable.
4. Fluor-spar, which cleaves perfectly.
5. Apatite, the asparagus-stone, from Salzburg.
6. Adularia.
7. Rock crystal, limpid and transparent.
8. Topaz.
9. Corundum, from Bengal, with smooth fractured faces.
10. Diamond.

Any mineral which neither scratches nor is scratched by any one of the substances above named, is stated to possess the degree of hardness expressed by the number opposite that mineral. Thus, supposing a body neither to scratch nor to be scratched by fluor-spar, its hardness is represented by 4; but if it should scratch fluor-spar, and not Apatite, then its hardness is stated to be from 4 to 5.

Another method of trying the hardness of minerals is passing them very gently over a fine hard file, and judging by the touch and appearance of the file as to the degree of hardness. [MINERALOGY.]

HARE. [LEPUS.]

HARE-BELL. [CAMPANULA.]

HARE'S-EAR. [BUPLEURUM.]

HARELDA. [DUCKS.]

HARFANG. [STRIGIDÆ.]

HARMODYTES, a genus of Tubular Stony Corals, proposed by Fischer and adopted by Bronn. The same species were afterwards designated by Goldfuss *Syringopora*, a name generally adopted.

HARMOTOME (*Andreolite; Ercinite*). This mineral occurs in attached crystals, generally intersecting each other lengthwise. Primary form a right rhombic prism. Cleavage parallel to the primary planes, and to both the diagonals of the prism. Hardness, 4·5. Colour, grayish-reddish, yellowish-white. Fracture uneven. Lustre vitreous, and sometimes pearly; streak white. Specific gravity, 2·35 to 2·4.

By acids, unless heated, Harmotome is scarcely acted upon. Before the blow-pipe it fuses into a clear glass. It occurs at Strontian in Scotland, and at Andreasberg and Oberstein in Germany.

The analyses of this substance do not greatly differ in general. The Harmotome of Strontian yielded, by the analysis of Mr. O'Connell—

Silica	47·04	
Alumina	15·24	
Barytes	20·85	
Lime	0·10	
Soda or Potash	0·88	
Water	14·92	
		99·03

HARPA. [ENTOMOSTOMATA.]

HARPAGON. [FALCONIDÆ.]

HARPAGUS. [FALCONIDÆ.]

HARPA'LIDÆ, an extensive family of Coleopterous Insects of the section *Geodephaga*, the species of which are distinguished by the tarsi of the two anterior pairs of legs being dilated in the male sex.

In these insects the tibiæ of the anterior pair of legs have always a deep notch on the inner side; the head is almost always short and rounded in front; the thorax is generally broader than long, somewhat convex, but slightly narrower behind than before, and nearly equal in width to the elytra. The body usually approaches more or less to a cylindrical form; the elytra are almost always rounded at the apex, and never truncated at this part. They are usually found under stones.

Of the family *Harpalidæ*, Dejean, in his 'Species Général des Coléoptères,' enumerates 27 genera: others however have been discovered since the publication of that work.

The number of species known is probably upwards of 500.

The most convenient way perhaps of grouping the genera of this family is to take, in the first place, the form of the mentum as a guide. We then find almost all the species divided into two great groups, those in which the mentum is simply emarginated, and those in which there is a small projecting process in the middle of the emargination. Besides these there are certain species (the natural situation of which is perhaps somewhat doubtful) which have the mentum trilobed, and there are others in which the mentum is bilobed.

The various genera described by Dejean are as follows:—

Section I.—Mentum trilobed.

Genus 1. *Pelecium* (Kirby), containing 2 species, both inhabiting the Brazils.

2. *Eripus* (Höpfner), containing 2 species, one of which is from California, the other inhabits Mexico.

Section II.—Mentum bilobed.

Genus 3. *Promecoderus* (Dejean), of which there is one species from Australia.

4. *Cyclosomus* (Latreille), containing 2 species, one from India, the other from Senegal.

Section III.—Mentum emarginate, and without central tooth.

Genus 5. *Daptus* (Fischer); 2 species. Found in North America.
6. *Cratognathus* (Dejean); 1 species. Probably from Buenos Ayres.
7. *Agonoderus* (Dejean); 5 species; three of which are from North America, one from India, and one from Senegal.
8. *Barysomus* (Dejean); two species from India, and one from Mexico.
9. *Amblygnathus* (Dejean); 5 species. All inhabitants of Cayenne.
10. *Platymetopus* (Dejean); 10 species. From Africa and India.
11. *Selenophorus* (Dejean); 59 species. From North and South America.
12. *Anisodactylus* (Dejean); 23 species. Chiefly from Europe and North America.
13. *Bradybænus* (Dejean); 3 species. From Senegal.
14. *Stenolophus* (Megerle); 22 species. Almost all European.

Section IV.—Mentum emarginate, and with a small projecting process in the middle.

Genus 15. *Cratocerus* (Dejean); 1 species. From Brazil.
16. *Somoplatus* (Dejean); 1 species. From Senegal.
17. *Axinotoma* (Dejean); 1 species. From Senegal.
18. *Acinopus* (Ziegler); 6 species. Chiefly European.
19. *Cratacanthus* (Dejean); 3 species. From North America.
20. *Paramecus* (Dejean); 2 species. From South America.
21. *Geodromus* (Dejean); 1 species. From Senegal.
22. *Hypolithus* (Dejean); 18 species; the greater portion of which inhabit Africa. Four are from South America.
23. *Gynandromorphus* (Dejean); 1 species. From Italy and South of France.
24. *Ophonus* (Ziegler); 45 species. Chiefly European.
25. *Harpalus* (Latreille); 134 species. From Europe, Asia, Africa, America, and Australia.
26. *Geobænus* (Dejean); 2 species. From the Cape of Good Hope.
27. *Acupalpus* (Latreille); 46 species. Chiefly European. There are however species found in all the other quarters of the globe.
28. *Tetragonoderus* (Dejean); Africa, India, and South America. One species is found in North America.
29. *Trechus* (Clairville); 22 species. Chiefly European.
30. *Lachnophorus* (Dejean); 4 species; three of which are from South America, and one from North America.

For the characters of the genera and species above alluded to, we must refer our readers to M. Dejean's work which has been quoted, and for the British species to Mr. Stephens's 'Illustrations of British Entomology.' We have followed Dejean in restricting the family *Harpalidæ* to such species only as will come under the definition given at the commencement of this article. Two very distinct groups are included in the family *Harpalidæ* as defined by Mr. Stephens.

(Stephens, *Illustrations of British Entomology;* Dejean, *Species Général des Coléoptères.*)

HARPES, a genus of Fossil *Crustacea* [TRILOBITES], from the Devonian Strata.

HARPY-EAGLE. [FALCONIDÆ.]

HARPYA. [CHEIROPTERA.]

HARPYIA. [FALCONIDÆ.]

HARRIER, the English name for the hound employed in hunting the Hare. The size and breed of the Harrier depend upon the taste of the owner, and that is most frequently regulated by the nature of the country in which the pack is to hunt. Mr. Beckford, a great authority in such cases, says, "The hounds, I think, most likely to show you sport are between the large slow-hunting harrier and the little fox-beagle; the former are too dull, too heavy, and too slow; the latter too lively, too light, and too fleet. The first, it is true, have most excellent noses, and I make no doubt will kill their game at last if the day be long enough; but you know the days are short in winter, and it is bad hunting in the dark. The other, on the contrary, fling, dash, and are all alive; but every cold blast affects them, and if your country be deep and wet it is not impossible that some of them may be drowned. My hounds were a cross of both these kinds, in which it was my endeavour to get as much bone and strength in as small a compass as possible. It was a difficult undertaking. I bred many years, and an infinity of hounds, before I could get what I wanted. I at last had the pleasure to see them very handsome; small, yet very bony; they ran remarkably well together, went fast enough, had all the alacrity that could be desired, and would hunt the coldest scent."

Hare-hunting, it has been said, is generally followed by sportsmen in the decline of life; though when the district is tolerably open, and the hare 'flies the country,' there is often opportunity for a good horse and bold rider to show themselves. But these capital runs come 'few and far between,' and the old fox-hunter can seldom brook the change. In a close or woody district, the constant repetition of the same scene, and the discovery that in consequence of a sudden double of the hare a rustic upon his galloway who knows the country is frequently as near the hounds as the man who is mounted on a first-rate hunter and has taken some daring leaps, prove rather disgusting both to the ardour of youth and the experience of age.

HARRIER (Ornithology), a name applied to certain Hawks (*Circus*). [FALCONIDÆ.]

HARRINGTONITE. [MESOLE.]

HARTITE, a Mineral occurring crystallised. Primary form an oblique rhombic prism. Cleavage imperfect. Colour white. Lustre somewhat greasy. Translucent. Hardness 1·0. Specific gravity 1·046. Found at Oberhart, in Austria. The following is an analysis, by Schrötter:—

Carbon	87·473
Hydrogen	12·048
	99·521

HART'S-TONGUE. [SCOLOPENDRIUM.]

HASSELQUISTIA, a genus of plants named by Linnæus in honour of Frederick Hasselquist, M.D., his pupil, who travelled in the Holy Land. It belongs to the natural order *Umbelliferæ*, and to the tribe *Tordylineæ*. The species closely resemble those of *Tordylium*, and are regarded by some botanists as monstrous forms of this genus.

HASSELTIA, a genus of Plants belonging to the natural order *Apocynaceæ*. It has a 5-parted permanent calyx; a corolla with the tube contracted in the middle; the throat naked; the limb campanulate, 5-parted, and contorted. The stamens are inserted in the throat. Anthers large, cuspidate, callous at the back, adhering to the stigma; the ovary double, surrounded by a fleshy ring; styles 2; stigma clavate; follicles 2, distinct, and long; seeds with a stipitate coma at the lower end.

H. arborea is found in Java, near Tjampiam. It is a handsome tree, with oval leaves, rather acute at each end, smooth above, paler and a little downy on the under side. The flowers are large, yellowish-white, in axillary fascicles. In Java the milk obtained from the trunk by incision, mixed with honey and reduced with boiling water, is employed as a powerful drastic for destroying the tape-worm; it is however apt to produce inflammation of the intestines, and in some cases has proved fatal.

(Lindley, *Flora Medica.*)

HASTINGS SANDS. The middle group of the Wealden Formation, which constitutes the uppermost part of the Oolitic system in England, is thus named from its characteristic development around Hastings in Sussex. In the Hastings Sands we may distinguish four divisions, which lie in the following order:—

The Horsham Beds . .	Fawn-coloured sand and friable sandstone: good flagstone occurs here.
The Tilgate Beds . .	Sandstones often calcareous, with various grits and conglomerates, resting on blue clay. These have yielded a considerable number of organic remains, plants, *Mollusca*, fishes, and reptiles of gigantic dimensions. [IGUANODON; HYLÆOSAURUS.]
The Tilgate Beds . .	White sand and friable sandstone, alternating with clay.
The Ashburnham Beds .	Nodules and beds of limestone, alternating with clays and sandstones.

The axis of elevation, or forest ridge of the Weald of Kent and Sussex, is chiefly formed of Hastings Sands, which rise in Crowborough Beacon to 804 feet above the sea. [GEOLOGY.]

(Mantell, *Tilgate Forest;* Fitton, *Geology of Hastings*, &c.)

HATCHETINE (*Mineral Adipocire*). This substance occurs in thin flakes in the cavities of the ironstone of South Wales. It is very soft, somewhat granular in appearance; translucent; colour yellowish-white or greenish; not elastic; inodorous; combustible. It melts at 170°, and is soluble in ether.

According to Professor Johnston it consists of—

One atom of Carbon	85·910
One atom of Hydrogen	14·624
	100·534

HATTERIA. [DRACONINA.]

HAUSMANNITE. [MANGANESE.]

HAÜYNE (*Latialite*), a Mineral occurring in detached rhombic dodecahedral crystals, also granular and massive. The primary form is the cube. Cleavage parallel to the diagonal planes of the cube, indistinct. Fracture uneven. Brittle. Hardness, 5·5 to 6·0. Specific gravity 2·68 to 3. Colour when opaque indigo-blue, when translucent blue or bluish-green; streak white; lustre vitreous. The massive varieties are amorphous; structure granular, compact. When heated in an acid it becomes gelatinous and transparent. Before the blow-pipe it fuses with borax into a clear glass, which becomes yellow on cooling. This mineral is found in the cavities of lavas and in the fragments of rocks ejected from Vesuvius, and also embedded in pumice and lava near Andernach on the Rhine, &c. According to Gmelin, the mineral from Marino yielded—

Silica	35·48
Alumina	18·87
Potash	15·45
Lime	12·00
Sulphuric Acid	12·39
Oxide of Iron	1·16
Water	1·20
	96·55

HAWFINCH. [COCCOTHRAUSTES.]
HAWK. [FALCONIDÆ.]
HAWK-MOTH. [SPHINGIDÆ.]
HAWK-WEED. [HIERACIUM.]
HAWKS'-BILL TURTLE. [CHELONIA.]
HAWTHORN. [CRATÆGUS.]

HAYDENITE, a Mineral resembling *Chabazite* in the appearance of its crystals, but is described as having an oblique rhombic prism. It occurs with *Heulandite*.

HAYESINE (*Borocalcite*), a Mineral occurring in globular masses of a fibrous structure, having externally a brown colour; when broken these masses appear to be formed of snow-white delicate fibres, interwoven, curved, and knotted. The lustre is satin-like, and the fibres so soft as to crush readily between the fingers. It incloses fragments of argillaceous slate, with brilliant and perfect crystals of *Glauberite*, which are sometimes penetrated by the fibres of this mineral. Found in the province of Tarapaca, Peru. The following is an analysis (after drying at 150° Fahr.):—

Boracic Acid	46·111
Lime	18·889
Water	35·000
	100·

HAY-TIT. [SYLVIA.]
HAZEL. [CORYLUS.]

HAZEL-NUT, the fruit of the wild bush of *Corylus Avellana*, unchanged and unimproved by cultivation. It differs from the domesticated varieties only in being smaller and rather more hardy. [CORYLUS.]

HEAD. [BRAIN; SKELETON.]
HEARING. [EAR.]

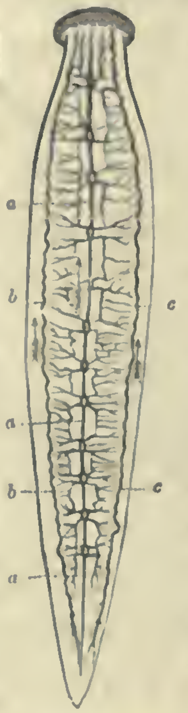
HEART is the central organ of the circulation, and by its alternate contractions and dilatations exercises the principal power by which the blood is moved through the bodies of the higher animals. Its anatomy and physiology will be made most easily intelligible by considering first the principal varieties of the circulation or other motion of nutritive fluid which occur in the animal kingdom; bearing in mind that the main objects for which such a motion is required are a constant supply of fluid adapted for their nutrition to all parts of the body, and its regular exposure to the influence of atmospheric air, that by the process of respiration it may be fitted for maintaining the life of the animal.

The simplest mode by which a distribution of nutritive fluid is effected is by means of ramifications proceeding from the stomach or intestinal canal to various parts of the body, which occurs in the polyps, *Infusoria*, intestinal worms, *Echini*, *Medusæ*, and other zoophytes. In all these the digestive canal and the circulating system form but one apparatus: the food, which in the higher animals requires a complicated process of assimilation before it is fitted to move with the blood, is in them already adapted for nutrition. In most of them currents can be seen passing in opposite directions along the canals opening into the digestive cavity, exactly like those well known to exist in the stems of *Charæ* and other plants, and probably produced by the motion of cilia which line the tubes, but are too minute to be discerned in all cases even with the microscope. In many instances however cilia have been observed, as in the case of *Grantia* among the sponges. Cilia have also been shown to exist and to cause the currents observed in many of the *Desmideæ*. ('Quarterly Journal of Microscopical Science,' vol. ii. p. 234.)

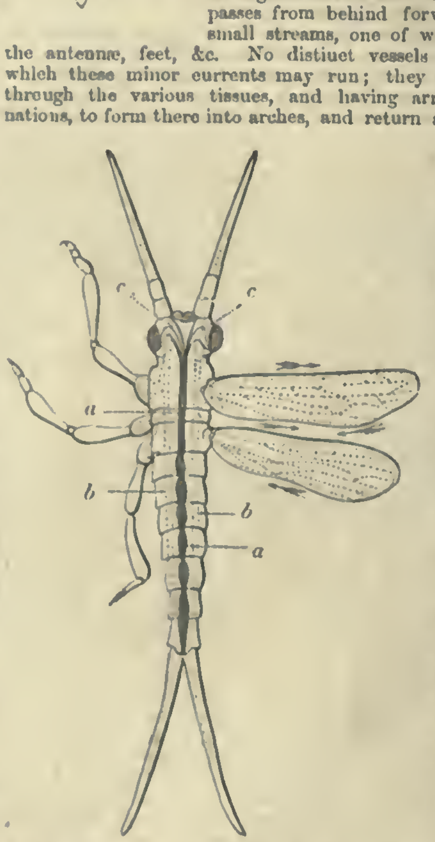
In the *Planariæ* and some of the *Trematoda* a separate vascular system has been discovered in addition to the ramified digestive tubes. In the former the main trunk has the shape of an oval loop (*a*, *b*, *c*, *d*), from which capillary networks arise and communicate freely together, and with a dorsal median vessel (*e*).

These vessels have been seen contracting and dilating, but no regular course of fluid has yet been discerned.

A more perfect form of circulation of this kind is found in the *Annelida*, and it has been closely observed by Müller in the leech, as shown in the next drawing. There are two main lateral vessels (*b*, *b*, *c*, *c*), communicating at their extremities and by transverse branches with each other, and with a third central vessel (*a*, *a*, *a*), which contains within it, bathed in its blood, the nervous cord, and presents knot-like swellings at the same situations as that cord does. Alternate motions of the blood may be seen in these vessels: at one moment the lateral vessel (*b*, *b*), and the central (*a*, *a*, *a*), with the communicating branches between them, are seen filled with blood; while the other lateral vessel (*c*, *c*) and its branches are empty. In the next moment *c*, *c* and its branches are filled, while *a* and *b* are empty; so that one lateral vessel, and the central one, are always opposed in action to the other lateral one. The central continues acting with one of the lateral for 20 or 25 pulsations, and then its relation changes and it acts in unison with the other. During the contraction of a lateral vessel the blood evidently flows from it through the middle transverse vessels over to the other side, and in the next moment returns. The contraction proceeds gradually from behind forwards, so that a wave (as it were) of blood is seen passing from one end of the lateral and of the central vessel to the other, and then returning in the contrary direction through the other lateral vessel. In this manner it is probable that a constant circulation is maintained along the sides of the animal, and its direction seems to be changed after every eight or thirteen pulsations. The same general type of circulating system is found in earthworms and all the other *Annelida*.

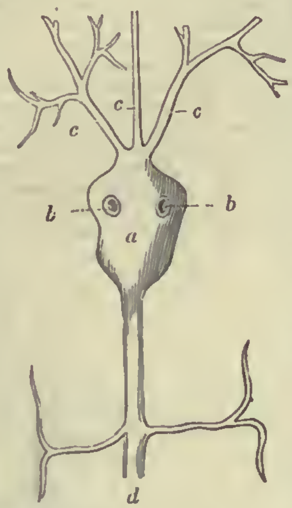


Hitherto nothing has been seen which could fairly be called a heart, nor have the vessels presented any characters by which they could be separated into systems of arteries and veins, for all alike seem to perform at different times the functions of both. A more distinct division of the parts of the circulating system is found in insects. They have a large vessel (*a*, *a*) running along the back, divided by numerous constrictions into a series of communicating cavities, between which there are lateral openings through which the blood is received, and which are guarded by valves to prevent the blood from flowing out. Through this, which is commonly called the dorsal artery, but which may rather be regarded as a series of ventricles, the blood passes from behind forwards, diverging into small streams, one of which flows to each of the antennæ, feet, &c. No distinct vessels can be detected in which these minor currents may run; they seem simply to pass through the various tissues, and having arrived at their destinations, to form there into arches, and return and empty themselves into abdominal vessels *b*, *b*, which may be regarded as veins, and through which the blood flowing from before backward is returned into the dorsal artery through the communications which exist between them and the posterior part. This is also the plan of the circulating system which with various modifications prevails in the *Arachnida* and the lower *Crustacea*.

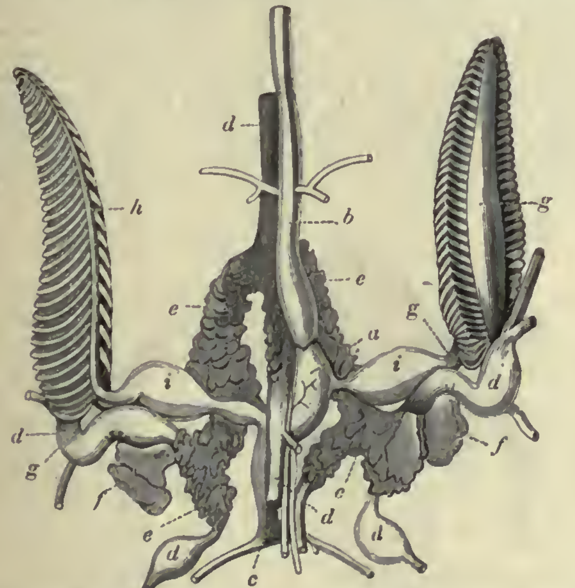


In the orders already mentioned no special arrangement of vessels has been found for the purpose of exposing the blood to the influence of the air. Either the whole or part of the blood undergoes respiration on the whole surface of the body, or at the tracheæ, or the vesicles arranged in especial systems for that purpose. In those which follow however, we shall observe a separate and complicated respiratory apparatus; and that the form of the heart and its large vessels are adapted in accurate correspondence with that of the gills or lungs, and according as the whole or part of the blood is required to be exposed at each round of the circulation to the influence of the air.

The simplest kind of a heart, forming a defined cavity, is found in the larger *Decapoda*, and some other *Crustacea*. The annexed sketch represents the heart and large arteries of the lobster. There is a single cavity or ventricle (*a*), into which the arterial blood flows from the gills by vessels which unite into two trunks, whose orifices (*b*, *b*) are protected by valves. Six main arteries proceed from the heart; the three anterior (*c*, *c*, *c*) go to the head; two from its inferior part to the liver; and the largest of all (*d*) from its posterior part. This last gives off a superficial and a deep artery to the tail, and then curving forwards under the sternum, gives branches to the feet and deep arteries to the head. From these the blood returns by veins into a number of venous sinuses which lie at the sides by the articulations of the legs with the chest, and all communicate together. From them branchial arteries proceed, which run on the outer edge of the gills, and pass through capillary vessels in them, terminating in branchial veins which unite into two trunks that open into the heart.

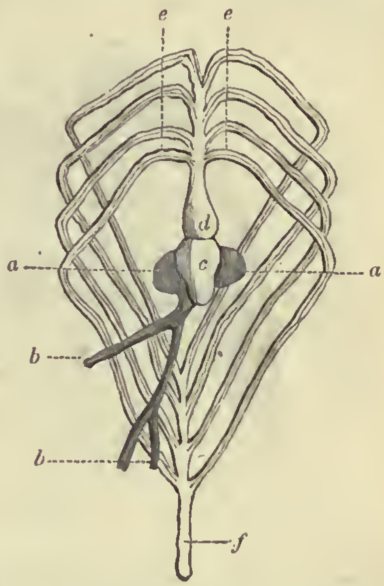


In most of the *Mollusca* the blood flowing through the branchial veins, instead of being poured directly into the ventrical, is received first into an auricle, presenting the first instance of a heart with more than one cavity. In most of the *Gasteropoda* and *Pteropoda* the auricle is single; in the bivalves the auricle is mostly double. In the latter division, the blood, collected from the systemic veins into one venous reservoir, before going to the gills passes by numerous branches into a spongy tissue consisting of lacunæ, which Bojanus calls a lung, and others a kidney. From this a few branches pass at once into the auricles, but the greater number go as branchial arteries to the gills. In the brachiopods the systemic ventricle is also double, each cavity giving rise to an aorta. In these cases, although the auricle is double, it is not to be regarded as representing the two auricles of warm-blooded animals, of which one receives the blood from the system, the other from the lungs, since here the two auricles have the same function, and there are two for the sake of convenience. In the oyster they are united into one cavity. But the most singular form of heart in this class, and one of much interest as presenting all the cavities separated, which in higher classes are united in one body, is that of the cuttle-fish. The blood passes in it from a systemic or central ventricle (*a*), through the aorta superior (*b*), and inferior (*c*), and is thence

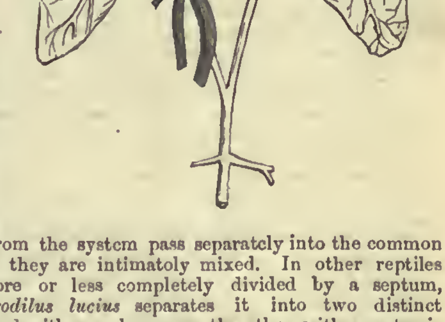


distributed throughout the body, whence it is collected into six venæ cavæ (*d*, *d*, *d*, *d*, *d*, *d*), which open into two branchial auricles (*e*, *e*), conducting into two branchial ventricles (*f*, *f*) by which it is forced through branchial arteries (*g*, *g*, *g*). From the extremities of these it is received into branchial veins, of which that of the left side (*h*) is here shown, which open into the two systemic auricles (*i*, *i*), conducting again into the systemic ventricle (*a*). Here then we have the first appearance of a separate heart for the respiratory circulation, and the elements of all the compound forms which we have now to notice.

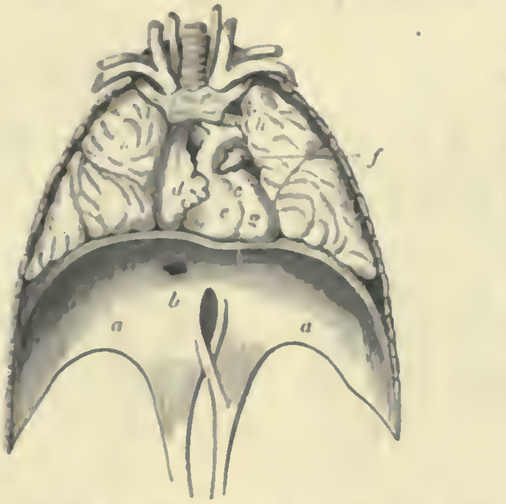
Among vertebrate animals the simplest form of heart is found in Fish. They have a single auricle (*a*, *a*), which receives the blood from the trunks of the veins of the whole body (*b*, *b*), and communicates with a single ventricle (*c*), which forces the blood into an arterial trunk with a contractile bulb (*d*). From this trunk all the branchial arteries (*e*, *e*) arise, and passing on each side in arches to the gills, divide there into capillary branches. The blood thus aerated passes on, and the arches again unite into a common trunk (*f*), the true aorta, which runs along the under surface of the spine, and sends the blood to all parts of the body. From these it collects again into the systemic veins (*b*, *b*), by which it is carried back to the auricle. The same type of formation is found in the reptiles which have gills, as in the *Proteidæ* in their adult state, and in the larvæ of many which at that period also breathe by gills.



In Fish all the blood is subjected to the respiratory process before it passes to the body: in the Reptiles, which breath in air, and have therefore a much more complete exposure of the blood to it than fish, who breathe only the air that is dissolved in the water, only a part is exposed before entering the general circulation, but the modes in which this is effected vary greatly. The annexed sketch represents the circulatory system of the Frog in its perfect state. It has a single ventricle (*a*), from which arises a single aortic trunk (*b*), from which proceed the two pulmonary arteries (*c*, *c*), conveying that part of the blood which is to undergo respiration to the lungs (*d*, *d*), whence it is returned by pulmonary veins (*e*, *e*). From the same aortic trunk four other arteries arise, two of which, forming arches, unite to form the dorsal aorta, while the two uppermost are distributed to the head and upper extremities. From the terminations of these arteries in all parts of the body the blood is collected into large venous trunks, which open into the double auricle (*f*, *f*), from which the aerated blood from the lungs and the impure blood from the system pass separately into the common ventricle, in which they are intimately mixed. In other reptiles the ventricle is more or less completely divided by a septum, which in the *Crocodilus lucius* separates it into two distinct cavities, one connected with a pulmonary, the other with a systemic aorta; in some others the septum is nearly complete, and the mixture of the two kinds of blood is supposed to be prevented by a valve; but in the rest of the order the septum is so small that the blood must necessarily be mixed. In all of this order however the abdominal aorta, which runs along the spine, is formed, as in the frog, of two arches, and in those which have separate ventricles a branch proceeds from each to form it, so that while the head and upper extremities are supplied with pure arterial blood from the left side of the heart, the lower portion of the body receives a mixed blood from the left side and the right.



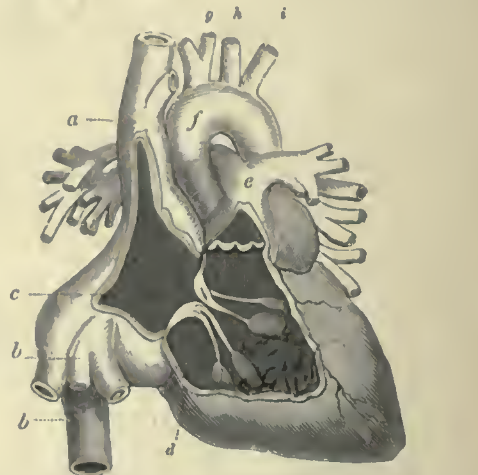
Lastly, we arrive at the complete double circulation of Man (*Mammalia*) and Birds, to which some of the forms just described make very close approximations. In all of them the blood arrives at the heart from the veins of all parts of the body by two large trunks, the venæ cavæ, superior and inferior, from which it is received into the right auricle, and thence passes into the right ventricle. The right ventricle, by contracting, forces it into the pulmonary artery, in whose branches it is exposed to the air, and passes from them to



the pulmonary veins, which open into the left auricle, from which it proceeds to the left ventricle, thence through the single aorta into all parts of the system, and again into the veins and right auricle.

We may now consider the anatomy of the heart, and the chief phenomena of the circulation, in Man.* The heart is of a somewhat conical form, having its base directed backwards towards the spine, and its point forwards, downwards, and to the left side, so that at each contraction it may be felt striking between the fifth and sixth ribs, about four inches from the middle line. It rests upon the diaphragm (*a*, *a*), the muscular partition between the chest and abdomen, and the surface upon which it lies is much flattened. It is firmly attached to the diaphragm at its right side and behind by the inferior cava, which passes through that muscle at the aperture *b*; and above and behind it is fixed, though more loosely, to the upper and back part of the chest by the rest of its great vessels, which there pass out of the pericardium, and are united to the surrounding cellular tissue and organs. Everywhere else it is quite free and moveable, though the range of its motions is limited by the pericardium, or membranous bag in which it is contained, and which closely surrounds it at all times. When the heart is exposed by cutting open the front of the pericardium, it is seen to be divided along its front and most convex surface by a line running from the middle of its base downwards to the right side of its apex. This line and a similar one on the under and flatter surface, both of which are traced out by two vessels, the principal trunks of the coronary arteries and veins by which the walls of the heart itself are supplied with blood, indicate the position of the septum or partition by which the ventricles are divided from each other. At the base, above and on each side, two other divisions will be seen, each having a little fleshy pendulous appendage at its corner; these are the auricles. Thus may be seen at once a right auricle (*d*) and ventricle (*c*) on the right side and front of the heart, and a left auricle (*f*) and ventricle (*g*) on its left side and behind. From the greater thickness of the walls of the latter they form the larger portion of the whole heart, but the cavities will be found to be nearly of the same size. The right anterior, or pulmonary, side of this double heart is exclusively for the circulation through the lungs (*h*, *h*); the left posterior, or systemic, for that through the body.

To examine the interior of the heart it should be removed from the pericardium, and an incision should be made into the front of the right or front auricle, so that an angular flap may be cut out of its walls, and the whole view of the back part and sides of its interior may be exposed. There will then be seen, behind and to the right side, two large apertures—the upper leading to the vena cava superior (*a*), through which all the blood is returned from the head and upper extremities; and the lower leading to the vena cava inferior (*b*, *b*), by which all the blood is conveyed from the abdomen and lower extremities. These apertures will be seen to be surrounded by a few muscular fibres continuous with those of the auricle itself, and that of the inferior cava is partially guarded by a thin semilunar membranous fold called the Eustachian valve, varying much in size and often much torn. The left side of the cavity, on the partition which separates it from that of the right auricle, presents an oval depression (the fossa ovalis) surrounded by an elevated border, indicating the situation of the foramen ovale, through which during the fœtal state the blood, which was prevented by the Eustachian valve from passing into the ventricle, was conveyed directly from the right into the left auricle, and thence into the left ventricle. Lastly, at the anterior and left angle of the cavity another and the largest aperture (c) is seen, which leads into the right ventricle, and has attached to its sides a membranous curtain (*d*), by which it is occasionally closed, and which is called the tricuspid valve. The general form of the cavity of the right auricle is that of a quadrangular sac, from the right and interior part of which a small flattened triangular process stands out, from the remote similarity of which to the ear (auris) of a dog the cavity has received its name. Its interior is tolerably smooth behind, by the orifice of the superior cava, on the partition, and about the opening into the ventricle; but to the right and front side, about the auricular appendage and the inferior cava, it is rendered uneven by prominent bands of muscular fibres (the musculi pectinati) which seem to radiate from the auricles.



Proceeding in the course of the circulation, a cut should be made from the right auricle through the aperture leading from it into the right ventricle, and along the front of the heart nearly to its apex; and then another from the end of the first upwards into the pulmonary artery, as it arises from the front and upper part of the ventricle. By raising the portion thus cut out, a complete view of the cavity of the right or pulmonary ventricle, and of its communication with the auricle, will be seen. The cavity of the right ventricle has a somewhat conical form, with its base uppermost; that part of its walls which is formed by the septum projecting somewhat into it. Its walls are rendered extremely irregular by prominent bands of muscular fibres crossing each other in every direction, and inclosing spaces of various size and form, which after death are generally found filled with coagulated blood entangled in and adhering to them. Here and there stand out short columns of muscle projecting into the interior, and pointing towards the right auricle; these are called columnæ

a, *a*, *a*, *a*, the columnæ carneæ; *b*, *b*, *b*, *b*, chordæ tendineæ; *c*, *c*, *c*, *c*, valves.

carneæ, and they have attached to their summits fine tendinous cords (chordæ tendineæ), which pass thence to be attached to the edges of the curtain-like membrane (the tricuspid valve) which guards the orifice between the auricle and ventricle. This orifice is of a broadly oval form, surrounded by a ring of firm dense tissue, to the whole interior circumference of which is attached the fold of membrane, strengthened by tendinous fibres, forming the valve. The edges of

* The heart and large vessels of any of the larger of our domestic quadrupeds may be used for popular dissection; their structure differs so little from that found in man, that the present description will almost exactly apply to them.

this valve are very irregular, but it may be roughly divided into three principal portions (whence its name), the largest of which lies so as to separate this orifice from that leading into the pulmonary artery. If this valve be pushed inwards towards the cavity of the ventricle, as in the larger of these figures of the mitral valve, of which the construction though similar is more simple, it will lie nearly flat against the walls, and would in this positiou present no obstacle to the passage of a fluid from the auricle into the ventricle; but if, on the coutrary, it be pushed from the ventricle towards the auricle, its edges will be found to meet so as to close the orifice as in the smaller figure. This we shall see is the mode in which it acts duriug life.

From the front and upper part of the ventricle a smooth short passage leads to the origin of the pulmonary artery (*e*), which is attached firmly to the deuse ring to which many of the muscular fibres of the ventricle are affixed. At their union, and at the very orifice of the pulmonary artery, three little valves (the semilunar, sigmoid, or pulmonary valves) are seen, of a semilunar form, attached by the whole length of their convex edges to the walls of the artery, and hanging loosely in it with their free festooned edges directed upwards, inclosing behind them three small spaces, where the artery bulges somewhat outwards. If one looks from the cavity of the ventricle along the interior of the artery, and blows gently into it, the valves will be seen to lie nearly flat against its walls, and will offer no obstacle whatever to tho passage of any fluid in that direction; but if one looks and blows in the opposite direction, from the artery down into the ventricle, the valves will fall inwards, so that their edges will meet, and they will completely close the tube of the artery, so that, unless driven with force sufficient to rupture them, no fluid could pass into the ventricle. It is evident that if the artery be circular the edges of these semilunar membranes could not exactly meet to close it, but would leave a little space of a triangular form between them. This is filled by three little bodies, the corpora arantii, one of which is attached to the middle of the edge of each valve, and which at the same time that they effect this afford a strong point of attachment for the tendinous fibres by which the valve is strengthened. The pulmonary artery proceeds upwards, and to tho left, in front of the other vessels; and after a course of about an inch divides into two branches, one of which turns sharply round to go to the right lung, while the other goes straight onwards to the left. Iu these organs each artery divides into numerous branches, which become smaller as they become more numerous, and terminate in a most delicate network of vessels, ramifying on the walls of the air-cells, from which, after the blood which they contain has been exposed to the air, it is received into equally delicate pulmonary veins, and through them conveyed in gradually increasing branches to the four main trunks of the pulmonary veins, which open into the left auricle.

It would be useless repetition to describe in detail the left posterior or aortic ventricle and auricle, which differ in no important particular from the right. The walls of both cavities on the left side, and all the parts contained in them, are thicker and stronger than those on the right; the orifice between them is guarded by a valve which has only two principal divisions, and is therefore called the mitral valve; and the aortic semilunar valves have larger aud more prominent bodies (corpera arantii) on their edges. The aorta (*f*) proceeds upwards, and to the right side, then arches backwards and to the left, and, turning over the main air-tube of the left lung, passes down along the spine, at the lower part of which it divides into two large arteries (the common iliacs), which supply the pelvis and lower extremities. From the upper part of its arch it gives off the main trunks of the head and upper extremities in three large trunks—that most to the right, called arteria innominata (*g*), is the common trunk which divides into the right carotid for the right side of the head, and the right subclavian for the right arm and side of the neck and chest. Next to it is the left carotid (*h*), and next the left subclavian (*i*), of which the distribution is similar to that of those on the right side.

During life, the blood, returning from the whole body by the veins which unite to form the two venæ cavæ, enters the right auricle and gradually distends it, at tho same time that the blood returning from the lungs by the pulmonary veins enters the left auricle and distends it; when completely filled, a kind of vermicular motion is seen commencing at the point of each auricle, which is rapidly propagated along their walls, and simultaneously empties the contents of the one into the right and of the other into the left ventricle. The ventricles are no sooner completely filled than they contract suddenly and with much greater force than the auricles, and propel the blood into the pulmonary artery and aorta. They drive it indeed in all directions, but in each ventricle there is but one orifice into which it can find a passage, for that by which it entered is closed by the valve surrounding it. The same contraction of the walls of the heart which propels the blood serves to raise and fix the valves by which its regurgitation into the auricle is prevented; for as soon as any blood is forced under their edges they are lifted up and pressed towards the auricles; and they would be forced iuto them, but that when they have arrived at such an elevation as to close the orifice they are restrained from passing farther by the chordæ tendineæ, which are attached at one end to the edges of the valves, and at the other to the summits of the columnæ carneæ—those muscular pillars which we have described as standing out into the cavity of each ventricle. The length of these little teudons is exactly measured to the distance to which the valves may be allowed to flap back, and as the columnæ carneæ contract so as to narrow the cavity of the heart, and force the blood out of it, they tighten and fix the edges of the valves against which some of the blood is forced, and thus keep them steady, till the ventricles being emptied their walls relax and permit the valves to be forced down again by the next current coming from the auricles. The blood forced into the artery pushes on that which was already there (for the whole circulating system is throughout life completely filled), and distends the lower part of the vessel, which by its elasticity recoils, and contracting would tend to force the blood as well back into the ventricle as forward into the branches. It would accomplish both, and half the power of the ventricles would be thus wasted, but that the semilunar valves, which are prevented from adhering to the walls of the arteries as well by their form as by the little projecting bodies on their edges, as soon as any blood gets behind them, are pushed dowu and close the passage into the veutricle. The whole of the blood is therefore driven on along the arteries, displacing that which had just before been thrown into them by the ventricles, and itself in turu displaced by the next succeeding wave.

Through the arteries it is distributed to all the body, and returned by the veins; but the veins of the iutestiual canal and the organs connected with it unite into a large trunk, the vena portæ, which, instead of at once entering the heart with the others, passes into the liver, and there again divides into minute capillary vessels, from which the bile is secreted, and which pass into the ultimate divisions of a series of hepatic veins, which collect into three or four large trunks which open into the vena cava inferior just before it passes through the diaphragm to enter the right auricle.

A point of much interest is the cousideration of the changes which the circulating system of man and the higher animals undergoes in the various periods of their life in the fœtal and in the perfect state. At the very earliest periods it has been clearly proved that in the embryoes of both man and the higher animals the first appearance of the motion of any nutritive fluid is iu the form of a circular canal running rouud the edge of the area in which the future development of the animal is to be effected—an arrangement in some measure analogous to that of the *Planariæ*, and those of the lowest animals, in which a circulating system is first added to the digestive. The first appearance of a heart is in the form of a long tubular pouch, lying beneath the spinal cord, analogous to the dorsal vessel of the insects. The first trace of a separate respiratory system is iu that of gills, for at very early periods of fœtal life fissures may be seeu by the sides of the neck, in birds and many *Mammalia*, and therefore in all probability they exist iu man, beneath which arches of vessels run from the anterior part of a single heart, and collect at their opposite extremities into a single aortic trunk; au arrangement most closely analogous to that of fish. After this, and to the end of fœtal life, the arrangement is adapted to the respiration by a placenta, previous to the possiblility of the action of the lungs, which are only formed for respiratiou in open air. The purified blood coming from the placenta circulates in great measure through the liver before it enters the right auricle by the inferior cava; from this cavity it passes straight through the foramen ovale, over the Eustachian valve, into the left auricle, whence it is conveyed into the left ventricle, aud by it forced through the aorta and its three principal branches to the head and upper extremities, wheuce it returns by the superior cava to the right auricle, and passes through it (without mingling with the other current going through it from the inferior cava to the left auricle) to the right ventricle. From this it is carried into the trunk of the pulmonary artery; but as the lungs are at present incapable of performing their functions, it is couveyed through a direct passage, the ductus arteriosus, from the pulmonary artery into the aorta, just below the origin of the left subclavian artery; and from this part it passes along the aorta through the chest and abdomen, aud is conveyed through the trunks of the iliac arteries to the placenta, to be again purified. Thus there is a single auricle, but through the right side of it two currents are constantly running in opposite directions; and two ventricles, one forciug the blood to the head and upper extremities, of which the former is at this time peculiarly active iu development, while the other forces the blood through the ductus arteriosus to the placenta, and therefore now, as during perfect development, may be regarded as tho respiratory portiou of the heart. At this time the two ventricles, haviug uearly equal extents to force the blood through, are of nearly equal size. After birth the left becomes much larger, and is thus enabled to accomplish the more exteusive purpose of propelling the blood through the whole body. Directly after birth changes commence which in a few days convert the arrangements for the fœtal circulation into those adapted for the circulation of the completely-formed animal: the foramen ovale is completely closed; the ductus arteriosus becomes consolidated; the branch of the umbilical vein, which had passed directly into the inferior cava, is obliterated; and the terminations of the iliac arteries which had carried the blood to the placenta contract, gradually close, aud are ultimately traceable only in the form of dense solid cords.

We may now consider the powers by which the motion of the blood is effected in man, and the chief phenomena of the circulation in the various parts through which it takes place.

When the ventricles of the heart contract they are shortened, and become narrower, harder, and firmer. The heart lying loosely in its pericardium, and fixed only where the great vessels pass out of that cavity, recoils from the blood which the ventricles force out; its point is tilted up, and strikes at each ventricular contraction, or systole, as it is called, against the wall of the chest, producing that impulse which may be felt by the finger or hand placed just beneath the left breast, and which is almost exactly coincident with the pulse felt at the wrist. At the relaxation, or diastole, of the ventricles they regain suddenly and forcibly their previous conditions. These actions are accompanied with certain sounds. If the ear be placed directly, or on a stethoscope, on or near the part where the heart is felt beating, a sound like that of a gentle breathing is heard coincidently with the impulse of the heart. This is immediately followed by a second sound, which is shorter, sharper, more defined, like the falling back of a light valve, coincidently with which the heart seems to fall back from the wall of the chest. A short pause of perfect silence succeeds, and then the first long sound is again heard. They take place in regular rhythm. Dividing the whole period occupied between each two impulses of the heart into four parts, the first sound would occupy two, the second one, and the pause one.

It is unnecessary to allude to various explanations given of those sounds. They were made the subject of an extensive series of experiments by a committee of the British Association, which were reported at the meetings in 1836 and 1837. From these and other experiments we may conclude that the first sound is produced by the vibrations of the muscular fibres of the ventricles during their contraction, and by the rush of the blood through the narrow passages leading to the aorta and pulmonary artery, assisted in a very slight degree by the vibration of the heart striking against the chest. The second sound is in all probability the result of the falling back and consequent tension of the semilunar valves when the blood just expelled from the ventricles regurgitates. The succession of actions in the heart has been described: the contraction of the auricles is coincident with the pause, for their vermicular and slight contraction does not produce any audible vibrations; the pause lasts till the ventricles are completely distended by the contraction of the auricles: then comes the first sound coincidently with the ventricular contraction, the forcing of the blood into the arteries, the elevation of the valves to prevent the blood from going into the auricles, and to permit it to go into the arteries, the impulse of the heart against the wall of the chest, the pulsation of the great arteries, and followed after a scarcely appreciable period by the pulse at the wrist and other parts distant from the heart. Lastly, the second sound is heard coincidently with the relaxation of the ventricles, the falling down of the valves to permit the blood to pass from the auricles into the ventricles, and to prevent its passing from the arteries back into the ventricles; and the rush of blood from the auricles into the ventricles, which continues through the whole time of the second sound and the pause.

At each contraction of the ventricles a very large proportion of the blood which they contained is expelled into the arteries, and a very little may flow back into the auricles, especially the right, before the valves are completely closed, producing the slight dilatation of the venæ cavæ which may often be seen at each contraction of the ventricles. At each contraction of the auricles also it is probable that some blood flows back into the cavæ and pulmonary veins, for they are seen distended rather more suddenly at this time than can be explained by the mere arrest and consequent accumulation of blood in them. However, so large a portion of the heart's power is exerted in propelling the blood into the arteries that these slight influences in the contrary direction need scarcely be taken into account in calculating its amount. At each contraction of the ventricles about an ounce and a half of blood is forced into each artery, with such force, that Hales found that the blood as it rushed from the open main artery in the thigh of a horse would rise 8 or 9 feet in a glass tube of the same size as the vessel, while in the temporal artery of a sheep it rose 6½ feet, and in those of dogs from 4 to 6 feet. Poiseuille (Magendie's 'Journal de Physiologie') also calculated, by deductions from accurate experiments on animals, that the force of the blood as it streams in the human aorta was sufficient to support a weight of 4 lbs. 3 dr. 43 grs. Now, if the quantity of blood in the whole body be assumed to be 30 pounds (troy weight), which is probably about an accurate average, and if an ounce and a half be forced from the ventricle at each pulsation, of which, on an average, there are 70 per minute, a portion of blood will go the complete round of the circulation in about 3½ minutes, which is however a somewhat slower rate than we might deduce from the experiments of Hering (Tiedemann's '*Zeitschrift*,' t. 3), who found that substances injected into the veins of horses could be detected in distant arteries in half a minute.

Harvey considered the heart to be the sole agent by which the circulation is effected, but it is certain that several other agents exercise auxiliary powers. That the heart has however an influence on all parts of the circulation is quite evident. In the larger arteries its effect is seen in the increase of the current which it had set in motion, in exact coincidence with the contraction of the ventricles; in the smaller ones, by the same increase at a scarcely appreciable interval; in the capillaries, by the occasional pulsatile motion which may be seen in them, when, after an animal has been largely bled, its transparent parts are examined with the microscope, and this though the heart is acting very weakly. Lastly, in the veins we find its influence still exerted; for if the main artery and vein in a limb be exposed and isolated, and the latter be wounded, the flow of blood from the orifice may be exactly regulated by compressing the artery, that is, by preventing, to a greater or less extent, the blood from flowing to the vein with the impulse given to it by the heart. There are cases again in which the veins have distinctly pulsated, and the pulsations have been clearly proved to have been communicated from the heart through the capillaries. To these we may add that the rapidity of the current in the arteries, veins, and capillaries, is always in direct proportion to the strength and frequency of the ventricular contraction, and always more rapid in the parts near them than in those remote from the heart; that it ceases in all the instant the heart is removed, or its influence on a part cut off by dividing the main artery; that in old persons, in whom the whole arterial system of the lower extremities is sometimes ossified and rendered incapable of contraction, the heart alone is sufficient to maintain the circulation through the affected parts; while, on the contrary, when the heart's power is by any cause weakened or interfered with, partial stagnation and an extremely languid motion of the blood is found in all the organs. In cases of suspended animation no motion of blood can be produced till the heart begins to act; but when this is the case, it has of itself sufficient power to set all the blood of the body in a current.

There are so many proofs that the contraction of the ventricles has a share in propelling the blood throughout the whole course of the circulation; but the heart also assists, by the enlargement of its cavities after their contraction, which, whether it be the effect of mere elasticity, or of an active power of dilatation, certainly takes place with great force. The heart, in short, acts at once as a forcing and as a sucking-pump. The proofs of this are, that the auricles, and still more the ventricles, dilate, not gradually, but suddenly, and with more force than they could be distended by the blood being impelled into them; that the currents observed in living animals are often seen to be increased coincidently with the dilatation of the auricles; by the velocity of the flow of blood from the auricles into the ventricles being disproportionate to the degree of contraction of the former.

1, trunk of the artery; 2, large branches into which it subdivides; 3, small branches, successively becoming smaller and smaller until they terminate in 4, the capillary branches.

From the heart the blood is poured into the arteries, a series of ramifying tubes through which the current is distributed, divided into a gradually increasing number of streams, which progressively diminish in size, till it arrives at a network of the most minute canals, the capillaries. As a general rule, when an arterial trunk divides, the sum of the diameters of the branches is greater than the diameter of the trunk—thus in the annexed diagram (in which the arrows indicate the course of the blood), the sum of the diameters of the branches 2, 2, is greater than that of 1, and the sum of these of 3, 3, 3, greater than that of 2, from which they arise. Hence the arterial system has been compared in form to a cone, of which the heart is at the apex—and the stream of blood will be like a current gradually growing wider, so that if no additional impulse be given to it, it will become slower as it becomes more distant from the heart, an effect to which the friction of the blood against the walls of the vessels will also contribute. The effect of both these causes however is so slight that M. Poiseuille has found that the force of the current of blood in all arteries sufficiently large to be experimented on is relatively the same; that in the aorta, for example, bears the same relation to its diameter as that in the artery at the wrist does to its diameter. Thus the diameter of an artery may be taken a measure of the force of the current of blood in it. It does not appear moreover that the direction in which a branch is given off from the trunk has any appreciable influence on the velocity of the current in it—most frequently the branches of arteries are given off so as to form an acute angle with the continued trunk as 2, from 1, 2,—but often they separate at right angles, and less frequently so as to form obtuse angles. Neither can the effect of the tortuosity of an artery be calculated, though there can be little doubt that, cæteris paribus, the current in it will be slower. An important point in the arrangement of arteries is the frequent union, or anastomosis, of branches with each other. The purpose of this is evidently to prevent any part being cut off from its supply of blood, by the compression or obliteration of one of its arteries. Hence it is that even when the main artery of a limb has been tied, the nutrition has still been amply effected by the current of blood being diverted into the collateral channels, which subsequently become enlarged. [ANEURISM, in ARTS AND SC. DIV.]

The chief property of the arteries by which they affect the circulation is their extreme elasticity. It is by this that when dilated they contract on the blood that had been forced into them, and propel it in every direction—and that when elongated they again shorten, and that when empty they remain open and tubular. The chief effect of the action of this elasticity is the gradual conversion of the jetting pulsatile motion which the blood receives from the forcible and successive contractions of the ventricle into an even and steady current. The elastic contraction of any part of an artery after its distension can have no general influence to accelerate the blood, for it would press that fluid equally in all directions, and thus would retard the current coming from the heart to any part to exactly the same degree that it accelerated that passing from that part towards the veins—the one influence exactly nullifying the other.

To convert the pulsatile motion however into a uniform one no more admirable property could have been imagined than this elasticity, which by continually acting to contract the arteries (which are always during health in a state of slight distension) maintains a propelling force upon the blood during the intervals in which the ventricles are at rest. If the elastic power were not exercised, we should see, on opening an artery, a jet of blood, and then a pause, then another jet, followed by a second stoppage of the current, just as when by the successive strokes of a piston we force water through a rigid tube—the jets of blood being coincident with the contractions of the ventricles, and the pauses with the intervals of their dilatation and rest. But the arteries being elastic, when the impulse of the ventricles, which at the same time distends them and forces a jet of blood through an orifice in them, ceases, their elasticity, making them contract, forces some more blood out of the orifice, and thus makes the stream from it continuous. In the arteries near the heart indeed the force of the ventricular contraction is so great that it predominates over that of the elastic contraction; and the current, though continuous, is irregular, presenting a succession of jets—but as we recede from the heart, this predominance becomes less, the succession of jets becomes less distinguishable, and in the veins we find a perfectly equable stream. An artificial contrivance for effecting the same object, namely, the conversion of a series of motions of a fluid into a continuous one, may be seen in an organ. The air is forced into the wind-chest by a series of strokes of the bellows, and if the walls of that chest were fixed it would issue from it into the organ-pipes in the same intermitting manner; but the top of the chest is moveable, and is loaded with weights (proportioned to the size of the instrument), so that it maintains a constant and steady pressure on the air below it, which therefore, though driven in by a succession of small forces, passes out into the organ-pipes under the influence of the single force from the top of the chest in a continuous steady current. A similar arrangement is employed in fire-engines, where the elastic power is the air which partly occupies the chest into which the water is forced. [FIRE-ENGINE, in ARTS AND SC. DIV.]

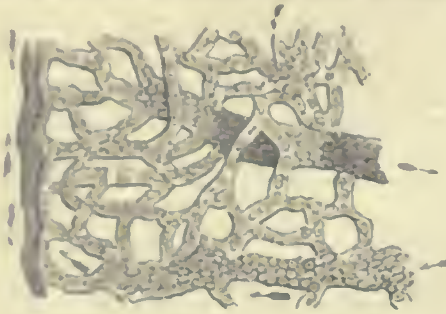
We have said that the arteries are dilated slightly by each column of blood poured out by the ventricles: from this arises their pulse, which may be said to be owing to the dilatation of the arteries produced by the wave which is propagated along the column of blood contained in them. One may form an idea of what is here called the wave by observing a ripple in a running stream. There are in that case two different motions of the particles of the fluid: they move all together, with an absolute change of place, and this constitutes the stream; but again, they move separately; one particle or series of particles rises, and the next falls, and as the first falls again, the second rises—this constitutes the ripple or wave. In it the particles undergo only a relative and temporary change of position, for they all return to rest in their former places, as is shown by any light body that may be floating in them, which merely rises to the top of the wave, and again descends to precisely the same place as it had before the wave arrived. So in the circulation there is a constant stream running through the vessels, and at every contraction of the ventricle an impulse is given to that part which is next the heart, producing a wave which is propagated with incalculable rapidity through all the arteries, and causes at each part of them a slight dilatation as it passes within them. The repeated contractions produce a series of such impulses, waves, and dilatations, and when a finger slightly compresses an artery, it feels the tendency to dilatations, in what is called the pulse. The degree of dilatation is so slight that its existence was much disputed; but M. Poiseuille has proved that in the larger arteries it is equal to about 1-11th of their average diameter. In feeling the pulse however we perceive a greater impulse than so slight a dilatation could produce, because the finger flattens the artery, and therefore we feel the force of the wave over a large part of its circumference, and we increase its velocity by diminishing the size of the channel. From this description it will be evident that the characters of the pulse by which the conditions of health or disease in any person are decided will depend on two circumstances—the state of the heart, and that of the artery itself. The frequency of the pulse will depend entirely on the number of contractions of the left ventricle in a certain time, and hence the varieties of frequent, slow, irregular, and intermitting pulses are entirely referrible to the heart. The size and degree of contraction of the artery will produce the fullness or smallness, the hardness or softness, and all the other characters which are determined by the touch rather than by mere counting.

But the arteries have another power besides that of their elasticity, by which they influence the circulation, though the mode and extent of its operation are less clear. This is the power of contraction which they possess during life, and which is sometimes, but erroneously, called muscular. The vital contraction of the arteries differs from the muscular contraction, in being slow and gradual, in not being at all times excitable by any of the stimuli that excite the muscles to contract, as mechanical irritation, electricity, &c., but following generally some peculiar influence, as that of cold, or some particular local excitement, as inflammation, &c. From elastic contraction it is distinguished by being exercised only during life, and then tending to reduce the artery often to a smaller calibre than its elasticity would, so that on the complete cessation of life the artery dilates to the size which its elasticity, the consequence of its mechanical structure, would in any circumstances tend to give it. It must be regarded as an instance of that vital contractility which is observed in many tissues quite distinct from the muscular, as in the skin, the dartos, &c. It is best seen by exposing an artery during life, and cutting it directly across; the orifice will then contract slowly, but powerfully, till it is completely closed, either at its very extremity or at a short distance within the tube; if the animal be killed the artery will remain closed for some time, but will then again gradually dilate under the influence of its elasticity.

It does not appear certain that this vital contractility of the arteries exercises any constant influence on the circulation; but, on the contrary, the immediate cessation of the flow of blood from a vein and in the capillaries, when the influence of the heart is cut off by tying the main artery (after separating the collateral vessels), or by removing the heart, and the possibility of exactly regulating the velocity of the current in the vein of a part by permitting or preventing the supply from the heart, seem sufficient to prove the reverse. There are many occasions however in which it evidently acts, and in none more importantly than in cases of wounded arteries, in which it is among the most effectual means of arresting hæmorrhage. [HÆMORRHAGE, in ARTS AND SC. DIV.] It is shown also in the paleness and shrinking of a part when exposed to cold, and in the smallness of the pulsations then felt in the main artery; and Schwann has seen the diminution in size of the arteries in the mesentery of a frog, when cold was applied. It is probably the principal cause of the emptiness of the arteries after death; for as they will contract long after the heart has ceased to act and to force blood into them, they will pour much of that which they contained into the veins, in which it will be retained by the valves. Hales found that this power of contraction resisted the passage of stimulants during life through the arteries; for a much larger quantity of water could be driven with a given force through the vessels of a part than of brandy, though the latter passed most easily after death. For some time too after the heart has ceased to act, this power is sufficient to resist the injection of fluids into the vessels, and hence in making preparations it is advisable to wait a few hours after death, that the fluids may run with more ease along the arteries.

It is probable that the vital contractility of the arteries is principally useful by regulating, according to their need, the supply of blood to certain organs, for it seems to exist in the greatest degree in arteries which run most tortuously and which are distributed in parts requiring occasionally increased supplies or velocity of blood, as the spleen, &c.; perhaps too it is exerted in maintaining the portal circulation, which can receive but little assistance from the heart, whose influence must be nearly expended in forcing the blood through the capillaries of the digestive apparatus. However, it must be acknowledged that at present we only know that such a power exists; the amount and manner of its action are quite problematical.

Much is undoubtedly due to the influence of the capillaries on the circulation. They form a dense network of extremely minute tubes, in which the arteries seem to terminate and the veins to arise; for their delicacy prevents the possibility of discovering any such structure as could decide to which set of vessels they belong, and indeed it is only by observing that the currents of blood-globules pass in regular directions, that we can prove that they are canals with definite membranous walls. [BLOOD.] When the circulation is examined in the web of the foot of a frog (from which the annexed highly-magnified sketch is taken), or in the transparent parts of other animals, as the fins, tails, or lungs of fish, frogs, lizards, &c., we see



a number of minute globules coursing along in little streams, in some parts in a confused multitude, as in the vessels which are sufficiently large to admit several to pass together, at others in only a single line, where the vessel is but little larger than the globule itself. Here and there a globule is seen to be checked in its course, as if the canal were too narrow for its passage; then it turns a little, and again rolls on. The currents run generally in the same direction in the same vessels, all tending to a larger branch, which may be regarded as the commencement of a vein, and setting out from the minutest termination of the artery. The capillaries are the most delicate of all organic tissues, measuring from 1-2000th to 1-5000th of an inch in diameter; they exist in all tissues of the body, varying in arrangement only in the greater or less closeness of the network which they form, and of which the meshes are in some organs so fine as not to exceed in width the diameter of the capillaries themselves, as is the case in the iris and lungs. It is through these vessels that all the important processes of secretion, nutrition, and absorption are effected, for there is no sufficient evidence for believing in the existence of a still more minute series traversed only by the colourless parts of the blood, and which some have described as vasa serosa, vasa exhalantia, &c. But hitherto no precise observations have been made on the manner in which these processes are performed; no pores can be discovered at the sides of the capillaries for the passage of fluids, which it is therefore probable is effected by simple transudation; nor can any open terminations be seen, for all appear to arise from arteries and terminate in veins.

The influence of the minutest arteries and veins, and of the capillaries, on the circulation, is best seen in the phenomena of local action, as inflammation, blushing, turgescence, &c. If the web of a frog's foot placed in a microscope be irritated, the capillaries are seen slowly contracting, so as sometimes to prevent the flow of blood through them, and if the stimulus be so great as to produce inflammation, then they dilate, and a larger number of globules is seen passing along them with great rapidity. The same may be seen in the human eye, the vessels in the front of which are so minute that they give no colour to it; but if they be irritated by a particle of dust, at once they dilate, and more blood-globules entering them, they are seen as tortuous canals filled with blood. On a larger scale one sees, after a wound or other injury, the parts around grow redder, and swell from the afflux of blood to its capillaries; and if the inflammation arise in a part which can be compared with another similar one, as in the hand, one feels that the pulse is fuller and stronger on the injured than on the sound side, indicating that a larger quantity of blood is passing through it. A still more evident accumulation of blood is shown in blushing, in which, from a mental impression, in an instant all the minute vessels of the face, neck, head, &c., become distended with blood. The paleness of fear is produced by the opposite condition, and we have other cases in which a decrease of the quantity of blood in a part is seen in the deficient nutrition and shrinking of parts which have become useless, as in the gills of tadpoles, the horns of deer, &c. All these circumstances are clearly sufficient to prove that, independent of any influence extending from the heart or arteries, there is in the very minute vessels of all parts a power by which the supply of blood passing through them may be either increased or diminished, whether it be effected by an alteration in the propelling power of the vessels themselves, or, as some imagine, by an increased attraction or repulsion between the tissues and the blood. An explanation of the phenomena which attend this circulation, independent of the heart, has been offered by Professor Draper of New York:—

"It is capable of being shown, by experiments on inorganic bodies, that if two liquids communicate with each other through a capillary tube, for the walls of which they have both an affinity, but this affinity is stronger in one liquid than in the other, a movement will ensue; the liquid which has the greatest affinity being absorbed most energetically into the tube, and driving the other before it. The same result occurs when the fluid is drawn, not into a single tube but into a network of tubes permeating a solid structure; for if this porous structure be previously saturated with the fluid for which it has the less degree of attraction, this will be driven out and replaced by that for which it has the greater affinity, when it is permitted to absorb this. Now if in its passage through the porous solid the liquid undergo such a change that its affinity be diminished, it is obvious that, according to the principle just explained, it must be driven out by a fresh supply of the original liquid, and that thus a continual movement in the same direction would be produced. Now this is precisely what seems to take place in an organised tissue which is permeated by a fluid, between whose particles and those of the tissue which it penetrates, affinities exist which are concerned in the formative changes that have already occurred, and thus in the circulation of the nutritive fluid there is a constant attraction of its particles towards the walls of the vessels, and a continual series of changes produced in the fluid as the result of that attraction. The fluid which has given up to a certain tissue some of its materials, no longer has the same attraction for that tissue; and it is consequently driven from it by the superior attraction then possessed by the tissue for another portion of the fluid which is ready to undergo the same changes, to be in its turn rejected for a fresh supply. Thus, in a growing part there must be a constantly renewed attraction for that portion of the nutritive fluid which has not yet traversed it; whilst, on the other hand, there is a diminished attraction for that which has yielded up the nutritive materials required by the particular tissues of the part; and thus the former is continually driving the latter before it. But the fluid which is thus repelled from one part may still be attracted towards another, because that portion of its contents which the latter requires may not yet have been removed from it, and in this manner the current may be maintained through the whole capillary network until the liquid has been entirely taken up by the tissues which it permeates."

"The source of the movement being thus attributable to the formative actions to which it is subservient, it is obvious that it must be effected by any external agencies which quicken or retard these; and it is thus that the influence of heat, cold, and electricity upon the rate of the flow seems most readily explicable." (Carpenter, 'Principles of Physiology.')

It will be seen that these elementary facts may be employed to explain the nature of the capillary circulation, and here again we may quote Dr. Carpenter's explanation of the phenomena:—

"It will be convenient to take the respiratory system as an example of its application; since the changes to which this is subservient are more simple than those which take place elsewhere. The venous blood transmitted to the lungs, and the oxygen in the pulmonary cells have a mutual attraction, which is satisfied by the exchange of oxygen and carbonic acid that takes place through the walls of the capillaries; but when the blood has become arterialised, it no longer has any such attraction for the air. The venous blood therefore will drive the arterial blood before it in the pulmonary capillaries, whilst respiration is properly going on; but if the supply of oxygen be interrupted, so that the blood is no longer aerated, no change in the affinities takes place while it traverses the capillary network; the blood continuing venous still retains its need of a change, and its attraction for the walls of the capillaries and its egress into the pulmonary veins is thus resisted rather than aided by the force generated in the lungs. In the systemic circulation the changes are of a much more complex nature, every distinct organ attracting to itself the peculiar substances which it requires as the materials of its own nutrition; and the nature of the affinities thus generated will be consequently different in each case. But the same law holds good in all instances. Thus, the blood conveyed to the liver by the portal vein contains the materials at the expense of which the bile-secreting cells are developed; consequently, the tissue of the liver which is principally made up of these cells possesses a certain degree of affinity or attraction for blood containing these materials, and this is diminished so soon as they have been drawn from it into the cells around. Consequently, the blood of the portal vein will drive before it into the hepatic vein the blood which has already traversed the capillaries of the portal system, and which has given up, in doing so, the elements of bile to the solid tissues of the liver. We are now prepared, therefore, to understand the general principle that the rapidity of the local circulation of a part will depend in great measure upon the activity of the functional changes taking place in that part—the heart's action, and the state of the general circulation remaining the same. When, by the heightened vitality, or the unusual exercise of any organ, the changes which the blood naturally undergoes in it are increased in amount, the affinities which draw the arterial blood into the capillaries are stronger, and are more speedily satisfied, and the venous blood is therefore driven out with increased energy. Thus, a larger quantity of blood will pass through the capillaries of the part in a given time without any enlargement of their calibre, and even though it be somewhat diminished; but the size of the arteries by which it is conveyed soon undergoes an increase in the supply of blood, alogether irrespective of any change in the heart's action. This principle has long been known, and has been expressed in the concise adage, 'Ubi stimulus ibi fluxus,' which those physiologists who maintain that the circulation is maintained and governed by the heart alone, cast into unmerited neglect."

Following the course of the circulation, we come now to the veins, which may be regarded as the most passive of the parts engaged in it, though they are constructed so as to permit many important external agencies to act upon the motion of the blood. While the arteries form a series of branching canals in which the main current is diverted into streams whose number increases as their individual size decreases, the veins are made up of a series in which a vast number of currents gradually unite into others whose number decreases as their size increases (as shown in the annexed figure), and which all at last meet in two great trunks — the venæ cavæ. In addition to other peculiarities of structure, the veins have valves (5, 5, 5), very similar to those at the origins of the arteries, which are arranged in pairs, or in threes, at different distances, in the course of nearly all those veins in which the blood has to rise against the power of gravitation. Their simple use is evident: the blood, returning slowly through the capillaries, and much of the force of the heart being expended in propelling it so far, would be apt to retrograde, or remain stationary, if the weight of the whole column in the veins bore down upon the arteries, and through them on the heart. As soon however as a portion is raised into a vein, when it tends to return to the arteries it forces down the valves, which close the canal of the vein and support the blood above them, till another portion rising sends it onwards. Thus, while they permit the blood to pass without obstacle towards the heart, they entirely prevent it from retrograding; and if it were stationary, the column of blood would be like a stream branching out, and divided by a number of closed locks in which the portion of fluid between any two is prevented from exercising any influence on the portions adjacent to it.

1, capillary venous branches; 2, small branches formed by the union of the capillary; 3, larger branches formed by the union of the smaller and gradually increasing in size, to form the great trunk, 4, a portion of which is laid open to show its inner surface and the arrangement of the valves, 5, formed by its inner coat.

The veins, like the arteries, are elastic, and this power is occasionally exerted in recovering them from too great distension; they too have a vital contractility whose influence is remarkably shown in their shrinking when cold is applied; but its effects have been even less calculated than in arteries.

We have seen that pressure exerted equably on all parts of the walls of an artery would force the blood as much in one direction as the other, so that it could be of no use in accelerating the circulation; but from the arrangement of the valves equal pressure on the veins has a very different effect, for it will be prevented by them from producing any retrograde current towards the extremities of the arteries, and thus the greater part of the power exerted will be gained in favour of the flow of blood towards the heart. Such pressure is exercised by the muscles surrounding the veins; as they contract they compress the veins, and thus force the fluid to flow in the only possible direction, namely, towards the heart. Their influence in this way is shown in the greater tendency to diseased and permanent dilatation of the veins immediately under the skin and other parts remote from the muscles, than in the deep-seated branches in which this varicose state (as it is called) very rarely occurs, although the number of valves in the former is always much greater; in the benefit derived by supplying the place of muscles by artificial pressure on the veins by bandages, &c.; by the increased fullness of the veins, and velocity of the current commonly seen in bleeding when the bleeding-staff is compressed and moved about in the hand; by the general acceleration of the circulation by muscular exertion; and, on the contrary, by the tendency to stagnation and swelling of the veins in the indolent, or those whose muscular systems are greatly debilitated.

But a still more important influence which is permitted by the presence of the valves is that of atmospheric pressure. It acts principally in respiration. When the chest is expanded for the purpose of inspiration, it is evident that the atmosphere will press with equal weight on all parts to fill up the vacuum thus produced. From without it will pass at once into the most open course through the trachea into the lungs, which it distends; but at the same time the blood will be forced towards the heart and the great vessels contained in the chest, and will assist in filling up the vacuum to a degree directly proportionate to their volume as compared with that of the lungs. An experimental proof of this influence in the veins (for in the arteries its effect is prevented by the valves at their origins) is afforded by introducing a tube into the jugular vein of an animal, and placing its opposite extremity in a vessel full of fluid. At every inspiration the fluid will be seen to rise, and at every expiration to descend a little, indicating first a suction towards the heart, and next a slighter expulsion of fluid from it. It is seen also in cases in which the brain is exposed by removing a portion of the skull; and in cases of Hernia Cerebri [Head, Injuries of, in Arts and Sc. Div.], in which, in addition to its slight elevation by the pulsation of the arteries at its base, the brain is seen to enlarge and rise at every expiration, and to become flattened at every inspiration. All these phenomena are still more evident when a strong inspiratory effort is made, as in sighing.

As inspiration draws the blood into the chest, so expiration acts by compressing all the large vessels to force it out of that cavity away from the heart. Its principal influence must be exerted on the arteries, for the blood would be prevented from passing far along the veins by their valves. In the arteries (and to a less extent in the veins) it is seen to act in the increased velocity of the current that issues from a wound; in the fullness of the vessels of the face and other parts during a strong expiration, or when holding the breath, coughing, or sneezing, actions which are sometimes the causes of rupture of the smaller vessels, and produce an evident alteration in the pulse.

Atmospheric pressure on the veins must also act to some extent in filling up the vacuum which the sudden contraction of the ventricles must produce in the pericardium. Of course the lungs will expand, and in part effect this by pressing the pericardium towards the heart; but at the same time the blood will tend to rush towards the auricles and dilate them, so that they may fill up the vacant space. Dr. Barry proved this further, by showing that if a tube be introduced into the sac of the pericardium, without allowing any air to enter with it, a fluid placed in it will be seen to be drawn towards and driven from the sac at each contraction and dilatation of the ventricles.

Such are the powers concerned in the circulation, and the principal effects which they produce. The influence of each is certain, but what is its extent, and what are the circumstances under which it is chiefly exercised, cannot be accurately determined. In order of importance, the contraction of the ventricles must undoubtedly be placed far highest; then would come the auricular contraction, the ventricular dilatation, the auricular dilatation; then inspiration, expiration, and the cavity in the pericardium when the ventricles contract. All these assist at all times in moving the blood; the elasticity of the arteries tends at all times to equalise the velocity of the current, while their vital contraction and that of the veins, the action of the contents of the capillaries, and the muscular pressure on the veins, would also seem to exercise an important influence.

One of the most interesting enquiries in connection with the heart is its development, to which we have before alluded, and on which considerable light has been thrown by modern research. The circulating system which has been described is not perfected until the moment of birth; and, as before observed, in its several transitory stages of growth it resembles permanent forms of the circulating apparatus amongst the lower animals. As the egg of the bird affords the best means of studying these changes, we give an outline of them, from Dr. Carpenter's 'Physiology:'—

"At an early period of incubation the yolk is found to be enveloped by a germinal membrane, composed of distinct cells, which is divisible into three layers; and a thickened portion of this is easily distinguishable, at which the embryo will be subsequently evolved.

"The middle layer gives origin to the circulating system, and is therefore termed the 'vascular' layer. The thickened portion of this that surrounds the germ soon becomes studded with numerous irregular points and marks of a dark yellow colour; and as incubation proceeds these points become more apparent, and are gradually elongated into small lines, which are united together, first in small groups, and then into one net-work, so as to form what is called the 'vascular area.' A large dark spot of a similar kind is seen in the situation to be subsequently occupied by the heart. These dark points and lines are formed by collections of blood-corpuscles, which originate in the transformation of the cells of the embryo and of the germinal membrane; and the rows and masses of blood-discs seem at first to lie in mere channels, the walls of the heart and blood-vessels that subsequently inclose them being of later formation.

"From the first however a definite plan is perceptible; the network of capillaries that is formed over the vascular area being supplied with blood by the ramifications of a pair of arterial trunks, whilst the blood is collected from them by the circular venous sinus which bounds the area, and is returned to the embryo by the venous trunk. In the blood-vessels which are first observed in the body of the embryo, as well as in the vascular area, no difference is at first perceived between the characters of the arteries and those of the veins, and these are only to be distinguished by the direction of the currents of blood circulating through them.

"But at about the fourth or fifth day of incubation the coats of the arteries begin to appear thicker than those of the veins, and the distinction between them soon becomes evident. After the principal vessels are formed, the development of new ones appears to take place in two modes, according as they are to occupy the interspaces existing among those previously formed, or are to extend themselves into outgrowing parts. In the first of these cases the new capillaries appear to be formed, like the original ones, from stellate cells [CAPILLARIES], whose prolongations meet the vessels in which the blood is already circulating, coalesce with them, and thus receive the current into their own cavities, to transmit it to some other vessel. But in the second, the new vessels are formed entirely by extension from those already existing. This takes place in the following mode:—Suppose a line, or arch, of capillary vessels passing below the edge, or surface, of a part to which new material has been superadded; the vessel will at first present a slight dilatation in one, and coincidently, or shortly after, in another point, as if its walls yielded a little near the edge or surface. The slight pouches thus formed gradually extend, as blind canals, or verticula, from the original vessels still directing their course towards the edge or surface of the new material, and crowded with blood-corpuscles, which are pushed into them from the main stream. Still extending, they converge, and meet; the partition wall that is at first formed by the meeting of their closed ends clears away, and a perfect arched tube is formed, through which the blood, diverging from the main or former stream, and then rejoining it, may be continuously propelled. This last process may be seen in the growing parts of the tail of the tadpole, in the development of the filamentous gills and legs of the water-newt, in the first evolution of the extremities of the embryoes of higher animals, and in the formation of new structures in the fully-developed organism, either for the repair of injuries or as the result of morbid processes. In some instances it would appear that the wall of the newly-forming vessel gives way, and that the blood-corpuscles escape from it into the parenchyma, at first collecting in an undefined mass, but soon manifesting a definite direction, and coming into connection with another portion of the arch, or with some adjacent vessel. Thus, then, a channel, and not a vessel, is formed; and it is probably in this way that those passages are excavated, which take the place of distinct vessels in many of the lower tribes of animals, and also, according to Mr. Paget, in some of the softer and least organised growths in man.

"The first rudiment of the heart appears about the 27th hour, and is a mass of cells, of which the innermost soon break down, so as to form a tubular cavity; for some time it is simple and undivided, extending however through nearly the whole length of the embryo; but the posterior part may be regarded as corresponding with the future auricle, since prolongations may be perceived extending from that part into the transparent area, which indicate the place where the veins subsequently enter. Although the development has proceeded thus far at about the 35th hour, no motion of fluid is seen in the heart or vessels until the 38th or 40th hour. When the heart, which may be considered as analogous at this period to the dorsal vessel of the *Annelida*, first begins to pulsate, it contains only colourless fluid mixed with a few globules. A movement of the dark blood in the circumference of the vascular area is at the same time perceived; but this is independent of the contractions of the heart, and it is not until a subsequent period that such a communication is established between the heart and the distant vessels, that the dark fluid contained in them arrives at the central cavity, and is propelled by its pulsations. This fact, which we have just seen to possess a very important bearing on the theory of the circulation, and which has been denied by some observers, appears to have been positively established by the latest researches of M. Von Baer.

"The contraction of this dorsal vessel (for so it may be termed) begins, as in the *Annelida*, at its posterior extremity, and gradually extends itself to the anterior; but between the 40th and 50th hours a separation in its parts may be observed, which is effected by a constriction round the middle of the tube; and the dilatation of the posterior portion becomes an auricular sac, and that of the anterior a ventricular cavity. Between the 50th and 60th hours the circulation of the blood in the vascular area becomes more vigorous, and the action of the ventricle is no longer continuous with that of the auricle, but seems to succeed it at a separate period. At the same time the tube of the heart becomes more and more bent together until it is doubled, so that this organ now becomes much shorter relatively to the dimensions of the body, and is more confined to the portion of the trunk to which it is subsequently restricted. The convex side of the curve which the tube presents is that which subsequently becomes the apex or point of the heart, and between the 60th and 70th hours this is seen to project forward from the breast of the embryo, much in the situation it subsequently occupies. About the same time the texture of the auricle differs considerably from that of the ventricle, the auricle containing the thin and membranous walls which it at first possessed; while the ventricle has become stronger and thicker, both its internal and external surfaces being marked by the interlacement of muscular fibres, as in the higher *Mollusca*. About the 65th hour the grade of development of the heart may be regarded as corresponding with that of the fish, the auricle and ventricle being quite distinct, but their cavities are as yet quite single. The heart of the dog at the 21st day bears a great resemblance to that of the chick at the 55th or 60th hour; it consists of a membranous tube twisted on itself, and partially divided into two principal cavities, besides the bulb or dilatation which at this period is found at the commencement of the aorta, and which corresponds with the bulbus arteriosus of fishes.

"Having thus traced the evolution of the heart of the chick up to the grade which it presents in fishes, we may now inquire what is the condition of the other parts of the vascular system at the same time. At the end of the second day the primitive arterial trunk is seen to have divided into two canals, which separate from one another to inclose the pharynx, and then unite again to form the aortic trunk, which passes down the spine. During the first half hour of the third day a second pair of arches is formed, which encompasses the pharynx in the same manner; and towards the end of the third day two other pairs of vascular arches are formed, so that the pharynx is now encompassed by four pairs of vessels, which unite again to supply the general circulation. These evidently correspond with the branchial arteries of fishes, although no respiratory apparatus is connected with them; and in fact the distribution of the vascular system of the bird on the fourth and fifth days exactly resembles that presented by many cartilaginous fishes, as well as by the tadpoles of the *Batrachia*. The first pair of arches is obliterated about the end of the fourth day, but a pair of vessels which is sent from it to the head and neighbouring parts, and which afterwards remains as the carotid arteries, continues to be supplied through a communicating vessel from the second arch. While the first pair is being obliterated a fifth is formed behind the four which had previously existed, and proceeds in the same manner as the fourth from the ascending to the descending aorta. On the fourth day the second arch also becomes less, and on the fifth day is wholly obliterated, whilst the third and fourth become stronger. From the third arch, now the most anterior of those remaining, the arteries are given off which supply the upper extremities; and the vessels of the head are now brought into connection with it by means of the communicating branches, which previously joined the third with the second arch. When these vessels are fully developed, the branches by which these arches formerly sent their blood into the aorta shrink and gradually disappear; so that about the thirteenth or fourteenth day the whole of the blood sent through the two anterior arches is carried to the head and upper extremities, instead of being transmitted to the descending aorta as before. There now only remain the fourth and fifth pair of branchial arches, the development of which into the aorta and pulmonary arteries will be described in connection with the changes which are at the same time going on in the heart. During the fourth day the cavities of the heart begin to be divided for the separation of the right and left auricles and ventricles. About the 80th hour the commencement of the division of the auricle is indicated externally by the appearance of a dark line on the upper part of its wall, and this after a few hours is perceived to be due to a contraction which, increasing downwards across the cavity, divides it into two nearly spherical sacs. Of these the right is at first much the larger, and receives the great systemic veins; the left has then the aspect of a mere appendage to the right, but it subsequently receives the veins from the lungs when these organs are developed, and attains an increased size. The septum between the auricles is by no means completed at once: a large aperture (which subsequently becomes the foramen ovale) exists for some time at its lower part, so that the ventricle continues to communicate freely with both auricles. This passage is often closed by the prolongation of a valvular fold, which meets it in the opposite direction; it remains pervious however until the animal begins to respire by the lungs, and sometimes is not completely obliterated even then. The division of the ventricle commences some time before that of the auricle, and is effected by a sort of duplicature of its wall, forming a fissure on its exterior and a projection on its interior; and thus a septum is gradually developed within the cavity, which progressively acquires firmness, and rises higher up, until it reaches the entrance to the bulb of the aorta, where some communication exists for a day or two longer. At last however the division is complete, and the inter-ventricular septum becomes continuous with the inter-auricular, so that the heart may be regarded as completely a double organ. The progressive stages presented in the development of this septum are evidently analogous to its permanent conditions in the various species of reptiles; but it must not be lost sight of that in all reptiles the inter-auricular septum is first developed, and that it is completely formed in many instances in which the inter-ventricular septum is absent or imperfect. The changes which occur in the heart of the *Mammalia* are of a precisely similar character, and as they take place more slowly they may be watched with greater precision. Soon after the septum of the ventricles begins to be formed in the interior a corresponding notch appears on the exterior, which as it gradually deepens renders the apex of the heart double. This notch between the right and left ventricles continues to become deeper until about the eighth week in the human embryo, when the two ventricles are quite separated from oue another except at their bases; this fact is very interesting from its relation with the similar permanent form of the Dugong. At this period the internal septum is still imperfect, so that the ventricular cavities communicate with each other, as in the chick on the fourth day. After the eighth week however the septum is complete, so that the cavities are entirely insulated; whilst at the same time their external walls become more connected towards their bases, and the notch between them is diminished; and at the end of the third month the ventricles are very little separated from one another, though the place where the notch previously existed is still strongly marked."

We may now finally trace the distribution of the arterial trunks to their final modifications, by which the creature is enabled to become an air-breathing animal. The first, second, and third branchial arches are replaced by the brachial and carotid arteries, and loose all communication with the primitive arterial trunk except at its commencement, when the third pair of arches arises with the other trunks from its dilated bulb. This remains as a single cavity even after the ventricles have been separated. About the fifth or sixth day the bulb in the chick becomes flattened, and its opposite sides adhere together, so as to form two tubes running side by side; one of which unites with the left, the other with the right ventricle. The one on the left becomes the ascending aorta, that on the right the pulmonary artery.

A knowledge of the changes which go on in the development of the heart enables us to explain some of the malformations to which it is subject. For an account of these see CYANOSIS; and HEART, DISEASES OF, in the ARTS AND SC. DIV. For further information on subjects connected with the structure and functions of the heart, see ARTERY; CAPILLARY VESSELS; BLOOD; BLOOD-VESSELS; VEIN; HEAT, ANIMAL; RESPIRATION; LUNGS; and FOOD.

(Carpenter, *Principles of Physiology, General and Comparative;* Carpenter, *Manual of Human Physiology;* Draper, *On the Forces which Produce the Organisation of Plants;* Todd and Bowman, *Physiological Anatomy;* Owen, *Lectures on Comparative Anatomy;* Lehmann, *Physiological Chemistry.*)

HEART'S-EASE. [VIOLA.]

HEARTWOOD. [ALBURNUM.]

HEAT, ANIMAL. The conversion of the food of man and the higher animals into nutriment for the body is attended with changes which produce an evolution of heat, which constantly maintains the temperature of an animal at a point above or below, according to circumstances, the temperature of the medium in which it exists. The degree of heat possessed by animals not gifted with the power of locomotion is very small above that of surrounding media, and in this respect resembles the heat given off by plants. [HEAT, VEGETABLE.] In proportion as animals possess the power of locomotion they evolve heat from their bodies. This arises from the fact that where the muscular system is most exercised there is greatest demand made upon the nutritionary processes going on in the system. We should therefore expect to find that the quantity of heat developed in the invertebrate animals was less than that in the vertebrate class. Infusoria are for a time capable of resisting cold; for when the water in which they are contained is frozen, the animalcule is observed to live for a time in a little uncongealed space which the caloric from its body prevents freezing. John Hunter found that various forms of *Annelida*, as leeches and worms, and several of the *Mollusca*, exhibit temperatures higher than the surrounding media. As might have been anticipated from their activity, the Insects of all the invertebrate animals exhibit the highest temperature. They have been lately the subject of experiment by Mr. Newport. He found that they possessed a temperature above that of the medium in which they lived, varying from 2 to 9 degrees. With respect to the temperature of the different tribes, Mr. Newport observes, "Our previous observations lead us to anticipate the fact, that the volant insects, in their perfect state, have the highest temperature, while, on pursuing the inquiry, it is found that those species which have the lowest temperature are located on the earth. Among the volant insects, those hymenopterous and lepidopterous species have the highest temperature which pass nearly the whole of their active condition on the wing in the open atmosphere, either busily engaged in the face of day despoiling the blossoms of their honied treasures, or flitting wantonly from flower to flower, and breathing the largest amount of atmospheric influence. Of these the hive-bee, with its long train of near and distant affinities, and the elegant and sportive butterflies, have the highest. Next to these are probably their predatory enemies the hornets and wasps, and others of the same order; and lastly, a tribe of insects which have always attracted attention, and in general are located on the ground, but sometimes enjoy the volant condition—the ants, the temperature of whose dwelling has been found to be considerably above that of the atmosphere. Next below the diurnal insects are the crepuscular, the highest of which are the sphinges and moths; and almost equal with them are the *Melolonthæ*." In Insects which live in societies the temperature is still greater. Mr. Newport found that a bees'-nest in a chalk bank had a temperature 14 to 16 degrees above that of the atmosphere, and 17 to 19 degrees above that of the bank.

Amongst the vertebrate animals, Fishes and Reptiles have the lowest temperature. Dr. Davy, John Hunter, and others, have found that fishes have a temperature of from 0·7 to 2·7 degrees above the surrounding medium.

In man the temperature of the accessible parts of the body, as the mouth, axilla, &c. is usually between 97·7° and 98·6°. The human blood is said to have a temperature in health varying from 100·6° to 101·75°; in disease it rises from 106° to 109°. In healthy persons the temperature is said to attain its maximum during the day, and to fall from 1·1 to 2·7 degrees during sleep. Dr. Davy found that the temperature of the interior of the body is 2·7 to 3·6 degrees higher in tropical than in temperate climates. Most of the *Mammalia* have a higher temperature than man, and Birds develop a greater quantity of heat than any other class of animals. This arises from the nutritionary changes going on in the bird in order to support the enormous muscular power which it is compelled to exert during flight. The following is a table of temperatures, as given by Rudolphi and Tiedemann, for several Birds and *Mammalia*:—

Birds.

	Degrees.
Great Titmouse	111·25
Swallow	111·25
Fringilla, different species	111·25 to 107
Anas, different species	111 to 106
Common Hen	109·94 to 102·99
Falco, different species	109·74 to 104·5
Pigeon	109·58 to 106·7
Raven	109·23 to 105·99
Vulture	107.49
Common Cock	103·78 to 102·99
White Game	102
Gull	100

Mammalia.

	Degrees.
Bat (*Vespertilio pipistrellus*)	106 to 105
Squirrel	105
Sheep	104 to 100·4
Ox	104 to 99
Rabbit	104 to 99·46
Ape	103·86
Cat	103·6 to 98·6
Bat (*Vespertilio noctula*)	102
Dog	101·3 to 99·3
Guinea Pig	100·4 to 96·37
Hare	100
Elephant	99·25
Horse	98·24 to 97

There is now no question that the cause of animal heat is the chemical changes which are going on in the nutrient fluid of the body. During the act of respiration a large quantity of oxygen gas is taken into the lungs, which is absorbed by the blood. In this fluid it meets the various compounds of carbon which have been taken in with the food; and the consequence is a union of the oxygen with the carbon, and the formation of carbonic acid gas, which gas is given out when the blood again reaches the lungs during expiration. [FOOD; RESPIRATION.] When carbon and oxygen unite out of the body, heat is the result, and the same thing occurs when they unite in the body; and it is through the medium of this change that the bodies of animals are raised to a given temperature by the circulation of the blood through the system. It has been calculated that there is more oxygen absorbed than is given out of the system in the form of carbonic acid gas: it is probable that this enters into combination with hydrogen, forming water and other compounds of hydrogen, nitrogen, and carbon, and thus contributes to the raising of the animal heat.

This theory of animal heat explains many well-known phenomena; as for instance, the slight independent warmth of the fœtus, and of those young animals which are born in an imperfectly developed condition. The low temperature of persons with morbus cœruleus, where the blood is only imperfectly oxygenated, and the cold experienced by aged and debilitated persons in whom a small quantity of blood circulates slowly; as also the increased temperature observed in persons labouring under attacks of inflammatory disease where the blood circulates rapidly, are also confirmatory facts. The phenomena also exhibited by the hyberuation of animals are explained by this theory. During the period of hybernation, when the blood is circulating only slowly and respiration is almost suspended, and the oxygenation of the blood is feebly performed, the temperature of the animal is low. The observations of Pallas and others show that hybernation is prevented by a temperature of from 50° to 80°, whilst it is induced in those animals which exhibit it even in summer by the application of artificial cold.

The production of heat is also dependent on the mass of the globules of the blood and the rapidity with which they circulate. When there are few blood-globules the necessity for the absorption of oxygen is diminished in the same ratio, and the circulation becomes slower, and the consequence is that there is less heat developed. On the other hand, blood containing an excess of globules, but which is circulated less slowly, developes less heat than blood which contains a smaller proportion of globules but which is more rapidly circulated, for more oxygen may be consumed in the latter than in the former case.

"The metamorphosis of the blood and the general change of matter lead to still another secondary source of heat. It has been shown by Pouillet that all solid bodies, organic and inorganic, undergo an elevation of temperature when moistened with different fluids. In organic substances it may amount to from 11° to 18°. Since the act of metamorphosis is always effected through humid membranes, this source of heat must be regarded as of great importance, even if it be not actually identical with the catalytic metamorphosis of the cells themselves." (Simon.)

(Carpenter, *Principles of General and Comparative Physiology*; Simon, *Medical Chemistry*, translated by Day.)

HEAT, VEGETABLE. That plants possess a temperature higher in winter than that of the air which surrounds them is known by the obvious fact that snow melts at the foot of a tree sooner than at a distance from it; that the temperature is lower in summer is equally well proved by the coldness of the fluid which is discharged from many vines and vine-like plants when cut across. These phenomena have been examined with care by several observers: John Hunter found that a thermometer whose bulb was plunged 11 inches deep in the trunk of a walnut-tree generally indicated in the autumn a higher temperature than that of the external air by 2 or 3 degrees; Schöpf at New York, and Bierkander in Sweden, Pictet, and Maurice, and various other observers, have obtained similar results; they have found even tubers and bulbs with a temperature higher in winter than that of the external air by 6 or 7 degrees Réaum., while on the other hand from the spring to the autumn it is lower.

The former fact accounts in some measure for the power possessed by some plants of resisting cold in winter, and for the protection given to the upper parts of trees by heaping straw up against their trunks in winter. During every season of the year trees are absorbing water from the earth; water when absorbed parts with its heat very slowly through the carbonated matter of a trunk; in winter the temperature of the earth, which determines that of the water it contains, is uniformly higher than that of the atmosphere, and consequently the temperature of the interior of a tree is also higher, in proportion to the difference between the heat of the soil and that of the air. In the spring and summer, on the contrary, the earth is cooler than the air, and the temperature of trees is cooler also.

These considerations throw some light upon the effects of frost upon trees. A young tree is, cæteris paribus, affected more than an old one of the same species; either because its roots derive their food from a smaller distance under the soil, or because the heat obtained from the soil is sooner parted with on account of the thinness of the bark and the smallness of the whole mass. Unhealthy trees, which also suffer in like manner, may be supposed to do so in consequence of the weakness of their power of pumping warmer fluid up from the soil in winter.

Independently of this source of heat in vegetables, there is another that deserves attention. Whenever oxygen combines with carbon to form carbonic acid, an extrication of heat takes place, however minute the amount; such a combination occurs much more extensively during the germination of seeds and the impregnation of flowers than at any other time. At the first of these periods extrication of heat takes place to a considerable amount, as is remarked in the germination of barley heaped in rooms, previously to being manufactured into malt: in the latter it also occurs, but in consequence of flowers not being confined in close cases, the heat is lost as soon as it is disengaged, and never accumulates, except in a few special instances. Saussure found the temperature of the male flowers of the common gourd, at between 7 and 8 o'clock in the morning, half a centigrade degree higher than that of the air; and those of the tuberose 9-10ths of a similar degree. It is however only when large quantities of flowers expand within close cases that this phenomenon is particularly remarkable. Accordingly, in the spathe of araceous plants it has been remarked at its greatest intensity. Lamarck, Senebier, and De Candolle, found the flowers of *Arum maculatum*, between 3 and 7 o'clock in the afternoon, as much as 7 degrees Réaum. warmer than the external air. Schultz found a difference of 4 to 5 degrees between the heat of the spathe of *Caladium pinnatifidum* and the surrounding air from 6 to 7 o'clock, p.m. Hubert and Bory de St.-Vincent assert that at sunrise the spathe of *Arum cordifolium* acquires in the Isle of France an elevation of 30 degrees Réaum. above the atmosphere. Finally, Messrs. Vrolik and Vriese at Amsterdam, and Adolphe Brongniart at Paris, have confirmed the fact by new observations in the hothouses of those cities.

The following tables of experiments on this subject by Dutrochet are given by Professor Balfour in his 'Classbook of Botany':—

TABLE I.

Observations made on the diurnal variations of heat in the stems of *Euphorbia Lathyris*.

Hour of Day.	Deviation of Thermo-electric Needle.	Proper heat of Plant above the Atmosphere.	Temperature of the Atmosphere.
5th June, 6 a.m.	1¼	0·160° Fahr.	62·24° Fahr.
7 a.m.	1½	0·198° Fahr.	62·24° Fahr.
8 a.m.	2	0·324° Fahr.	62·24° Fahr.
9 a.m.	3	0·324° Fahr.	62·42° Fahr.
10 a.m.	4	0·450° Fahr.	62·60° Fahr.
11 a.m.	4	0·500° Fahr.	62·96° Fahr.
12 noon.	5¼	0·558° Fahr.	63·14° Fahr.
1 p.m.	5½	0·610° Fahr.	63·50° Fahr.
2 p.m.	4½	0·500° Fahr.	63·86° Fahr.
4 p.m.	3	0·216° Fahr.	63·68° Fahr.
6 p.m.	1	0·108° Fahr.	63·50° Fahr.
8 p.m.	½	0·054° Fahr.	62·96° Fahr.
9 p.m.	¼	0·027° Fahr.	62·60° Fahr.

The next table gives some results of experiments on different species of plants.

TABLE II.

Names of Plants.	Hour of Maximum of Vital Heat.	Deviation of the Needle	Maximum of Vital Heat.	Temperature of the Atmosphere.
Rosa canina	10 a.m.	3½	0·380° Fr.	71·60° Fr.
Allium Porrum	11 a.m.	2	0·216° Fr.	74·84° Fr.
Borago officinalis . . .	12 noon.	1½	0·160° Fr.	66·20° Fr.
Euphorbia Lathyris . .	1 p.m.	5½	0·610° Fr.	63·50° Fr.
Papaver somniferum . .	1 p.m.	3½	0·380° Fr.	68·72° Fr.
Cactus flagelliformis . .	1 p.m.	2	0·216° Fr.	67·10° Fr.
Helianthus annuus . .	1 p.m.	3⅔	0·396° Fr.	56·84° Fr.
Impatiens balsamina . .	1 p.m.	1¼	0·108° Fr.	60·80° Fr.
Ailanthus glandulosa . .	1 p.m.	2⅓	0·290° Fr.	71·60° Fr.
Campanula medium . .	2 p.m.	5	0·558° Fr.	61·16° Fr.
Sambucus nigra . . .	2 p.m.	3½	0·380° Fr.	66·74° Fr.
Lilium candidum . . .	2 p.m.	4½	0·504° Fr.	63·10° Fr.
Asparagus officinalis . .	3 p.m.	4	0.450° Fr.	53·6° Fr.
Lactuca sativa	3 p.m.	1½	0.160° Fr.	71·21° Fr.

The hour of maximum varied from 10 a.m. to 3 p.m., and the temperature varied from about one-tenth to rather more than half a degree Fahrenheit. In the case of *Fungi* the following results were obtained:—

TABLE III.

Names of Plants.	Deviation of the Needle.	Heat of Fungus above the Air.	Temperature of the Atmosphere.
Agaricus eburneus . . .	3¼	0·36° Fahr.	68·90° Fahr.
Agaricus colubrinus . .	1½	0·18° Fahr.	68·36° Fahr.
Agaricus annularius . .	1½	0·18° Fahr.	63·50° Fahr.
Boletus æreus	7½	0·81° Fahr.	66·74° Fahr.
Lycoperdon hirtum . .	4¼	0·47° Fahr.	70·06° Fahr.

HEATH. [CALLUNA; ERICACEÆ.]

HEATHER. [ERICA.]

HEBRADENDRON, a genus of Plants belonging to the natural order *Clusiaceæ*. It was established by Professor Graham of Edinburgh, for the Gamboge-Tree of Ceylon. The gamboge of commerce is known by the names of Ceylon and Siam gamboge.

The gamboge of Siam is in cylinders, either solid or hollow, usually called pipes: it is supposed to have this form from being so rolled, or from being poured into the hollow of bamboos, according to Lieutenant White, in his 'Visit to Cochin China.' It is usually of the best quality, but Mr. Pereira has shown that some very impure is occasionally in the form of pipes. As this pipe-gamboge is usually exported from Singapore, it has been doubted whether it was actually the produce of Siam; but we have specimens from Mr. G. Swinton, which were sent to him direct from Siam when he was chief secretary of the Indian government, as the produce of that country, and which are identical with the best pipe-gamboge of commerce. The only information respecting its preparation which we possess is that given to Kœnig by a Catholic priest, who officiated as such to the Catholics of Cochin China, and who stated that the inspissated juice obtained from breaking the leaves and young shrubs, as well as the fragrant lignum aloes, is given as a tribute to the king of Siam by the Christians residing there. The tree must therefore be common, and probably near inhabited places, and therefore very likely to be *Oxycarpus Cochinchinensis* of Loureiro (now referred to the genus *Garcinia*), who names it from its acid fruit, and describes it as cultivated in Cochin China. We have specimens of a plant something similar to this in the form of its leaves from Mr. Malcolmson, collected by him in Rangoon, which he thought might be the gamboge plant, as it contained a yellow purgative juice in the rind of its fruit. Dr. Graham thinks that the Siam plant may be a nearly allied species of the same genus as the Ceylon plant.

The Ceylon gamboge is usually considered inferior; that which forms an article of commerce no doubt is so; and we have been informed by one of the principal merchants of Ceylon that finding the gamboge there very cheap, he had been induced to purchase and send it to England, but had not been able to sell it from its inferior quality. No doubt however some of very excellent quality is produced in Ceylon by the tree which has been called *Hebradendron cambogioides*, and Mrs. Colonel Walker describes it as "brilliant and excellent," and "as good for water-colour drawings as any she ever used." Dr. Graham ascribes its inferiority to want of care in preparing the article for market; though it is yet doubtful whether the Ceylon gamboge of commerce is all yielded by this tree; but Mrs. Walker on one occasion, in passing through a forest of these trees, saw all of them with the bark cut off in various places. Dr. Christison has shown that there is all but an identity of composition with that of Siam; and its medicinal effects are precisely the same, as proved in Ceylon by Dr. Pitcairn, and by Drs. Graham and Christison in Edinburgh.

This plant, though new named, is far from being new. Dr. Graham considers it to be identical with the *Carcapuli* of Herman, the *Cambogia gutta* of Linnæus, the *Garcinia Morella* of late authors, and the *Stalagmitis cambogioides* of Moon's 'Catalogue of Ceylon Plants.' The last name might have been retained, as it was originally intended for it, had it not been discovered by Mr. Brown that the specimens in the 'Banksian Herbarium' collected by Kœnig, and from which Murray's character of the genus and species was established, consist not of one, but of two distinct plants, the flowers of *Xanthochymus ovalifolius* being stuck by sealing-wax upon a branch of what appears to be this Ceylon plant. The genera *Stalagmitis* and *Xanthochymus* are therefore one genus, as was previously inferred by Cambessedes, who has retained for it the former, as the prior name.

The genus *Hebradendron* has diœcious flowers, the male having the calyx membranaceous, 4-sepalled, persistent; corolla 4-petalled; stamens monadelphous; column 4-sided; anthers terminal, opening by the circumcision of a flat and umbilicate terminal lid. The inflorescence of the female tree is similar to that of the male, the flower white and a little larger, with a germen precisely in miniature of the fruit, and surrounded (like it) with several (ten?) abortive stamens. The berry is many (4-) celled; cells 1-seeded, surrounded at the base with some free abortive stamens, crowned by a lobed and muricated sessile stigma; cotyledons fleshy, united; radicle central, filiform; trees with entire leaves.

1, a flowering branch of *Hebradendron cambogioides*; 2, a flower seen from below; 3, a flower seen laterally; 4, anther with its umbilicate lid.

The species called *H. cambogioides* forms a moderate-sized tree, with the leaves obovate, elliptical, abruptly sub-acuminate; the male flowers clustered in the axils of the petioles on short single-flowered peduncles; sepals yellow on the inside, yellowish-white externally; petals yellowish-white, red on the inside near the base; berry about the size of a cherry, round, with a firm reddish-brown external coat and sweet pulp; ripe in July. It is called in Ceylon Kana (eatable) Goraka. *G. cambogia* is called simply Goraka. The gamboge is used by the natives both as a pigment and medicinally. Mrs. Walker describes it as being collected by cutting pieces of the bark about the size of the palm of the hand early in the morning. The gamboge oozes out in a semi-liquid state, but hardens on exposure to the air, and is scraped off by the collectors next morning.

This tree is found in various parts of Ceylon, but not very abundantly near Colombo. In a tour through different parts of the island, Mrs. Walker writes: "We found the Ceylon Gamboge-Tree several times in forests distant from the habitation of man, which proves the tree to be indigenous." Colonel Walker writes to Dr. Wight, that "it is found in great abundance along the western and eastern coast in the neighbourhood of Battocola; but it also grows inland, where it could not have been planted by the Dutch. Its favourite abode seems to be low sandy ground, as about Kanderaane, Negombo, and towards Chilaw; also, 100 miles inland, at so high an elevation as 2000 feet above the sea." *Garcinia elliptica*, a native of Silhet, and *G. pictoria* of the Wynaad district, are thought to be other species of this genus.

Besides the above species there is probably another belonging to the same genus or to the same group of a larger genus, which appears to yield a very good kind of gamboge. It is the *Garcinia pictoria* of Roxburgh, and

H. pictorium of Lindley and other botanists. It is a tall tree, about 60 feet high, of a conical shape, and very full of branches. The bark is pretty thick, scabrous and ramous on the outside, of a dark ferruginous colour, intermixed with many yellow specks, and through its substance, particularly on the inside, considerable masses of gamboge are found. The young shoots are somewhat angular, smooth polished, of a deep green colour. The leaves are opposite, short-petioled, oblong, ventricose, rather acute, entire, smooth on both sides, and of a firm texture, from 3 to 4 inches long, by 1½ or 2 inches broad. The calyx consists of two unequal pairs of concave obtuse leaflets, permanent. Petals 4, oval, longer than the calyx. Anthers from 10 to 15, oblong, 2-lobed, and seemingly fertile. Ovary superior, round, 4-celled, with one ovule in each, attached to the axis a little above its middle. The berry is the size of a large cherry, oval, smooth, very slightly marked with four lobes, crowned with the sessile 4-lobed verrucose permanent stigma. Roxburgh says he received frequent samples of the gamboge of this tree from a correspondent at Tellicherry, and uniformly found it, even in its crude unrefined state, superior in colour while recent, but not so permanent as that from China. The tree grows on the highest parts of Wynaad in India.

(Lindley, *Flora Medica;* Royle, *Materia Medica.*)

HEDENBERGITE. [Augite.]

HEDERA, a genus of Plants belonging to the natural order *Araliaceæ*. The calyx has an elevated or toothed edge. The petals 5 or 10, not calyptrate and cohering; stamens 5 to 10; styles 5 to 10, converging or consolidated; the berry 5- or 10-celled.

H. Helix, Ivy, is a common plant all over Europe, clinging to trees and walls. It has a stem climbing with root-like fibres; leaves coriaceous, smooth, shining, 5-angled, or 5-lobed, the upper or old ones ovate and acute; umbels simple and downy; leaves austere and bitter; berries bitter, aperient, and emetic. It is mentioned as a sudorific, and was once reputed to prevent drunkenness and to dissipate the effects of wine. The berries are black at maturity. The flowers are yellowish, and appear late in the season, and, in consequence, are much resorted to by bees and flies when little other food is to be had.

It is found commonly wild in England, and is dispersed through many distant parts of the Old World, lying between the Canaries and Europe on the west, and the northern parts of China on the east. In the Canaries it acquires its largest size, being what is called in English gardens the Irish or Giant Ivy, which grows so much faster than the European form. In the north of India, and indeed occasionally in Italy, the berries, instead of being black as with us, are bright yellow, and it is supposed that this is more particularly the *Hedera* of the Roman poets. The leaves vary much in form, and there is a kind which never runs or creeps upon other plants, but merely forms a compact bush.

H. umbellifera is a native of Amboyna. It has a shrubby unarmed stem; leaves on long stalks, lanceolate acuminate, distantly serrated; peduncles 16, trifid and umbellate; partial umbels capitate, roundish. It yields a blackish or dull-brown resin with a very powerful aromatic camphorated smell. It is called 'Sarura' in Amboyna. There are 50 species of Ivy enumerated, all of which are of easy culture.

HEDGE-HOG. [Erinaceus.]

HEDGE-MUSTARD. [Sisymbrium.]

HEDGE-SPARROW. [Sylviadæ.]

HEDYPHANE. [Lead.]

HEDY'SARUM (from ἡδύσαρον, the Greek name of the *Coronilla securidaca*), a genus of Plants belonging to the natural order *Leguminosæ*. It has a 5-cleft calyx, with the segments linear-subulate and nearly equal; the corolla with a large vexillum, and obliquely truncate; keel much longer than the wings; the stamens diadelphous; the legume of numerous flat orbicular or lenticular regular 1-seeded joints, which are connected together in the middle, and therefore the sutures are convex on both sides. The species are herbs or under-shrubs, with unequally pinnate leaves, axillary, with simple peduncles, and bearing racemose spikes of large purple, white, or cream-coloured flowers. The old genus *Hedysarum* has been subdivided into many smaller genera. The Saintfoin, *H. onobrychis* of older writers, now forms the genus *Onobrychis*, which differs from *Hedysarum* in the legumes consisting of many joints, not of one joint, as in that genus. [ONOBRYCHIS.]

H. coronarium, French Honeysuckle, has diffuse stems, the leaves with 3-5 pairs of elliptic or roundish leaflets, which are pubescent beneath and on the margins; the spikes or racemes of flowers are ovate, crowded; the wings of the flower twice the length of the calyx; the legumes glabrous, with 25 orbicular prickly joints. It is a native of Spain and Italy. It has deep red or white flowers. In Calabria this plant grows wild in great abundance, and horses and mules are fed with it. It grows well in our gardens, but probably would not make a good field crop.

H. fruticosum has an erect shrubby stem, the leaves with 5-7 pairs of alternate elliptic obtuse leaflets, which are clothed with pubescence on both surfaces; the flowers few, disposed in spikes; the wings hardly longer than the calyx; the vexillum the length of the keel; the joints of the legume wrinkled; the nerves slightly echinate. It is a native of Siberia in sandy places. It has a pale purple flower, and is a very handsome plant. Horses eat it with avidity, and it may be made useful in fixing sand, in which is grows readily.

H. Mackensii has recumbent stems; the leaflets oblong, clothed on both surfaces with canescent pili; the stipules sheathing; the joints of the legume transversely wrinkled and pilose. It is a native of arctic America and about the Saskatchewan, on the Eagle and Red-Deer Hills. The flowers are large and of a red colour. This was described as a liquorice plant by Sir A. Mackenzie, and named after him. The whole plant has a sweet taste.

H. lineare is used in Cochin China as a stomachic, and *H. alpinum* is used in Siberia for the same purpose. The *H. sennoides* of Willdenow, now *Ormocarpum sennoides*, has a root which is used in India as a tonic and stimulant. The *H. Alhagi* of Linnæus is the *Alhagi Maurorum* of recent writers. It is a spiny shrub, and from its branches exudes a sweet substance like manna. *H. tuberosum* of Roxburgh, *Pueraria tuberosa* of De Candolle, grows in the Circar Mountains. The roots are used by the natives as poultices for swellings of the joints.

All the species of the genus *Hedysarum* may be cultivated. They thrive in a light rich soil; the perennial sorts may be increased by dividing the roots; and the seeds of the annual species should be sown in an open border.

(Lindley, *Flora Medica*; Don, *Dichlamydeous Plants*; Burnett, *Outlines of Botany*.)

HEIMIA, a genus of Plants belonging to the natural order *Lythraceæ*. It has a hemispherical campanulate calyx, bracteolated at the base, with six erect lobes and as many alternating horn-shaped patent angles; petals 6, alternate with the erect lobes; stamens 12, somewhat equal; ovary sessile, nearly globose, 4-celled; capsule included within the calyx; seeds numerous, minute, and wingless. Glabrous herbaceous plants. Peduncles 1-flowered, shorter than the calyx.

H. salicifolia is found in New Spain on the volcano of Jorullo. It has ternate or opposite leaves, the upper often alternate, on very short stalks, lanceolate, acute, narrowed to the base. The petals are obovate. It is a powerful sudorific and diuretic. The Mexicans consider it a valuable medicine, and call it Hanchinol.

HEISTERIA. [PARTRIDGE-WOOD.]

HELAMYS, a genus of Rodents nearly allied to the Jerboas. [PEDETES.]

HELARCTOS. [BEAR.]

HELIA'NTHEMUM, a genus of Plants named from ἥλιος, the sun, and ἄνθος, a flower, because the flowers open with the rising of the sun, and fall with the setting of the sun in the evening. This genus belongs to the natural order *Cistineæ*, or *Cistaceæ*, and the species were at one time included under the genus *Cistus*, but they differ materially in their characters. There are about 150 species enumerated, which are distributed in various parts of the world. They are chiefly found in the south of Europe, the north of Africa, and a few species in America. The calyx consists of 5 sepals, the 2 exterior ones smaller or wanting, 5 deciduous petals, numerous stamens, and 3-valved capsules. The flowers are yellow, red, or white, and are very elegant; none of the species possess any available property in the arts or medicine, but they are extensively cultivated on account of their very beautiful and ornamental appearance.

H. guttatum is an erect herbaceous plant with oblong lanceolate or linear leaves, the racemes without bracts, and the stigma subsessile. The flowers are yellow, with a deep red spot at the base of each petal. It is a native of France, Italy, Spain, Portugal, and Turkey, and is found in Anglesey and Jersey in Great Britain, but is a very rare plant.

H. canum, the Hoary Sun-Rose, is distinguished by its shrubby appearance, without stipules, and having terminal bracteated racemes. The flowers are yellow and small. It is a native of the south of France and Germany, and is rarely found in Great Britain.

H. vulgare, the Common Rock-Rose, is a procumbent shrub, with stipules, bracteated racemes, the style larger than the ovarium, and bent at the base. The flowers are yellow, and bloom from May to September. It is a native of Europe, and is found in Great Britain in dry hilly pastures.

There is a very beautiful variety with double pale yellow flowers, which is much cultivated by florists. The stamens, if touched in the sunshine, spread slowly, and lie down upon the petals.

H. Breweri is a British plant. It has obtuse obovate leaves, without stipules; racemes without bracts.

H. polyfolium is found in Devonshire and Somersetshire. It is a hoary plant, with stellate pubescence; the leaves opposite, ovate-oblong, or oblong-linear; the sepals tomentose, inner ones obtuse.

Almost all the species of *Helianthemum* are elegant plants, of hardy growth, and easily cultivated. They grow best in a light sandy soil, and should be protected during the winter in a frame.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Loudon, *Encyclopædia of Trees and Shrubs*.)

HELIANUS, a genus of Fishes belonging to the *Sciænidæ*, a family of *Acanthopterygii*.

HELICARION. [HELICIDÆ.]

HELI'CIDÆ, a family of Gasteropodous *Mollusca* to which the land Shell-Snails are referred.

Dr. J. E. Gray, in his paper on 'Streptaxis' ('Magazine of Natural History,' vol. i.), observes that zoologists have divided land-shells into several genera; but that the late Baron Férussac united most of them into a single genus, as he wished to establish as a rule that all the genera of *Mollusca* should be alone characterised by some peculiarity in the animal. "The increased knowledge," continues Dr. Gray, "of the animal has shown that some of the species which he (Férussac) referred to the genus *Helix* have very different animals from the typical kinds; and it is probable that eventually several of the genera established before his time (which he attempted to set aside) will be found to be true genera, according to his own theory. The knowledge of the animal, and the history of several species which were unknown at the time he wrote his system, have shown that several of the characters which he considered as of generic importance are common to other species belonging to quite different groups. Thus we now know that some *Helices* (*Carocolla inversicolor*, *Balea Chemnitzii*, and some others) are viviparous, as well as the *Partulæ*; that the degree of development in the lower pair of tentacles is variable in the different species of *Pupa* and *Vertigo*; and that to separate the latter genus from the former, on account of the partial obliteration of these organs, has the effect of dividing very nearly allied species. I am inclined to think that these and numerous similar facts, which must be well known to every practical conchologist, show us that we are warranted in establishing genera from any peculiarity in the structure or form of a series of shells, as well as on a peculiarity in the animal alone; especially when we consider how very few of the animals of the different species which we are called upon to arrange are or ever can be known; and also, as we constantly find by experience, that every peculiarity in the form or structure of the shell is the indication of some peculiarity in the habit or organic structure of the animal which formed it, and warrants its separation from the rest of the species of the family."

The organisation of this group of animals may be illustrated by the structure of the large Roman Snail (*Helix Pomatia*), of which there are several preparations in the museum of the Royal College of Surgeons in London.

Nutrient Organs.—In the Physiological Series—Gallery, No. 301, is a preparation of the *Helix Pomatia*, Linn., showing the form of the mouth and the part which performs the office of teeth. This is a dentated horny substance, of a dark colour and arched form, situated transversely above the aperture of the mouth, and forming, as it were, the margin of the upper lip; the lower lip is divided by a vertical fissure. No. 302 of the same series shews in the head of another Shell-Snail the same structure of mouth. No. 767 shows the soft parts of *Helix Pomatia*, and the alimentary canal has been injected with size and vermilion; so that the salivary glands, from their white colour, may be distinctly perceived upon the parietes of the stomach. These glands are of a flattened, elongated, and irregular form, and of a conglomerate structure; they may be seen diminishing in breadth as they extend upwards towards the pharynx, where their ducts terminate. Here also the semicircular dentated horny jaw, the course and termination of the alimentary canal, and the position and form of the liver, are well displayed. The next preparation (No. 768), which exhibits the mouth, œsophagus, and stomach of the same species, shows the junction of the two salivary glands at their lower extremities, and the termination of their ducts. The œsophagus and stomach being laid open, their internal structure is seen. ('Catalogue'—Gallery, vol. i.)

Circulating System.—In the Shell-Snail (*Helix*) the heart is situated on the right side of the posterior third of the pulmonary sac; and in the Slug (*Limax*) it is situated at nearly the middle of the posterior surface of the pulmonary sac, and protected above by the rudimentary shell, so that this part of the structure in these animals is, as in other points, nearly allied. The preparation in the College Museum, No. 882 (Gallery), is a specimen of *Helix Pomatia* with the shell removed in order to show the heart, which is situated on the left side of the dorsal aspect of the body, near the posterior part of the branchial sac. The pericardium is laid open, and the heart being injected, the auricle, from its thinner parietes, is seen of a red colour; a bristle is passed behind the ventricle, and the aorta may be seen ramifying over the liver. No. 883 is a specimen of *Limax ater*, Linn. (Slug), to show the heart situated in the middle of the back. ('Catalogue'—Gallery, vol. ii.)

Respiratory System.—In the same series the soft parts of *Helix Pomatia* are prepared (No. 1081), to show the pulmonary sac, which receives the air by an anterior orifice on the right side of the neck. The sac is laid open from that orifice to the opposite extremity; and the roof of the cavity, upon which the pulmonary artery or continuation of the veins of the body ramifies, is turned back to exhibit the reticulation of the vascular and respiratory surface. The parts are injected with size and vermilion. No. 1082 is a similar specimen, with the left parietes of the pulmonary sac removed, and the orifice by which the air is admitted and expelled left entire. No. 1083 is the portion of the vascular parietes of the pulmonary sac removed from the preceding preparation, and inverted to show the ramifications of the pulmonary vessels. These are continued from the veins of the body without the interposition of the propelling ventricle. No. 1084 is a similar preparation. No. 1085 shows the roof of the pulmonary sac of another *Helix Pomatia*, with the vessel injected; and in No. 1086 there is, in a similar specimen, a bristle inserted into the rectum, which terminates close to the orifice of the pulmonary sac. ('Catalogue'—Gallery, vol. ii.)

Brain, Nervous System, and Senses.—In the same series of the same collection is a preparation of a Slug (*Limax rufus*, Linn.)—No. 1304—laid open longitudinally along the back to show the nervous system. The viscera are removed. "In this," says Professor Owen, "as in other Encephalous Mollusks, a well-developed ganglion is situated above the œsophagus; it is of a transverse shape, slightly enlarged at its extremities, and supplies the antennæ, or horns, and the eyes. The œsophageal nervous ring is completed by a larger ganglion below the tube, from which numerous nerves radiate to supply the body. The principal nerves are the two inferior ones, which extend on either side the mesial line of the ventral surface straight to the opposite end of the body, giving off nerves to the muscular disc, or foot, from their outer sides. A small unsymmetrical ganglion is formed on the nerve, which supplies the heart and respiratory apparatus." No. 1305 is the same species of slug laid open along the ventral aspect, and the viscera removed, to show more especially the subœsophageal ganglion and its nerves. A bristle occupies the place of the œsophagus. No. 1306 exhibits the nervous system of a Black Slug removed from the body. ('Catalogue'—Gallery, vol. ii.)

Touch.—In the Shell-Snails the sense of touch will be readily supposed, by any one who has observed the motions of a common garden-snail, to reside especially in the ventral disc, or foot, and the lower tentacles. In the museum of the College we find, No. 1391, a specimen of *Helix Pomatia* prepared to show the different character of the surface of the skin in the exposed and protected parts of the body: in the latter it is thin and smooth; in the former, thick, vascular, and rugose. No. 1392 is a snail injected, slit down the back and eviscerated, to show the vascularity of the foot. No. 1393 is a snail injected, with one pair of tentacles, which serve as special instruments of touch, extended. Here too the pulmonary cavity is laid open. ('Catalogue'—Gallery, vol. ii.)

Sight.—In the gallery (Physiological Series) of the same rich museum is a preparation of a *Helix Pomatia* (No. 1756), with the posterior tentacles or horns extended, showing the eye-specks, or ocelli, situated at the side of the extremity of each horn. "In this position, although destitute of appropriate muscles, the eyes have the advantage of all the mobility with which the tentacle itself is endowed; and by the admirable construction of the same part, they are defended from external injury by being retracted and inverted, together with the extremity on which they are supported within the cavity of the tentacle, as in a sheath." (Professor Owen, 'Catalogue,'—Gallery, vol. iii.)

Swammerdam describes the eyes in detail; but some are of opinion that the organs above alluded to are not eyes. Sir Everard Home denied that they were visual organs; and so does M. Gaspard, who allows the snail no senses, save those of taste and touch, the latter of which he admits it to possess in an extreme degree of delicacy. See M. Gaspard's 'Memoir on the Physiology of Helix Pomatia.' (Majendie's 'Journal de Physiol.,' tom. ii. p. 295, et seq.; and an abstract of the paper, with notes, by T. Bell, Esq., 'Zool. Journ.,' vol. i.) See also Mr. Brayley's paper 'On certain Organs of the Helicidæ, usually regarded as their Eyes, &c.' ('Zool. Journ.,' vol. ii.)

Generative Functions.—In the common Shell-Snails (*Helix*), the male and female sexual organs are complete in one individual, but it requires a reciprocal junction of two individuals to produce a fruitful impregnation. The situation of these organs is at the anterior orifice of the neck; and at the time of congress a sharp horny or glass-like excitatory appendage is protruded, apparently for the purpose of stimulus. Some assert that these appendages are absolutely shot out from the body of one snail into the body of another, and engravings even exist where two snails are represented at a distance from each other reciprocally darting these spicula amoris, some of which are seen actually in the intervening space, and others on the ground. There is reason to doubt whether the spiculum amoris is ever thrown: we have had opportunities of examining the common garden shell-snails frequently when engaged in the reproduction of the species, and have never seen the hard excitatory appendage thrown from the body of the snail. Colonel Montagu, it appears, is of the same opinion. He admits the existence of the spicula in the animal of *Helix aspersa*, as well as *H. nemoralis* (or at least some of them); but "that they are missile darts," he continues, "we have much reason to doubt, though it is natural to suppose the animals are furnished with them for the purpose of stimulating each other to love, because it is only at that season they are found to possess them. If such are ever discharged at each other, we have been extremely unfortunate in our observations, for in no one instance could we ever find the dart penetrated, though at the time the animals are close the point may irritate; but it is neither sufficiently strong nor sharp-pointed to penetrate the tough skin with which these animals are furnished; and indeed the extremely viscid secretion with which they are so copiously provided adheres so strongly to the spiculi (spicula), when wholly projected from the body, that they are for a time held by it. Perhaps we may be told hereafter that this tough excretory fluid is used as a cord to regain these darts after they have been discharged; but such we should hold equally fabulous with much of the accounts related by various authors. These celebrated love-darts are sub-pellucid, white, and very brittle, about one-fourth or three-eighths of an inch in length, and somewhat triangular like the blade of a small sword." ('Testacea Britannica.') Dr. Maton often observed these spicula, but never saw them actually projected from one to the other.

Where the reproduction is by means of eggs, as it is in the great majority of *Helicidæ*, these are either enveloped in a skin, and round, as in the common garden-snail, or provided with a hard calcareous shell, generally of a white or of a dirty-white colour, as in *Achatina* and *Bulimus*. [BULIMUS.] These hard-shelled eggs are generally oval; in other instances they are round. Specimens of these eggs, some whole, some showing the young shell included, and others showing it breaking out of the egg-shell, are now in the British Museum (from Mr. Brodcrip's collection). In the museum of the College of Surgeons are several preparations, showing the organs of generation in the shell-snail.

Power of repairing Injuries.—The power which snails, in common with other Testaceous Mollusks, possess of repairing their shells, is known to most observers, and requires no comment; but the extent to which these animals will repair lesions of the soft parts, and even reproduce some of the principal ones after they have been deprived of them, is deserving of notice. The works of Schoeffer, Spallanzani, Bonnet, and others bear testimony to the wonderful vis vitæ in these animals, and its energy in replacing parts, the deprivation of some of which must, it might have been previously thought, have been followed by immediate death. Spallanzani cut off one of a snail's horns: it began to bud again in about 25 days, and continued to grow till it was equal in length to the other. He removed part of the head: in course of time the part was renewed. Not that this was always the case in those instances where the entire head had been taken off; but even in these instances the snail often recovered, and at the end of a few months appeared with a new head in all respects equal to the old one. The snails so treated retired into their shells the moment the operation was over, and there they concealed themselves for weeks and even months, covering the aperture with the parchment-like secretion so well known to those who have seen this temporary sort of operculum. When forced out for examination at the end of 30 or 40 days, some appeared without any marks of renewal; but in others, especially in those cases which had the advantage of warm weather, there was a fleshy globule towards the middle of the trunk, soft, and whitish-ash in colour. At this period no organisation was detected in the globule; but in 8 or 10 days the globule became larger, rudiments of lips were seen, and of the smaller horns, mouth, and tongue. A membranaceous substance was observed fixed in the upper jaw: this proved to be the new tooth. The parts then became further developed and more conspicuous, occupying a greater space, and in two or three months the injury was so completely repaired that the lighter colour only of the new head served to distinguish it from the old one. These experiments were confirmed by others, by Gerardi among the rest.

Hybernation.—M. Gaspard remarks that in our temperate climate, as soon as the first autumnal chills are felt, about the commencement of October, generally, *Helix Pomatia* becomes indolent, loses its appetite, and associates in considerable numbers on hillocks, the banks of ditches, in thickets, hedges, and such places. In a day or two the animals cease feeding, expel the last contents of the intestines, and then hide themselves under moss, grass, dead leaves, or the like rubbish. Here each forms for itself, with the anterior part of its muscular foot, a cavity sufficiently large to contain at least its shell: this cavity it enlarges and excavates by turning itself round on every side, then raising itself against the sides of the cavity, and at last against the roof formed of moss or leaves, or a small quantity of earth brought there by its motions. When it has succeeded in bringing the aperture of the shell to nearly a horizontal position, it stops. The foot is soon contracted within the shell, the snail then expands, so as completely to cover the collar of the mantle, which is at this period very white; and then inspires a quantity of air, after which it closes the respiratory hole. When this is done, a fine transparent membrane is formed with its mucus, and interposed between the mantle and any extraneous substances lying above. The mantle then secretes a quantity of very white fluid over its whole surface, which sets uniformly, like plaster of Paris, and instantly forming a continuous covering about half a line thick. When this is hardened, the animal separates its mantle from it by another and stronger mucous secretion; and after a few hours, expelling a portion of the air it had previously inspired, it is enabled to shrink a little farther into the shell. It now forms another lamina of mucus, expires more air, and thus retires farther into the shell. In this way sometimes a fourth, fifth, and even sixth partition are formed, with intermediate cells filled with air. Such is M. Gaspard's account, but Mr. Bell remarks that it does not completely explain the manner in which the excavation is formed. "It is not by the pressure of the foot," says the last-named zoologist, "and the turning round of the shell, that this is principally effected. A large quantity of very viscid mucus is secreted on the under surface of the foot, to which a layer of earth or dead leaves adheres; this is turned on one side, and a fresh secretion being thrown out, the layer of earth mixed with mucus is left. The animal then takes another layer of earth on the bottom of the foot, turns it also to the part where he intends to form the wall of his habitation, and leaves it in the same manner, repeating the process until the cavity is sufficiently large, and thus making the sides smooth, even, and compact. In forming the dome or arch of the form, a similar method is used, the foot collecting on its under surface a quantity of earth; and the animal turning it upwards, leaves it by throwing out fresh mucus, and this is repeated until a perfect roof is formed. As I have very often watched this curious process, I am certain of the facts. On removing very carefully a portion of the roof soon after its completion, I was enabled to see the formation of the operculum. In about an hour, or even less, after the hybernaculum is covered in, the whole surface of the collar of the mantle instantaneously pours out the calcareous secretion in considerable quantity. This is at first as fluid as thick cream, but very soon acquires exactly the consistence of bird-lime, being excessively adhesive and tenacious; and in about an hour after it is poured out it is perfectly solid."

M. Gaspard states that the labour of each individual continues for about two or three days; but that the whole of the month of October is occupied by the general closing of the shells of the species. He adds that about the beginning of April the hybernation ceases. "The mode by which their escape from confinement is effected is simple and easily comprehended. The air which is contained in the different cells, and which had been expired on the animal withdrawing itself farther and farther into the shell after the formation of the operculum, is again inspired, and each separate membranous partition broken by the pressure of the hinder parts of the foot projected through the mantle. When it arrives at the calcareous operculum, the animal, making a last effort, bursts and detaches its most obtuse angle. Then insinuating by little and little the edge of the foot between the shell and the operculum, it forces the latter off, or breaks it away." ('Abstract of M. Gaspard's Memoir,' by T. Bell, Esq., Pres. L. S., 'Zoological Journal,' vol. i.)

We now proceed to give a sketch of the views of systematists with regard to this numerous tribe of animals.

The genus *Limax* (Slugs) is placed by Linnæus at the head of the *Mollusca* in his last edition of the 'Systema Naturæ,' and is numbered 312. The genus *Helix* is numbered 328, and consequently is widely separated by him from *Limax*. Both land and fresh-water testaceous gastropods were assembled under this genus, which stands between *Turbo* and *Nerita*.

Cuvier's Pulmonés Terrestres, or Terrestrial Pulmoniferous Mollusks, consisted of the Slugs, Limaces (*Limax* of Linnæus, including *Vaginulus*, *Testacella*, and *Parmacella*), the Escargots, (*Helix*), the Nonpareilles (*Clausilia*, Drap.), and the Agatines (*Achatina* Lam.).

Under *Helix* Cuvier arranges *Helix*, *Vitrina* (Helicolimax), *Bulimus*, *Pupa*, *Chondrus*, and *Succinea*.

Then comes the *Clausiliæ* (*Turbo perversus*, *T. bidens*, Linn., &c.).

The *Achatinæ*, including *Liguus* and *Polyphemus* of De Montfort, follow.

Lamarck defines his Colimacés to be Air-Breathing Trachelipods (Trachélipodes Aëricoles), provided with or deprived of an operculum, and having cylindraceous tentacles. Their shell he characterises as spirivalve, having no projecting parts on its exterior except the striæ and riblets (costules) of growth, and whose aperture is often recurved or reflected outwards. He divides this, the first family of his Phytiphagous (Plant-Eating) Trachelipods, into the following sections and genera:—

(*a*) Four Tentacles.

Helix, *Carocolla*, *Anostoma*, *Helicina*, *Pupa*, *Clausilia*, *Bulimus*, *Achatina*, *Succinea*.

(*b*) Two Tentacles.

Auricula and *Cyclostoma*.

M. de Férussac makes the fourth and fifth orders of Gastropods consist of the Pulmoniferous Gastropods without an operculum (Pulmonés sans Opercule), and the Pulmoniferous Gastropods with an operculum (Pulmonés Operculés).

The fourth order consists of the following sub-orders and genera:—

1st Sub-order. *Geophila*.

The 1st Family of this order consists of the different genera of Slugs, and of *Parmacella*, *Testacella*, &c.

The 2nd Family embraces the following genera of Snails:—*Helicarion*, *Helicolimax*, *Helix*, *Vertigo*, *Partula*.

2nd Sub-order. *Gehydrophila*.

3rd Family (Les Auricules), *Carychium*, *Scarabus*, *Auricula*, *Pyramidella*, *Tornatella*, *Pedipes*.

3rd Sub-order. *Hygrophila*.

This sub-order consists of the Limneans, or Water-Snails, such as *Limnæa*, *Planorbis*, &c.

The fifth order contains two families:—

1st. The Heliciniians (*Helicina*).
2nd. The Turbicinians (*Cyclostoma*).

The *Pulmobranchiata* form the first order of M. De Blainville's *Paracephalophora Monoica*, the second sub-class of the second class (*Parcephalophora*) of his *Malacozoa*.

M. De Blainville gives the following description of the *Pulmobranchiata*:—

Organs of respiration retiform or aërian, lining the roof and floor (plafond) of the cavity situated obliquely from left to right on the origin of the back of the animal, and communicating with the ambient fluid by a small rounded orifice, pierced on the right side of the swollen (renflé) border of the mantle. All these animals are more or less framed for breathing air; the greater part are terrestrial; some live on the banks of fresh waters, and others on the sea-banks (rivage des mers). None bury themselves in the mud, with the exception of the Limnaceans, during the rigorous season; all are phytiphagous. Some of them are known in all lands.

M. De Blainville divides the *Pulmobranchiata* into the following families and genera:—

1st Family, the Limnaceans. (*Limnæa*, *Physa*, *Planorbis*).
2nd Family, the Auriculaceans. (*Pedipes*, *Auricula*, *Pyramidella*.)
3rd Family, the Limacinians. (*Succinea*, *Bulimus*, *Achatina*, *Clausilia*, *Pupa*, *Tomogeres*, *Helix*, *Helicolimax*:—*Testacella*, *Parmacella*, *Limacella*, *Limax*, *Onchidium*.)

M. Latreille divides the Pulmonés, his fourth order of his first section of Gastropods (the Hermaphrodites), into the following families and genera:—

1st Family, Nudilimaces. (The Slugs, and *Parmacella*, *Testacella*, &c.)
2nd Family, Géocochlides. (*Helicarion*, *Vitrine* (Helicolimax), *Succinea*, *Helix*, *Carocolla*, *Anostoma*, *Pupa*, *Chondrus* (Grenaille), *Clausilia*, *Bulimus*, *Achatina*, *Vertigo*, *Partula*.)
3rd Family, Limuocochlides. (*Carychium*, *Scarabus*, *Auricula*, *Conovula*, *Cassidula*, *Limnæa*, *Physa*, *Planorbis*, *Ancylus*.)

The second section, the Diœcious Gastropods, consists of his fifth order (*Pneupomes*), and contains two families:—1st, the Helicinides (*Helicina*); 2nd, the Turbicines (*Cyclostoma*.)

M. Rang, in his 'Tableau Méthodique,' makes the Limaçons of Férussac (Trachélipodes Colimacés of Lamarck; Limaciués of De Blainville; Géocochlides of Latreille) the second family of the Pulmonés Inoperculés of Férussac (Pulmobranches of De Blainville).

M. Rang, following De Férussac, thus, with some slight alterations, defines and arranges the family:—Animal elongated, having the body distinct from the foot, and forming a twisted spiral, rarely furnished with a cuirass, but always showing a fleshy collar which closes the shell. Tentacula to the number of four, rarely two, the upper ocellated. Pulmonary cavity placed forward, and opening in the thickness of the collar. Organs of generation united in front; vent near the respiratory orifice. Shell always spiral, very variable in form, receiving the animal more or less completely. Terrestrial.

TETRACEROUS.

A. A cuirass and a collar.

Genera, *Vitrina*, Draparnaud. (*Helicolimax* and *Helicarion* of Férussac.)

B. A collar without a cuirass.

Genera, *Helix*, Müller (*Helix*, *Succinea*, *Amphibulimus*, *Acavus*, *Polydontes*, *Tomogeres*, *Anostoma*, *Carocolla*, *Bulimus*, *Achatina*, *Polyphemus*, *Pupa*, *Clausilia*, &c., &c., Fér.)

(†) *Redundantes.*

‡ *Volutatæ*:—*Helicoides.*

I. Sub-genus. *Helicophanta*, Férussac.
Peristome simple.
1st Group. *Vitrinoides*, Fér. (*Helix brevipes*, &c.).
Peristome thickened and subreflected.
2nd Group. *Vesiculæ*, Fér. (*H. Cafra*, &c.).
‡‡ *Evolutatæ:—Cochloides.*

II. Sub-genus. *Cochlohydra*, Fér. (*Succinea*, Drap.; *Amphibulima*, Lam.; *Amphibulimus*, Montf.).
(††) *Inclusæ.*
‡ *Volutatæ:—Helicoides.*

III. Sub-genus. *Helicogena*, Fér. (*Helix*, Linn.).
Columella solid and twisted.
1st Group. *Columellatæ.*
a. Peristome simple. (*Helix naticoides*, &c.)
β. Peristome reflected or thickened. (*Helix Jamaicensis*, &c.)
Shell perforated.
2nd Group. *Perforatæ*, Fér. (*Helix ligata*, &c.).
Shell umbilicated; umbilicus entirely covered.
a. Shell globulose or subtrochoid.
3rd Group. *Acavi* (*Helix aspersa*, &c.).
Shell imperforate.
β. Shell somewhat depressed (surbaissée).
4th Group. *Imperforatæ*, Fér.
1. Mouth rounded; peristome open. (*Helix guttata*, &c.)
2. Mouth sinuous; peristome strongly reflected. (*Helix, squamosa*, &c.)
3. Mouth turning over (versante); columellar border sinuous, flattened, and subdentated. (*Helix cognata*, &c.)

IV. Sub-genus. *Helicodonta*, Fér. (*Tomogeres*, Montf.; *Anostoma*, Lam.).
1st Group. The Grimaces, *Personatæ*, Fér. (*Helix dentiens*, &c.).
Aperture defended by one or more elongated and internal laminæ.
2nd Group. *Lamellatæ*, Fér.
* Many laminæ. (*Helix carabinata*, &c.)
** A single lamina. (*Helix labyrinthica.*)
Peristome furnished with large teeth, one of which at the base of the columella forms a gutter.
3rd Group. *Maxillatæ*, *Polydontes*, Montf. (*Helix imperator*, &c.).
Mouth reversed, furnished with elevated folds, the impressions of which are visible outwards.
4th Group. Anostomes, Fér.; *Anostoma* (*Helix ringens*, &c.), *Streptaxis*, Gray.
Interior border of the aperture furnished near the peristome with elevated longitudinal folds, the impressions of which are visible outwards.
5th Group. *Impressæ* (*Helix cepa*, &c.).

V. Sub-genus. *Helicigona*, Fér.
Umbilicus covered.
1st Group. *Carocolla*, Montf. (*Helix angistoma*, &c.).
Umbilicus masked or visible.
2nd Group. *Vortices*, Ok. (*Helix marginata*, &c.).

VI. Sub-genus. *Helicella*, Fér.
Peristome reflected.
1st Group. Lomastomes, *Lomastoma*, Fér. (*Helix carascalensis*, &c.).
Peristome simple.
2nd Group. Aplostomes, *Aplostoma*, Fér.
* *Verticilli.* (*Helix lineata*, &c.)
** *Hyalinæ.* (*Helix olivetorum*, &c.)
*** *Fasciatæ.* (*Helix candida*, &c.)
Peristome bordered.
a. Shell horn colour or brown, nearly unicoloured, rarely fasciated, often hairy; peristome rather spread; epidermis caducous.
3rd Group. *Hygromanes*, Fér. (*Helix cinctella*, &c.)
β. Shell white or reddish, very much ornamented with bands or small vivid-coloured lines; epidermis insensible, never hairy; sometimes carinated; peristome bordered but not spread.
4th Group. *Heliomanes*, Fér.
* Shell somewhat depressed or globulose. (*Helix groyana*, &c.)
** Shell trochoid and a little carinated. (*Helix pyramidata*, &c.)

VII. Sub-genus. *Helicostyla*, Fér.
Columella straight; peristome simple; shell subdepressed.
1st Group. Aplostomes, *Aplostoma*, Fér. (*Helix misella*, &c.).
Columella twisted, truncated as it were at its base, or furnished with an internal spiral rib, forming a gutter, and appearing under the form of a tooth or callosity.
2nd Group. *Canaliculata*, Fér. (*Helix delicatula*, &c.).
Columella flattened, without either tooth or lamina, forming a sort of gutter at its intersection with the penultimate whorl; peristome reflected.
3rd Group. *Marginatæ*, Fér. (*Helix studeriana*, &c.).

‡‡ *Evolutatæ.—Cochloides.*
* Mouth generally toothless.
Columella solid.
a. En filet, not truncated at its base.

VIII. Sub-genus. *Cochlostyla*, Fér.
Peristome reflected.
1st Group. Lomastomes, Fér. (*Helix metaformis*, &c.).
Peristome simple.
2nd Group. Aplostomes, Fér. (*Helix Dufresnii*, &c.).
β. Columella solid, flattened, and truncated at its base.
† Shell conic, or very ventricose; aperture enlarged.

IX. Sub-genus. *Cochlitoma*, Fér.
Shell conical; mouth short; anterior border advanced.
1st Group. The Rubans, Fér. (*Helix exarata*, &c.).
Shell ventricose; mouth very large; external border in a vertical direction.
2nd Group. *Achatinæ.*
†† Shell ovoid or turriculated; mouth elongated and narrow.

X. Sub-genus. *Cochlicopa*, Fér.
Shell ovoid; mouth long; exterior border in a vertical direction.
1st Group. The Polyphemes, Montf. (*Helix Priamus*, &c.).
Shell turriculated; mouth short; external border a little advanced.
2nd Group. Styloides, Fér. (*Helix fulminea*, &c.).
Shell perforated or umbilicated; umbilicus masked or uncovered; peristome simple.
a. Whorls of the spire equalised; the last whorl shorter than the others united.

XI. Sub-genus. *Cochlicella*, Fér.
Only group, *Turritæ*, Fér. (*Helix conoidea*, &c.).
β. Last whorl of the spire generally larger and longer than the others united.

XII. Sub-genus. *Cochlogena*, Fér.
† Peristome simple or thickened, but with sharp edges.
a. Shell umbilicated; columella straight.
1st Group. *Umbilicatæ*, Fér. (*Helix flammata*, &c.).
β. Shell perforated; columella twisted.
2nd Group. *Perforatæ*, Fér.
* Shell oblong. (*Helix fasciolata*, &c.)
** Shell ovoid. (*Helix costulata*, &c.)
†† Peristome reflected or dentated.
Mouth crescent-shaped, without either teeth or folds; peristome reflected and regular; columella twisted, perforated; last whorl of the spire sometimes shorter than the others united.
3rd Group. Lomastomes, Fér.
* Last whorl of the spire larger and longer than the others united, shell ornamented with vivid colours. (*Helix Favannii*, &c.)
** Last whorl shorter and less than the others united; shell unicoloured. (*Helix Beticata*, &c.)
Mouth short, crescent-shaped; peristome simple or thickened and regular; columella twisted, more or less projecting and bent, or furnished with a plait which turns upon it and makes it appear subtruncated; umbilicus masked or exactly closed; last whorl of the spire sometimes shorter than the others united.
4th Group. Helicteres, Fér. (*Achatinella*, Sw.).
* Shell coniform. (*Helix vulpina*, &c.)
** Shell turriculated. (*Helix turritella*, &c.)
*** Shell ovoid. (*Helix tristis*, &c.)
Mouth angular at its extremities, or overlaid superiorly, often narrowed by the sinuosities of the external border; columella large, more or less spiral, and forming a plait more or less projecting in the aperture. Peristome thick and reflected; last whorl of the spire longer and more convex than the others united.
5th Group. Stomotoides, Fér. (*Helix Auris Leporis*, &c.).
Mouth crescent-shaped, rather angular at its extremities, most frequently furnished with short teeth at the peristome, which is bordered or a little opened out or reflected; never any laminæ; columella twisted, hollow, flattened at its base, or forming a protuberance; generally perforated.
6th Group. Dontostomes, Fér.
(*) Last whorl of the spire larger and longer than the others united. (*Helix Auris Bovis*, &c.)

(**) Whorls of the spire equalised, often pressed and narrow. (*Helix turgnus*, &c.)

(***). Mouth generally furnished with teeth or laminæ.

1. Without gutters; peristome generally not continuous.

XIII. Sub-genus. *Cochlodonta*, Fér.

Shell cylindrical.

1st Group. *Pupa*, Fér. (*Helix*, *Uva*, &c.).

Shell fusiform.

2nd Group. Cereales, Fér. (*Helix Moricandi*, &c.).

2. One or two gutters; peristome generally continuous.

XIV. Sub-genus. *Cochlodina*, Fér.

* Shell right-handed.

† Mouth without teeth or laminæ.

Peristome not continuous.

1st Group. Pupoides, Fér. (*Helix Carinula*, &c.).

Peristome continuous.

2nd Group. Tracheloides, Fér. (*Helix Sloanii*, &c.).

†† Mouth armed with great plaits or elongated teeth. (*Helix Gargantua*.)

** Shell left-handed.

Mouth without any lamina. (*Balea*, Gray.)

3rd Group. Anomales, Fér. (*Helix perversa*, &c.).

Mouth armed (with laminæ, one of which performs the part of an elastic operculum).

4th Group. *Clausilia*, Draparnand (*Helix torticollis*, &c.).

DICEROUS.

Genera. *Vertigo* (Muller).—Animal elongated, demi-cylindrical, with a rather large spiral body and a collar closing the shell; only two tentacles, long, obconical, retractile, rounded at their extremity; orifice of the pulmonary cavity upon the collar and to the right, approximated by that of the vent; organs of generation united and showing their orifice near the right tentacle. Oviparous.

Shell cylindrical, very spiral; aperture straight, in the direction of the axis, short, often dentated; peristome often sinuous and reflected; right or left handed (dextral or sinistral).

Partula (Fér).—Animal elongated, demi-cylindrical, with a rather large spiral body; a collar closing the shell and carrying the orifice of the pulmonary cavity on the right and at the external angle of the aperture; two tentacles only, cylindrical and retractile, ocellated on their summit; organs of generation united (?), showing their orifice near the right tentacle. Ovoviviparous.

Shell oval, pointed; spire conical, last whorl convex and longer than the others united, whorls of the spire 4 to 6; aperture straight in the direction of the axis, short, sometimes dentated, or furnished with elevated laminæ; peristome commonly very much reflected, with the edge in the same vertical plane; columellar side or lip callous at its base; dextral or sinistral.

M. Rang's third family of Inoperculate Pulmoniferous Mollusks consists of the Auricules of Férussac (*Auriculacea* of De Blainville; *Auriculidæ* of Gray; Limnocochlides (à collier) of Latreille). These are either terrestrial or marine, and one has been announced as fluviatile. They comprehend the genera *Carychium*, *Auricula* (*Auricula* and *Conovula*, Lam.; *Melampus*, Montf.), *Pedipes*, and *Scarabus*. To these may be added *Chilina*, Gray; *Acmea*, Hartmann; and *Marinula*, King. None of these can be considered to belong to the *Helicidæ*, properly so called.

The fourth family, the Limneans of Lamarck (*Limnacea* of De Blainville; Limnocochlides (without a collar) of Latreille), is entirely fluviatile, consisting of the genera *Planorbis*, *Limnæa*, or, as Lamarck writes it, *Lymnæa*, and *Physa*, *Aplexus*, Flem., and *Amphipeplea*, Nils. This family cannot be considered as belonging to the *Helicidæ*, properly so called.

The order Pulmonés Operculés of Férussac (Trachélipodes Colimacés of Lamarck; Pectinibranches of Cuvier; Chismobranches Cricostomes of De Blainville; Pneupomes of Latreille), is thus defined by M. Rang:—

Animal furnished with a foot fitted for creeping, no branchiæ, but a pulmonary cavity receiving the ambient fluid by a large opening placed above the head; tentacles two in number; organs of generation on different individuals.

Shell external, complete, spiral, globulose, or conical. Operculum calcareous or horny. All terrestrial.

M. Rang observes that this order was established by M. De Férussac at the expense of the *Pectinibranchiata* of M. Cuvier, and for the genus *Cyclostoma* only; but afterwards M. De Férussac added to it the genus *Helicina*, which was at one time confounded with the Colimacés of Lamarck. At present, continues M. Rang, the Operculated Pulmonians establish very well the passage from the Pulmonians to the Pectinibranchians, because they are related to the first with reference to the organs of respiration, and to the second with reference to the separation of the sexes.

1st Family.

Helicines of Férussac (Helicinides of Latreille).

Animal furnished with a collar, and two filiform tentacles carrying the eyes at their external base upon tubercles.

Shell more or less globulose, with a demi-oval aperture, and the columella transversal and delicate. Operculum horny, sometimes calcareous externally.

M. Rang observes that M. De Férussac established the two families of Helicinians and Tubicinians for two genera nearly approximated, and that it would be perhaps more convenient to unite them, the difference between them being really not very remarkable, except in their testaceous envelope; but Mr. Gray has pointed out that one has an annular and the other a spiral operculum. See also the Rev. M. G. Berkeley's 'Memoir' hereinafter alluded to.

Genera. *Helicina*, Lam. (*Oligyra*, Say; *Ampullina*, De Blainville).—Animal very spiral, furnished with a proboscidiform head and a bilabiated muzzle; tentacles filiform, carrying the eyes at their extended base on tubercles; foot short, rounded, with a transverse anterior furrow; pulmonary cavity opening in front of the mantle by means of a large transversal slit.

Shell sub-globulose or conoid, a little depressed, not umbilicated, with a low spire, an aperture demi-oval, or nearly oval, the peristome reflected into a border (bourrelet), the left lip enlarged upon the umbilicus, which it entirely covers; columella transversal and planulate. Operculum horny, sometimes slightly calcareous externally; lines of growth concentric.

Helicina was established by Lamarck, and placed by him among his Colimacés. M. Rang is of opinion that the genera *Ampullina* of De Blainville and *Oligyra* of Say ought to be referred to *Helicina*, an opinion which seems to be in unison with that of M. De Blainville himself, who has arranged both these genera under *Helicina* in his 'Manual.' Dr. Gray has published a valuable monograph of the genus in the first volume of the 'Zoological Journal,' and the late Rev. Lansdown Guilding has recorded some other species, with plates of the animal, in the same work, vol. iii.

The definition of M. De Férussac's second family, the Turbicinians, is—Animal without a collar, provided with two tentacles, ocellated at their external base.

Shell conoid, more or less elevated, with a roundish aperture and continuous borders. Operculum calcareous.

Cyclostoma (Lamarck).—Animal very spiral, furnished with a proboscidiform head, which bears two cylindraceous tentacles, convex, or swollen at their summit, contractile, and ocellated at their external base; foot elongated and oblong; pulmonary cavity communicating with the exterior by means of a large slit at the superior and anterior part of the mantle; position of the male organ indicated by a tentaculiform appendage situated at the right side.

Shell conoid, discoid, or turriculated, more or less elevated, with a sharp or mammillated summit, having all the whorls rounded; aperture round, with continuous and reflected borders. Operculum calcareous, with concentric lines, summit subcentral. (Rang.)

The species of *Cyclostoma* are very numerous, and many of them are very beautiful. Mr. G. B. Sowerby has added considerably to the catalogue. They are principally the inhabitants of temperate or warm climates; there is one English species, *C. elegans*. The reader will find an excellent paper on the anatomy of this species, by the Rev. M. G. Berkeley, in the 4th vol. of the 'Zoological Journal.'

M. Rang adds to these Pulmoniferous Operculated Mollusks, the fossil genus—

Ferussina, Grateloup (*Strophostoma*, Deshayes).—Animal unknown. Shell oval, subglobulose; aperture round, bordered, oblique, simple, toothless, turned over from the side of the spire; umbilicus more or less large. Operculum? (Rang.)

M. Rang remarks that M. Grateloup established this genus for a fossil shell from Dax, which seems at the first view very near to *Anostoma*, but which M. Grateloup, from the examination of its aperture, considers as more approximate to *Cyclostoma*. M. Rang states that he participates in this opinion, which the knowledge of the operculum can alone confirm; and he goes on to observe that M. Deshayes, doubtless not having seen the publication of this genus in the first number of the 'Bulletin of the Linnean Society of Bordeaux,' had subsequently published it under the name of *Strophostoma*. Three or four species are known.

Some may have doubts as to the propriety of placing these operculated pulmoniferous terrestrial mollusks under the family *Helicidæ*. But we believe, notwithstanding the difference of the operculum, that their general organisation will warrant their being so placed; and that the terrestrial shell-snails may without violence be placed in one great family, which may be subdivided into the *Helicidæ* without opercula, and the *Helicidæ* with opercula.

Before we conclude this part of the subject, we must draw the reader's attention to the following arrangement proposed by Dr. J. E. Gray:—

Terrestrial.

Tentacles retractile. Eyes pedicillate.

Gasteropodous. *Limacidæ*.

Trachelipodous. *Helicidæ*.

Aquatic.

Tentacles contractile. Eyes sessile.

Trachelipodous (mantle thick-edged). *Auriculidæ.*
Trachelipodous (mantle thin-edged). *Limnæadæ.*
Gasteropodous (mantle shield-like). *Onchidiadæ.*

With regard to the arrangement, Dr. Gray has since corrected that of the first division, because the distinction between the first two families, though it is that used by Lamarck, Cuvier, and others, is, in his opinion, artificial, and of little importance; and the knowledge which he has since acquired of the animals of several genera which were before unknown, have shown him that the character which De Férussac pointed out as the distinction between *Arion* and *Limax* (but which many succeeding naturalists have considered of little importance) is even of more importance than was accorded to it by De Férussac, affording a good character for dividing the Land Pulmonobranchous *Mollusca* into two families. Thus, he observes, the *Arionidæ* are characterised by having a gland on the end of the tail (which, in the gasteropodous genera, is produced beyond the mantle), and they have the orifices of the organs of generation on the right side immediately under the respiratory hole; whilst in *Helicidæ* there is no gland on the end of the tail, and the orifice above referred to is just behind the base of the upper right tentacle. There is also, he states, an important difference in the nervous system between the two families: in the first, the under part of the infra-gular ganglion is 6-lobed, whilst it is only 4-lobed in the *Limacidæ*. Dr. Gray is further of opinion that at present only a few genera, as *Arion* and *Helicarion*, Fér., *Nanina*, Gray, and *Stenopus*, Guilding, can be referred with certainty to the *Arionidæ;* but he thinks it very probable that, when the animals of other shells are known, many of them may be found to belong to that family.

Geographical Distribution and Habits.—The *Helicidæ* are most widely diffused over the surface of the earth; scarcely any countries but those where the climate is surpassingly rigorous are without some species of the family. Many of the shells are strikingly beautiful in form and colour, and these are mostly the inhabitants of intertropical countries. Some of the genera (*Achatina*, for instance) attain a very large size, and lay eggs in proportion. *Helix aspersa*, the common Garden Snail, is distributed over a large portion of the globe. It is found, for instance, at the foot of Chimboraço, in the forests of Guyana and Brazil, and on all the coasts of the Mediterranean in Europe, Asia, and Africa. *Helix Pomatia* has been naturalised with us, and is still found in some countries. The first importation is attributed by some to Sir Kenelm Digby. Merrett mentions it as a British inhabitant before his time. A moist and rather warm state of the atmosphere seems most congenial to this family. To avoid great dry heat they get under stones, under old trunks of trees, leaves, &c., and some of the species will burrow into the earth for protection against it. A shower will bring them forth in such numbers sometimes, the smaller species especially, as to induce the belief in some cases that it has been raining snails. Most of the species hybernate.

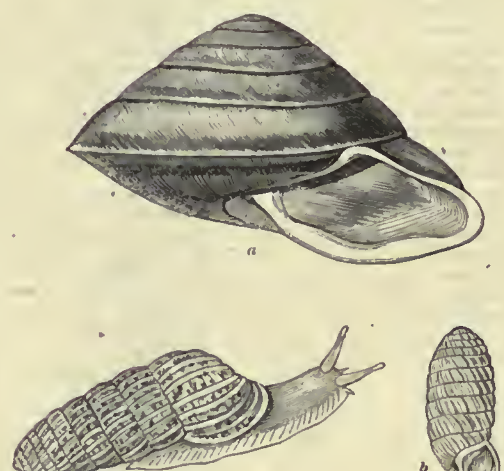
Utility to Man.—The *Helicidæ*, from their voracity, are very injurious to the agriculturist and horticulturist; but there can be no doubt that the larger species are good food. We know that they were a favourite dish with the Romans, who had their 'Cochlearia,' where they were regularly fattened with new wine boiled down and meal (sapa et farre, &c.) (Pliny, 'Hist.,' lib. ix. c. 56.) *Helix Pomatia* is used as food in many parts of Europe during Lent, and the snails are kept in an escargotoire (snaillery), which is generally a large place boarded in, having the floor covered half a foot deep with herbs, where the animals fatten. Many are familiar with the passage in Pliny (loc. cit.), who, on the authority of Varro, relates the incredible size to which the art of fattening had brought the snails. There must, one should think, be some mistake in the text, which says—"Cujus artis gloria in eam magnitudinem perducta sit, ut octoginta quadrantes caperent singularum calices." Pennant, referring to this and to Varro ('De Re Rusticâ'), says, "If we should credit Varro, they grew so large that the shells of some would hold ten quarts! People need not admire the temperance of the supper of the younger Pliny ('Epist.,' lib. i.; Epist., xv.), which consisted of only a lettuce a-piece, three snails, two eggs, a barley cake, sweet wine and snow, in case his snails bore any proportion to those of Hirpinus."

The following cuts, and those given under Bulimulus and Bulimus, will afford the reader an idea of some of the forms of the *Helicidæ:* —*Partula, Anostoma, Carocolla, Clausilia, Streptaxis, Balea, Vertigo, Cyclostoma.*

Partula Australis.

Anostoma depressum.

Carocolla Lamarckii.



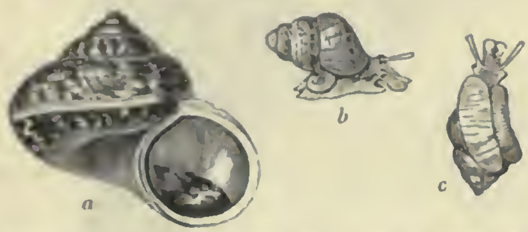
a, Carocolla albilabris; b, Pupa Uva; c, Pupa Chrysalis, with the animal.

a, Clausilia Macascarensis; b, the same, broken, to show the clausium, *c.*

Streptaxis contusa.

Balea fragilis, magnified.

a, *Vertigo pusilla*, *b*, another species of *Vertigo*, with the animal; both magnified.



a, *Cyclostoma involvulus*; *b*, *Cyclostoma elegans*, with the animal; *c*, *Cyclostoma elegans*; showing the alternate contraction of the two sides of the animal's foot.

The following is a list of the genera and species of British *Helicidæ* given in Forbes and Hanley's 'British Mollusca:'—

Vitrina pellucida.
Zonites cellarius.
Z. alliarius.
Z. nitidulus.
Z. purus.
Z. radiatulus.
Z. nitidus.
Z. excavatus.
Z. crystallinus.
Helix aperta.
H. Pomatia.
H. Arbustorum.
H. Cantiana.
H. Carthusiana.
H. nemoralis.
H. Pisana.
H. virgata.
H. caperata.
H. ericetorum.
H. obvoluta.
H. lapicida.
H. rufescens.
H. hispida.
H. revelata.
H. sericea.
H. lamellata.
H. aculeata.
H. fulva.
H. fusca.
H. pulchella.
H. rotundata.
H. umbilicata.
H. pygmæa.
Bulimus acutus.
B. Lackhamensis.
B. obscurus.
Pupa umbilicata.
P. Muscorum.
P. Anglica.
P. secale.
P. edentula.
P. minutissima.
P. pygmæa.
P. substriata.
P. antivertigo.
P. pusilla.
P. Venetzii.
Balea fragilis.
Clausilia laminata.
C. biplicata.
C. plicatula.
C. nigricans.
Zua lubrica.
Azeca tridens.
Succinea putris.
S. oblonga.

Fossil Helicidæ.—Fossil species of *Helicidæ* are by no means rare. Thus M. Deshayes enumerates thirty-five species of *Helix*, two of *Anostoma*, one of *Helicina*, three of *Pupa*, two of *Clausilia*, three of *Bulimus*, three of *Achatina*, seven of *Pedipes*, and six of *Cyclostoma*, &c., as fossil (tertiary), mostly in the Pliocene period of Lyell, and many of them as both living and fossil. Other species have also been found fossil.

HELICINA. [HELICIDÆ.]

HELICOLIMAX. [HELICIDÆ.]

HELICOSTEGA. [FORAMINIFERA.]

HELICTIS (Gray), a genus of *Mammalia* belonging to the order *Carnivora*. The species inhabit eastern Asia, and have the general appearance and colouring of *Mydaus*, combined with a dentition resembling that of *Gulo* or *Mustela*, but differing from both the latter genera in the large internal central lobe of the upper carnivorous tooth. The genus is thus characterised by Dr. Gray:—

Incisors (primores) $\frac{6}{6}$; canines (laniarii) $\frac{1-1}{1-1}$; molars $\frac{5-6}{5-6}$.

Head elongated. Feet short; soles of the feet nearly naked to the heel; toes 5—5; claws strong, the anterior ones long and compressed. Tail cylindrical and moderate.

There are two species, *H. moschata* from China, and *H. Nepalensis* from Nepaul. [MUSTELIDÆ.]

HELIOPORA, a genus of stony *Polypiaria*, established by De Blainville, from observations of Messrs. Quoy and Gaimard on a recent species called by Lamarck *Pocillopora cærulea.*

It is characterised as follows:—Animal short and cylindrical, provided with a simple circle of thick tentacula, 15 or 16 in number, contained in vertical or diverging cylindrical cells; cells immersed, internally crenulated by imperfect radiating lamellæ, united into a calcareous mass, which is regularly porous in the intervals of the cells. The coral is found attached to various bodies.

Three recent species are mentioned by De Blainville, all from warm seas. One of the fossil species (*Heliopora porosa*, De Bl.; *H. interstincta*, Bronn) abounds in strata of the Silurian system; others occur in the chalk and in tertiary deposits. ('Manuel d'Actinologie.')

HELIORNIS, Bonaterre's name for a genus of Water-Birds (Grébifoulques of Buffon), which have lobated feet like the Coots and Grebes, but with a greater development of tail, and they have sharper claws. [PODOA.]

HELIOTROPE. [BLOOD-STONE.]

HELIOTROPIUM (from ἥλιος, the sun, and τροπή, a turning), a genus of Plants belonging to the natural order *Ehretiaceæ*. It has a salver-shaped corolla, with the throat usually naked, but in some species bearded; the segments of the limb furnished with a single fold or a tooth between each; the stigma sub-conical; the carpels 4, 1-celled, combined, closed at the base, without any manifest receptacle. The species are annual or shrubby plants, with alternate leaves, and circinate spikes of small blue or white flowers.

H. Peruvianum, Peruvian Heliotrope, or Turnsole, has a shrubby stem, petiolate oblong-lanceolate wrinkled leaves, terminal branched spikes; the tube of the corolla hardly the length of the calyx. The mouth of the corolla is intersected with five plicatures of a purple-lilac colour, with a greenish throat. It is a shrub, growing one or two feet high, and is much cultivated on account of the scent of its flowers, which resembles very much the smell of the vanilla or cherry pie. It is a native of Peru.

H. Europæum, the European Turnsole or Heliotrope, has an herbaceous erect stem, with ovate flat-lined finely tomentose leaves, the lateral spikes solitary, the terminal ones conjugate, the calyx spreading in the fruit-bearing state. It is a native of the south of Europe and the regions of the Caucasus. The flowers are sweet-scented. The leaves were formerly used medicinally.

H. villosum has an herbaceous erect very villous stem, with ovate, flat, villous leaves; the spikes lateral, terminal, solitary, and conjugate; the corollas large; the calyx spreading in the fruit-bearing state. It is a native of Greece and of the islands of the Archipelago. It has large white corollas with a yellow throat. This appears to be the Ἡλιοτρόπιον μέγα of Dioscorides (iv. 190) and the *H. supinum*, the Ἡλιοτρόπιον μικρόν.

Upwards of 80 species of this genus have been enumerated. They are natives of the warmer parts of Europe, Asia, Africa, and America, and are found in Australia. They do not possess any active properties.

Many other species besides those here described have sweet-scented flowers, and are cultivated on that account. Some of them are consumed in large quantities by perfumers for the sake of their volatile oil. They are astringent and also mucilaginous, and poultices made of the leaves have been applied to cancerous and scrofulous sores. It is supposed that the plant used for the cure of warts, and called *Verrucaria*, belonged to this genus. In their cultivation the shrubby and perennial kinds will be found to thrive in any kind of rich light soil, and cuttings will root readily in sand under a hand-glass. The European annual species may be propagated from seed sown in an open border, whilst the tropical annual species must be sown upon a hot-bed before being planted out.

(Don, *Dichlamydeous Plants*; Burnett, *Outlines of Botany*; Fraas, *Synopsis Plant. Floræ Classicæ.*)

HELIX (Linnæus), a genus of Pulmoniferous *Mollusca*, embracing the various forms of animals called Snails. The following are the characters of this genus:—Shell spiral, opaque, or translucent, solid or thin, more or less globose, in some discoid, smooth or sculptured; surface variously coloured, but seldom covered with a polished epidermis; mouth lunated, thickened within, simple or toothed; peristome frequently reflexed. Animal moderately large in proportion to shell; head with four developed tentacles; mantle not reflected on shell; tail lanceolate and never truncate; foot often ample; tongue with the edge teeth serrate. (Forbes and Hanley.)

The species of this genus, at the approach of winter, or in very dry weather in summer, recede into their shell, and secrete a quantity of mucus, which forms a covering over the aperture. This thickened matter, which the animal has the power of throwing off by producing fresh mucus within, is called an 'epiphragm.' The power of forming this kind of epiphragm was supposed to be confined to the Land *Mollusca*, but it is now known that the Pond-Snails (*Limneus* and *Planorbis*), when left dry by the evaporation of the water in which they live, have the same power of thickening the edge of the lip, and forming a distinct epiphragm. [HELICIDÆ.] We shall now subjoin the descriptions of some of the most common British species.

H. aspersa, the Common Snail. The shell is obliquely subglobose, beneath the epidermis pale fawn-coloured, with four (usually interrupted) chocolate-brown bands. This is the commonest and one of the handsomest of British snails. It is found wherever there is vegetation, but is more especially addicted to gardens. This snail is collected and sold in Covent-Garden and other markets as a cure for diseases of the chest. It is prepared by being boiled in milk. Large quantities are collected, and sent every year from this country to the United States of America, where they are said to be regarded as delicacies. They are packed in casks, in which way they travel very well, as they fix themselves on one another around the circumference of the cask, leaving a vacant space in the centre. At Newcastle-upon-Tyne the glassmen hold a snail feast once a year, when large quantities of this species of snail are consumed.

H. Pomatia, the Edible Roman Snail, or Large-Shelled Snail. The shell is solid globose, coarsely wrinkled lengthways, most minutely striated in a spiral direction; pale-tawny, with rufous bands. The animal is of a general brownish-gray, speckled with whitish and brown granulations.

This species in Great Britain is nearly confined to the chalk districts of the south of England. It has been found as far north as Wiltshire. There is a notion prevalent that it is not an original inhabitant of England, but that it was introduced by the Romans, who were famous for its culture. [HELICIDÆ.] There is no evidence to prove this, and it is found in Sweden, where the climate is much more rigorous than our own. Its great necessity is chalk, and where this substance prevails it is found. This snail is eaten in this country. Lister says, "They are boiled in spring-water, and, when seasoned with oil, salt, and pepper, make a dainty dish." Dr. Turton says, "After the animal has been extracted there remains at the bottom of the shell a glairy transparent matter, which affords one of the best and most durable cements in nature, resisting every degree of heat and moisture."

H. Arbustorum, Shrub-Snail. Shell brown, closely marbled, with small linear paler markings, usually one-banded; outer lip white and reflected. This snail is very generally distributed in woods and in damp gardens throughout the British Isles. It is remarkable for being found higher up the sides of mountains than any other British species. In the Alps it nearly approaches the snow-line.

H. Cantiana, the Kentish Snail. Shell depressed, globular, semi-transparent, bald, open; adult, pallid above, rufous below, and towards the lip, periphery not angulated; outer lip edged within; umbilicus moderately large. It is chiefly found in England in localities south of the Thames, where it occurs amongst brambles and by hedges throughout the whole district. It has been taken in the west of England.

H. Carthusiana, Gibbs's Snail. Shell rather small, depressed, whitish, bald; mouth margined within by a milk-white rib; umbilicus minute. This shell is only found on the chalk downs of Kent and Surrey. It was discovered by Mr. Gibbs in 1814.

H. nemoralis, the Garden, Girdled, or Brown Snail. The shell is depressed globose, imperforated when adult, with or without coloured bands, not marbled; outer lip reflected; pillar lip callous, retiring.

The species thus characterised embraces the *H. hortensis* and *H. hybrida* of other naturalists. Messrs. Forbes and Hanley, in the 'British Mollusca,' say, "We have followed Pfeiffer, Deshayes, &c., in reuniting *hortensis* and *hybrida* to the typical *nemoralis*, not being able to detect any peculiarity in individuals of the dark-mouthed form which is not likewise represented in the white-mouthed variety, between which extremes the *hybrida* is the connecting link.

H. virgata, Zoned Snail. Shell depressed turbinate, smooth, banded; bands not linear; upper whorls for the most part with only a single zone above the suture; mouth usually livid red; outer lip edged internally.

This species is found in prodigious numbers in many chalk and limestone districts. It is also found in larger numbers near the sea. On the chalk off the coast of Kent it occurs frequently in great profusion. It is widely diffused and is found in the same localities throughout central and southern Europe.

H. ericetorum, Heath-Snail. Shell depressed, semi-transparent, not regularly striated, banded with brownish-yellow; mouth small, outer lip acute, not edged with colouring matter; umbilical region capacious.

This snail prefers calcareous soils, and is often abundant on sandy soils near the sea. It is very widely diffused through the British Isles, ranging to the north of Scotland.

H. hispida, Bristly-Snail. Shell reddish horn-coloured, more or less depressed; outer lip edged below, with white internally; umbilicus moderately large.

The species *H. depilata* and *H. concinna* may be regarded as varieties of this species. It is an abundant species, on waste places, by hedges, and under stones in all parts of the British Isles.

H. sericea, Silky Snail. Shell depressed, globular, pallid, transparent, closely downy; spire more or less raised; umbilicus decidedly small. It is widely distributed, and appears to be most abundant in the neighbourhood of wet mossy rocks. "It is more frequent in the west and south than elsewhere." (Forbes and Hanley.)

H. fusca, Brown Snail. Shell depressed, subglobular, almost imperforated, not minute, transparent, umber-coloured, wrinkled; outer lip acute.

It appears that this delicate and well-marked species is peculiar to the British Islands. It is found in bushy places in many parts of England and Ireland.

H. pulchella, White Snail. Shell depressed, minute, white; mouth nearly circular, its edge flatly reflected. The animal is milky white. It is very generally found in Great Britain. It lives under stones, in walls, and on the ground often in dampish places. A ribbed variety has been described under the name of *H. costata*.

H. umbilicata, Open Snail. Shell small, dark brown, unpolished, merely wrinkled; whorls five, of slow increase; umbilicus large; mouth small; outer lip acute. The animal is dusky, nearly black. It is the *Zonites umbilicata* of Gray. It is abundant in many localities on the faces of rocks and walls, or under stones in dry places.

H. pygmæa, Pigmy Snail, resembles the last, but smaller, paler, more transparent, more compressed, composed of four turns at most; the mouth less circular. It is found in wet places, among dead leaves in ditches, and by springs. It is often overlooked on account of its minuteness.

For a list of species of *Helix* found in Great Britain see HELICIDÆ.

(Forbes and Hanley, *A History of the British Mollusca;* Dr. Turton, *A Manual of the Land and Fresh-Water Shells*, edited by Dr. J. E. Gray.)

HELLEBORE, BLACK. [HELLEBORUS.]

HELLEBORE, WHITE. [VERATRUM.]

HELLEBORUS, a genus of Plants belonging to the natural order *Ranunculaceæ*. It has 5 permanent sepals, rounded, blunt, large, often herbaceous; petals 8 or 10, very short, tubular, nectariferous, narrowed to the base; stamens 30 to 60; stigmas terminal, orbicular; capsules leathery; seeds arranged in two rows, elliptical, umbilicated.

H. niger, Christmas Rose, is found in the shady woods of the lower mountains of many parts of Europe. The plant is herbaceous, with a perennial blackish-coloured rhizoma, tuberculated and scaly, from which descend numerous thickish radicles. The leaves are all radical, with long cylindrical and spotted foot-stalks, pedately divided, with the lobes from 7 to 9, oblong-lanceolate, sometimes cuneate-obovate, largely serrated towards their apices, and arranged apparently along the forked terminations of the petiole; they are stiff, almost leathery, of a dirty green colour, smooth above, paler and reticulate beneath. The scape is shorter than the petiole, furnished with two or three oval bracts, often simple and single-flowered, sometimes forked and 2-flowered. The flower is large, terminal, white, with a tinge of pink, the most conspicuous part being the petaloid calyx. Of this the sepals are 5, ovate and permanent; the petals, 8 to 10, are small, greenish-coloured, tubular, tapering towards the base, with the limb tubular, bilabiate, and their outer margins terminated in a tongue-shaped lip; stamens numerous, longer than the petals; ovaries 6 to 8; stigmas terminal, orbiculate; capsules follicular, leathery; seeds many, elliptical, umbilicated, arranged in two rows. It is a narcotic acrid poison, and was long supposed to be the genuine Black Hellebore of the ancients. The fibres of the rhizoma are the parts used officinally.

H. orientalis is found in mountainous broken ground in Greece and the Levant. It has a black thick rhizoma, with cylindrical fibres; the radical leaves are stalked pedate, downy beneath, their segments almost sessile, oblong, acutely serrulate; stem taller than the leaves, corymbose, 3-5-flowered; floral leaves subsessile, palmated, the lobes 3 to 5, oblong-acute, serrulate; calyx purple, with oval very blunt sepals; capsules 5. The root was formerly much celebrated in mania, epilepsy, and dropsy. It is still used in the Levant, and is called 'Zoptâne' by the Turks. It is acrid and violently cathartic.

H. viridis is found in the woods and thickets of Europe on a chalky soil. It has a black fleshy rhizoma, with numerous long stout fibres; the leaves are a bright deep green, quite smooth, pedate, the cauline ones subsessile and palmate; the segments oblong, undivided, entire at the base, somewhat serrated at the apex; stems often forked, one foot and a half high; the flowers are few, terminal, and axillary, stalked, mostly solitary, drooping, green in every part; the sepals are roundish-ovate; capsules 3 to 4, short and wrinkled. This is said by Stevenson and Churchill to be the best substitute for *H. orientalis*, though less active.

H. fœtidus is found in thickets and waste ground, chiefly in a chalky soil, in the more western parts of Europe. It has a leafy many-flowered stem; the leaves are stalked pedate, of a livid green colour, quite smooth, with linear oblong or lanceolate serrated segments, the upper ones gradually losing their blade, and changing into pale lanceolate entire bracts; the flowers are numerous, panicled, and drooping; petals nearly erect, stained with dull purple about the edges. It is similar in its effects to *H. niger*. The leaves are emetic and purgative. They have been strongly recommended as a vermifuge against the large round worm (*Ascaris lumbricoides*). The fresh root of Hellebore applied to the skin induces inflammation and vesication, given internally, it acts as an irritant to the intestinal canal, producing vomiting and purging.

(Royle, *Materia Medica*; Lindley, *Flora Medica*.)

HELMINTHIA, a genus of Plants belonging to the natural order *Compositæ*, to the sub-order *Cichoraceæ*, and the section *Scorzonereæ*. It has the phyllaries in one row, equal, with equal subulate adpressed ones at the base, and surrounded by 3-5 leaf-like loose bracts; the receptacle dotted; the fruit compressed, transversely rugose, rounded at the end, and with a slender beak longer than itself; pappus in several rows, feathery. There is but one species inhabiting Great Britain, *H. echioides*, the Ox-Tongue. It is a plant from 2 to 3 feet in height; the branches, stem, leaves, and involucre are covered with strong prickles springing from white tubercles, and with 3 minute hooks at the apex. It is found on dry banks; and blossoms in July, August, and September. (Babington, *Manual of British Botany*.)

HELMINTHOCORTON. [ALGÆ.]

HELODUS. [FISH.]

HELONIAS, a genus of Plants belonging to the natural order *Melanthaceæ*. It has a 6-parted perianth; segments narrow, rather unequal, obtuse, not striated or herbaceous, nor imbricating; stamens 6, inserted into the base of the segments, unequal; filaments subulate; anthers reniform, with confluent cells; capsule separating into 3 many-celled follicles; seeds compressed, winged at the apex, or wingless.

The species of this genus contain veratria. The *H. officinalis* of Don, it is well known, has been employed for obtaining this substance. This plant differs from *Helonias*, and Dr. Lindley has described it under the name of *Asagræa officinalis*. [CEBADILLA.] The other species of *Helonias* used medicinally are as follows:—

H. frigida (*Veratrum frigidum*, Schlectendal). It is found in the alpine region of Mount Orizaba in Mexico. It is a poisonous plant, and called Savoeja by the Mexicans.

H. erythrosperma is a native of the United States in moist situations, on river banks, and high mountains. It is used in the southern states of America for destroying flies.

H. dioica, Unicorn's-Horn and Devil's-Bit of the Americans. It is found in wet meadows and bogs, and in hilly and mountainous regions in the United States. It is bitter, and is used as an anthelmintic and tonic.

(Lindley, *Flora Medica*.)

HELOTIDÆ (Leach), a family of Coleopterous Insects of the section *Heteromera* and sub-section *Stenelytra*. Distinguishing characters:—Head short, obtusely terminated anteriorly; mandibles notched at the apex; antennæ placed near the eyes, generally filiform, or nearly so, or slightly thickened at the apex, where the joints are short; the basal joint of the antennæ hidden above by a projected margin of the head; the third joint long; terminal joint of the maxillary palpi large and securiform; eyes emarginated anteriorly; legs moderate; the penultimate joint of the tarsi generally simple or but slightly emarginated; claws simple; body usually convex, and of an oval form.

The larvæ of these insects live in rotten wood, upon which they feed; they are of a cylindrical form, hard to the touch, and have six small legs, attached, two to each of the thoracic segments. The perfect insects are, like the larva, also found in rotten wood, or under the bark of trees; they are rather slow in their movements, and generally adorned with metallic colours.

In the genus *Helops*, as it is now restricted, the joints of the antennæ are somewhat compressed; the two basal joints are short, the third is long; the two or three terminal joints are short and obconic, the last joint is the shortest; the intermediate joints are moderately long and nearly cylindrical. The thorax approaches to a square form, or is slightly attenuated behind, and is closely applied to the elytra: the body is of an oblong oval form.

H. caraboides, an insect very abundant in various parts of England, will afford an example of this genus. It is rather less than half an inch in length, of an oval form and deep brown colour, having a bronze gloss in certain lights; the upper surface of the body is finely punctured, and so are the striæ of the elytra. This insect is usually found under the bark of trees, near the root.

H. cæruleus is another species of this genus, which is common in many parts of England. This insect is nearly three-quarters of an inch in length, and of a violet-blue colour. It is generally found in old pollard willow-trees. The larva is cylindrical in form, of a yellowish-white colour, and has two recurved hooks on the terminal segment of the body.

Upwards of sixty species of the genus *Helops* are enumerated in catalogues, and these are chiefly confined to Europe and North America.

HELOPS. [HELOPIDÆ.]

HELOSCIA'DIUM, a genus of Plants belonging to the natural order *Umbelliferæ* and to the tribe *Ammineæ*. It has a calyx of 5 teeth or obsolete; the petals ovate, entire, with a straight or incurved apiculus; the fruit ovate or oblong; the carpels with 5 filiform prominent equal ridges; the interstices with single vittæ, the carpophore entire. There are 3 British species of this genus:—

H. nodiflorum, with the leaflets obtusely serrate; *H. repens*, with the leaflets roundish ovate, unequally and acutely inciso-serrate; and *H. inundatum*, with the leaflets of the lower leaves divided into capillary segments. The first is a native of brooks and ditches, and is frequently mistaken for the water-cress. [SIUM.] The second is a rare plant in Great Britain. The last species is found in ponds.

(Babington, *Manual of British Botany*.)

HELVELLACEÆ (Lindley), a natural order of Plants belonging to the *Fungales*, and equivalent to Berkeley's order *Ascomycetes*. The genera included in it are embraced in Fries' cohort *Hymenomycetes*. [FUNGI; HYMENOMYCETES.]

HELVIN, a crystallised Mineral of which the primary form is a cube. Cleavage parallel to the planes of the regular octohedron, indistinct. Fracture uneven. Hardness 6·0 to 6·5; scratches glass. Colour, pale-wax and greenish-yellow. Streak white. Lustre resinous, vitreo-resinous; translucent; transparent on the edges. Specific gravity, 3·166. It is found at Schwarzenburg in Saxony.

Before the blow-pipe or charcoal it melts with effervescence into a globule of the same colour as the mineral; in the oxidising flame the colour becomes deeper and the fusion is more difficult; with borax it yields a transparent glass often coloured by manganese. Analysis by Gmelin:—

Silica	35·272
Glucina	8·026
Alumina and Glucina	1·445
Protoxide of Manganese	29·344
Protoxide of Iron	7·990
Sulphuret of Manganese	14·000
Loss by calcination	1·155
	97·232

HELWINGIACEÆ, *Helwingiads*, an order of Diclinous Exogenous Plants, represented by one species *Helwingia Rusciflora*. This plant is a native of Japan, where its young leaves are eaten. It is a shrub with alternate stipulate leaves, and fascicled flowers. Decaisne, who first constituted the order, regarded it as allied to *Hamamelidaceæ*. But its minute embryo and unisexual flowers remove it far from this order, whilst its inferior fruit and seed bring it near to *Garryaceæ*. It has an indirect affinity also with *Santalaceæ*. (Lindley, *Vegetable Kingdom*.)

HEMATITE. [HÆMATITE.]

HEMERIPUS. [ELATERIDÆ.]

HEMERO'BIUS, a genus of Insects of the order *Neuroptera* and section *Planipennes*. The genus, as established by Linnæus, has been dismembered by subsequent entomologists, and is now equivalent to a family distinguished by the filiform antennæ and by the number (four) of the palpi of the insects included in it. They have soft slender bodies, much exceeded in length by the large reticulated wings, which, when the animal is at rest, are deflexed. Their eyes are globular and vividly metallic. The larvæ are ferocious in habit, and prey upon plant-lice, seizing them with their powerful jaws and sucking their prey to death. When full grown, they spin and envelop themselves in a silken cocoon. The eggs of *Hemerobii* are deposited on plants, and are penduncilated, so as to resemble fungi, for which they have sometimes been mistaken. These insects range from Europe to Australia, and there are many species natives of the British Isles.

HEMEROCALLIS, a genus of Plants belonging to the natural order *Liliaceæ*. It has a campanulate corolla, seated on a cylindrical tube; the stamens are bent down; the capsule is 3-edged; the root is composed of thick fibres; the leaves are scattered, linear; the flowers are large, yellow or yellow-brown. The species are called Day-Lilies. *H. flava* is a native of Germany, and *H. fulva* of Italy. Several species are cultivated in our gardens, as *H. disticha* from China, *H. Sieboldii* from Japan, *H. speciosa*, and *H. graminea*.

HEMICARDIUM. [CONCHACEA.]

HEMICI'DARIS, a genus of Fossil *Echinodermata*, from the Oolite.

HEMICYCLO'STOMA, M. De Blainville's name for the fourth family of his order *Asiphonobranchiata*, the latter being the second order of the first sub-class (*Paracephalophora dioica*) of the class *Paracephalophora*, the second class of his *Malacozoa*. [NERITIDÆ.]

HEMIDACTYLUS. [GECKOTIDÆ.]

HEMIONUS. [EQUIDÆ.]

HEMIPNE'USTES, a genus of Fossil *Echinodermata*, from the Chalk-Marl.

HEMIPODIUS. [TETRAONIDÆ.]

HEMI'PTERA (from ἡμί, half, and πτερόν, a wing), one of the orders of the class *Insecta*.

The order *Hemiptera*, according to the twelfth edition of the 'Systema Naturæ' of Linnæus, contains insects which agree in having incomplete metamorphoses (that is, the larva and pupa both possess the power of locomotion, and bear a great resemblance to the perfect insect), and also in having the superior wings generally coriaceous, and the inferior membranous. Thus Linnæus included in this order the Cockroaches, Locusts, Grasshoppers, Bugs, *Cicadæ*, &c. The last-mentioned insects, the Bugs and *Cicadæ*, however differ very materially from the former, inasmuch as they possess a suctorial instead of a masticatory mouth; and as these latter characters have been considered of great importance by all the more modern entomologists, the term *Hemiptera* has been restricted to such insects as have imperfect metamorphosis and a suctorial mouth.

This definition will include the Linnæan genera *Fulgoria*, *Cicada*, *Notonecta*, *Nepa*, *Cimex*, *Aphis*, *Chermes*, *Coccus*, and *Thrips*, and these, with the addition of the genus *Pulex*, constitute the order to which Fabricius applies the name of *Ryngota*. Without the last-mentioned genus they constitute the order *Hemiptera* according to Latreille, Burmeister, and most of the foreign entomologists; and the orders *Hemiptera* and *Homoptera* according to Leach, Stephens, M'Leay, and several other British authors.

The *Hemiptera* are divided by Latreille into two sections; to the first he applies the name of *Heteroptera*, and to the second that of *Homoptera*. [HOMOPTERA.] The *Heteroptera* are characterised by having the rostrum attached to the fore part of the head; the elytra coriaceous with the extremity membranous, folding one over the other when at rest, and the first segment of the trunk (or the prothorax) the largest, and forming the most conspicuous part of the thorax. The second section, *Homoptera* (which by many of the English entomologists is regarded as an order), is distinguished by the proboscis being attached to the lower portion of the head, near the chest; the elytra almost always of a uniform coriaceous texture, with their inner margin straight and contiguous: the three segments of the thorax are united in a mass, and the first is frequently shorter than the second. All the insects of this section feed exclusively on vegetable juices. [HOMOPTERA.] We shall at present confine our remarks to the first section, or to the true Hemipterous insects.

In the greater number of the Heteropterous *Hemiptera* the head is small, situated on the same plain as the thorax, or nearly so; the fore part is somewhat produced; the eyes are of moderate size, very convex, and hence project rather suddenly from the sides of the head: between the eyes there are in many species two ocelli, or simple eyes; the antennæ are of moderate size, composed of long joints, few in number, and situated in front of the eyes: the part usually termed the thorax in descriptions, but which is in fact the prothorax, is of moderate size, often broader than long, and very frequently produced on each side, so as to form an angular projection; the scutellum is large, generally triangular; but in some (the *Scutelleræ*, for instance), it assumes the form of the body, and is so large that it completely covers that part; the body itself is often flat or concave above; convex and more or less distinctly keeled beneath: when the wings are closed the upper part of these insects generally presents a flat or slightly convex surface, and is seldom very convex. The legs are of moderate size, or not unfrequently long. In certain groups (the *Coreidæ*) the posterior thighs of the males of many of the species are remarkably large, and many have the tibiæ also large, often broad and compressed.

The proboscis springs from the fore part of the head, and when not in use is suddenly curved downwards and backwards, and lies close to the under surface of the thorax and between the fore pair of legs. It consists of a jointed process (*a*), which is grooved upon the upper side, and in this groove there are four setæ (*b*), or bristle-like organs, which are covered above, at their base, by another appendage (*c*), which is supposed to be analogous to the upper lip or labrum of mandibulate insects; whilst the four setæ probably represent the mandibles and maxillæ, and the jointed process the labrum. In the figure, the setæ (*b*) are represented as disengaged from their sheath (*a*), and the labrum is lifted up. When in the ordinary position these organs form together a tube, by means of which the juices of plants or animals are extracted and conveyed to the œsophagus.

The *Heteroptera* are divided by Latreille into two families; the first, or the *Geocorisæ*, are characterised as having the antennæ free, longer than the head, and inserted between the eyes and near their anterior margin. The tarsi are 3-jointed, but the first joint is sometimes very short. The second family, to which the name of *Hydrocorisæ* is applied, have the antennæ inclosed and hidden in a groove beneath the eye; the tarsi have but two distinct joints, and the eyes are generally very large.

The species of the family *Geocorisæ* are for the most part found on the leaves of trees or small plants; some there are which do not quit the ground, and there are others which live upon the surface of the water. The genera *Hydrometra*, *Gerris*, and *Velia* afford examples of this mode of life. [HYDROMETRIDÆ.]

The insects belonging to the second family (*Hydrocorisæ*) live, as their name implies, in the water, and they prey upon other insects.

The two families which have just been characterised are by most entomologists regarded as sections or subsections rather than families; the latter is in fact an aberrant group, the former containing by far the greater portion of the species. Regarding them therefore as sections, they may be divided into the following families:—

Geocorisæ.

Family 1. *Scutelleridæ*. Family 5. *Cimicidæ*.
2. *Pentatomidæ*. 6. *Reduviidæ*.
3. *Coreidæ*. 7. *Hydrometridæ*.
4. *Acanthiidæ*.

Hydrocorisæ.

Family 1. *Nepidæ*. Family 2. *Notonectidæ*.

HEMIRAMPHUS. [ESOX.]

HEMITRAGUS. [CAPREÆ.]

HEMI'TRYPA, a genus of Fossil *Polypiaria*, in the Limestone of Devonshire, allied to *Fenestella*. (Phillips.)

HEMLOCK. [CONIUM.]

HEMLOCK, WATER. [CICUTA.]

HEMP. [CANNABIS.]

HEMP-AGRIMONY. [EUPATORIUM.]

HEMP-NETTLE. [GALEOPSIS.]

HENBANE. [HYOSCYAMUS.]

HENBIT. [LAMIUM.]

HENIOCHUS. [CHÆTODON.]

HENNA. [LAWSONIA.]

HENSLOVIA'CEÆ, a very small natural order of Exogens. Of this order there is but one genus, *Henslovia*, and three or four species. They are all natives of the hot and damp parts of the East Indies. They are all trees, with opposite entire exstipulate leaves, and minute racemose apetalous flowers, with as many anthers sessile in the sinus of the calyx as there are lobes of that organ; a 2-celled many-seeded ovary, and a single style.

Henslovia pubescens.
1, a flower magnified; 2, a vertical section of the ovary.

In his 'Vegetable Kingdom' Dr. Lindley says of this order:— "After vain attempts at settling the true place of the genus *Henslovia* in the natural system, some specimens with ripe fruit, for which I am indebted to Mr. Griffith, place the question nearly at rest. The habit of the plant was evidently that of *Viburnum*; but its superior ovary and indefinite ovules forbade any reference to Caprifoils. But Hydrangeads differ from that order mainly in their indefinite seeds, small quantity of albumen, and constant tendency to produce a superior ovary. *Henslovia* agrees with them still further; the flowers are polygamous, the seeds are winged, which is also the case in *Hydrangea cordifolia* and others, and the albumen is wholly deficient. The chief distinction consists in the complete adhesion of the styles into one undivided cylinder; but in Hydrangeads we have the same pecularity in *Schismphragma* and *Brousssisia*. On that account however *Hensloria* may be regarded as a relation of *Brexia*, but its decidedly opposite leaves are unfavourable to the union of the two in the same order."

HEPATICÆ, that portion of the old family of *Musci*, or Mosses, known commonly as Liver-Worts, have received this name. In his alliance, *Muscales*, Dr. Lindley refers the orders *Ricciaceæ*, *Equisetaceæ*, *Jungermanniaceæ*, and *Marchantiaceæ* to the division *Hepaticæ*. [ACROGENS; RICCIACEÆ; JUNGERMANNIACEÆ; MARCHANTIACEÆ; MUSCI.]

HEPATITE. [BARYTES.]

HEPATUS, Latreille's name for a genus of Brachyurous Crustaceans, placed by M. Milne-Edwards under the tribe of Calappians, and, in the opinion of the latter, establishing the passage between the Cancerians, which they approach in their general form; the *Calappæ*, which they resemble in the disposition of their chelæ (manus); and the Leucosians, from which they differ but little with reference to the method of the organisation of the mouth. The carapace is large, convex, regularly arched anteriorly, strongly narrowed posteriorly; the hepatic regions are very large, and the branchial regions very small. The front is narrow, straight, rather projecting, and placed a good deal above the level of the lateral border of the carapace, which prolongs itself under the orbits to reach the sides of the buccal frame. The orbits are small, circular, and placed on the same level with the front. The internal antennæ are somewhat apart, and are bent back very obliquely under the front. The external antennæ occupy the internal angle of the orbits, which they separate from the antennary pits; their basilary joint is narrow, but rather long; the second is, on the contrary, small, and their terminal stem is nearly rudimentary. The buccal frame, which is very narrow forwards, and nearly regularly triangular, prolongs itself beyond the level of the lower border of the orbits, and is entirely occupied by the external jaw-feet, the third joint of which is triangular and terminated internally by a straight edge, under which are concealed the remaining joints. The sternal plastron is oval, and presents nothing remarkable. The anterior feet are strong without being large, and are capable of a close and exact application against the lower surface of the body, where they are entirely concealed: the hand is surmounted by a crest, and the claws are rather inclined downwards and inwards. The remaining feet are of moderate length, and the abdomen is divided into seven joints in both sexes.

The only species known, *Hepatus fasciatus* (*Calappa angustata* of Fabricius; *Cancer princeps* of Herbst; and *Calappa angustata* of Bosc), and *H. Chiliensis*, are inhabitants of the coasts of America: the first having been found in the north and at the Antilles; the second on the coast of Valparaiso. (Milne-Edwards.)

Hepatus fasciatus.

HEPIALIDÆ, a family of Lepidopterous Insects of the section *Lepidoptera Nocturna* of Latreille. The Moths belonging to this family are distinguished by the want of tongue, the wings being deflexed, long and narrow, and the thorax devoid of crest. Their larvæ live in the interior of vegetables, on which they feed, or in some instances they live in the ground, and feed upon the roots of plants; they are fleshy, naked, and have six thoracic, eight abdominal, and two anal feet. The pupæ have the segments of the body denticulated.

The principal genera contained in this family are *Hepialus*, *Cossus*, *Stygia*, and *Zeuzera*.

In the genus *Hepialus* (Fabricius) the antennæ are much shorter than the thorax, the wings are long and narrow, the posterior pair nearly equal to the anterior. The larvæ live in the ground and upon the roots of plants.

Hepialus Humuli, an insect commonly known by the name of Ghost-Moth, will afford an example of this genus. This moth measures from 1½ to 2 inches in width when the wings are expanded, and a large female is sometimes 3 inches in width. The male is of an immaculate silvery-white colour above, and brown beneath. When on the wing, which is usually in the evening about twilight, it is seen with tolerable distinctness if below the eye, on account of its white colour; but upon a slight change in its position, when the darker colour of the underside of the wings is opposed to the eye, it suddenly disappears; hence probably arises the name which has been applied to it.

Mr. Stephens, in his 'British Entomology,' however accounts for the name in another manner; he says it is "very common in grassy places in the middle of June, and not unfrequently met with in churchyards, whence its name of Ghost-Moth." The female Ghost-Moth is very dissimilar in colour to the male; indeed such is the case in all this species of *Hepialus*. The anterior wings are of a buff yellow colour above, with spots of a deeper hue; the under wings are palish-brown, having a faint pink-tint.

Five or six other species of this genus inhabit this country.

(Stephens, *Illustrations of British Entomology*.)

HERACLE'UM, a genus of Plants belonging to the natural order *Umbelliferæ* and the tribe *Peucedaneæ*. The calyx consists of 5 minute teeth, the petals abcordate with an inflexed point, the outer ones radiant. There are thirty-four species noticed, but only one of these is found in Great Britain, and few are applied to any useful purpose.

H. Sphondylium, Cow-Parsnip, or Hog-Weed, has ternate pinnate leaves, the leaflets lobed or pinnatifid, cut, and serrated. The stem is about 4 feet high, the lower leaves very large, and the flowers white or reddish. It is a native of Europe, and probably of Siberia, and is found plentifully in the meadows and hedges of Great Britain. The whole plant affords wholesome and nourishing food for cattle, and is collected in Sussex for fattening hogs; hence it is sometimes called Hog-Weed. Cows and rabbits are also fond of it, and horses will sometimes eat it, but it does not appear to be so agreeable to them. The Kamtschatkadales and Russians are in the habit of using the shoots and leaf-stalks as food, after the rind, which is bitter, has been taken off. They collect large bundles of the plants, and during the process of drying the stalks become covered with a saccharine efflorescence, which is esteemed a great delicacy. The Russians distil an ardent spirit from the stalks thus prepared, by first fermenting them in water with bilberries. The seeds of the plant are diuretic and stomachic, and exhale a powerful odour.

H. pubescens has ternate leaves, somewhat pubescent beneath; the leaflets toothed and pinnatifid; the umbels of many rays; involucre from 1 to 2 leaves; the fruit elliptic having the disc rather villous. It is a native of Taurida in shady places, and of the Caucasus in alpine places. The young shoots are filled with a sweet aromatic juice, which is eaten by the natives of the Caucasus in a crude state.

H. Pyrenaicum has large leaves, tomentose beneath; the leaflets lanceolate, toothed, or ternate; the involucre of few leaves; the young fruit covered with long hairs; the matured ones glabrous and nearly orbicular. It is a native of the Eastern and Central Pyrenees, and of Italy. D. Don thinks that this plant is identical with the *H. gummiferum* of Willdenow, which was supposed to yield the Gum Ammoniacum of commerce. Don has however identified the plant which yields this gum, and has placed it in a new genus. [DOREMA.]

All the species of *Heracleum* grow well in any soil, and are easily propagated by seeds or by dividing the root.

(Don, *Dichlamydeous Plants*; Burnett, *Outlines of Botany*; Babington, *Manual of British Botany*.)

HERBARIUM, the name given to specimens of Plants when they have been collected and dried. The possession of an herbarium is almost essential to the study of systematic Botany, as it is impossible to cultivate at once the larger proportion of the species of plants which inhabit the earth's surface. The use also of an herbarium will be found constantly to supply the place of recent plants. Hence all persons who study botany possess themselves of an herbarium more or less extensive according to the range and nature of their studies. The following hints for forming an herbarium are chiefly derived from Professor Balfour's valuable 'Class-Book of Botany:'—

The specimens to be dried and kept in the herbarium should, if possible, be gathered in fine weather, and free from external moisture. In selecting them care should be taken to have the plants in a perfect state of growth, with all the parts from which the characters of the order, genus, or species are taken. The entire plant, where practicable, should be preserved. Of course this is impossible with trees, but the completer the specimens the better for study. In trees, portions of the branches, with the leaves, flowers, and fruit should be taken, and, where possible, sections or small portions of the stem, roots, &c. In the case of tall and slender grasses and sedges, they may be folded once or twice backwards and forwards, to make room for them on a single sheet. Thick branches, roots, stems, &c. may be split to allow of pressure. In plants with diœcious flowers, both the staminiferous and pistilliferous flowers should be obtained. Some plants, as species of the genus *Rubus* and *Salix*, demand that both flowering and leafing shoots should be gathered. In glueing the plants on to the paper, care must be taken to expose both sides, so that all parts of the structure may be seen. Careful dissections of plants may be dried and fastened on to paper, and these will facilitate subsequent examiuation very much. All bad, doubtfnl, injured, or imperfect specimeus should be rejected.

In collecting plants a trowel will be found useful, and when gathered they should be placed in a tin box or vasculum till they are transferred to paper. Some plants require drying or pressure immediately. Under these circumstances, Dr. Balfour recommends a field-book, consistiug of some bibulous paper strapped between two pieces of board, iuto which the plants needing drying may be thrust at once.

The paper employed may he ordinary blotting-paper, but the paper-makers have made a paper for botanical use which may be more advantageously employed. Iu London, Bentall's drying-paper is used; there is also another paper used iu Scotland, called the 'Edinburgh botanical drying-paper.' It is made in sheets 18 inches long and 11 inches broad. This paper is included between boards. These should be exactly the size of the drying-paper. Several sets of boards of varying thicknesses should be employed, and pressure may be applied by means of a weight or straps. The letter is the most easy process whilst travelling. Iu order that the plants may dry freely, various suggestions have been made for makiug holes iu the boards or forming them of a kind of framework, by which the air would pass through.

In putting down the plants the following plan should be pursued:—"A parcel of not less than four sheets of paper is put on one of the outside boards, then one or more specimens are laid on this sheet according to their size. The specimens should be spread out carefully, their natural habit being preserved as far as possible. When plants require to be folded, the slips of paper already mentioned are passed over the bent portions so as to retain them in their position. Having placed one specimen or set of specimens on the sheet, another parcel of not less than four sheets is laid over them; and in doiug this the leaves and other parts are arranged with the haud or the forceps. The same process is repeated until a dozen or more such parcels have heen arranged one over the other. Then a thin hoard is iuserted, and other parcels of paper and specimens are arranged above it, until they are exhausted, or until the hundle is of sufficieut size. Another such board is then laid on the top, and the whole is subjected to pressure. The paper is changed after twelve hours' pressure, the plants being lifted by means of the forceps and placed in dry parcels of paper, while that which is moist is hung up to dry. The intervals between the changing of the paper may be increased or diminished according to circumstances." Very succulent and wet plants require frequent changing and much drying. Most specimens will dry in eight or ten days. Succulent plants need to bo killed first by immersion in boiling water. Aquatic plants and wet plants should be placed in a napkin and pressed before they are put into the paper. The moist paper will dry in ten or twelve hours. Along with the plant a lahel should he inserted, with all particulars known about the specimen, as where gathered, what elevation, &c.

When the specimens are thoroughly dry a selection is made for the herharium. These should be fastened by means of thin fine glue on thick wide paper, 17 inches long and 10½ inches hroad. The name of the plant, its locality, or any other particulars, may be then written on the paper. In order to preserve the specimens from the attacks of insects, &c., they should he touched with a strong solution of corrosive sublimate in camphorated spirit, or in a solution of naphtha (half a drachm to the ounce). The sheets may then be arranged in a case, according to their genera or natural orders.

Fruits, specimens of wood and bark, large roots, lichens and algæ on rocks and stones, may be arranged iu drawers, glazed cases, or glass jars. Succulent fruits and roots are hest preserved in a strong solution of salt and water, or in pyroligneous acid, diluted with 3-5 parts of water, or iu alcohol. In some instances a solution of 4 ounces of bay salt, 2 ounces of burnt alum, and 5 grains of corrosive sublimate, in 2 quarts of boiling water, has been used with advantage. These jars are best covered with a stout piece of caoutchouc tied round the neck.

For the preparation of specimens for the microscope, see MICROSCOPE in ARTS AND SC. DIV.]

HERB-PARIS. [PARIS.]

HERCINITE. [SPINEL.]

HERDERITE, a Mineral, which occurs in crystals embedded in fluor at Ehrenfriedersdorf in Saxony. Primary form a right rhombic prism. Cleavage parallel to the lateral planes, and in the long diagonal of the prism. Fracture small, conchoidal. Hardness 5. Colour grayish and yellowish-white. Streak white. Lustre vitreo-resinous; nearly transparent. Specific gravity, 2·985.

HERI'ADES, a genus of Hymenopterous Insects of tho section *Mellifera* (Latreille) and family *Apidæ*. Distinguishiug characters:—Body elongated, slender, almost cylindrical, that of the males with a small cavity beneath near the apex; mandibles triangular; maxillary palpi 2-jointed.

The little bees belonging to this genus, we are informed by Latreille, make their nests in holes in old trees; we presume that, as in the genus *Chelostoma*, the holes are made by the bees themselves.

H. campanularum, a species very common in various parts of England, is about a quarter of an inch in length, of a black colour, and sparingly covered with grayish hairs. This little bee is by far the smallest British species known of the family to which it belongs; it is common during the summer and autumnal months in the flowers of the various species of *Campanulæ*, and apparently is uever found in the flowers of any other genus of plants. "The males are often taken asleep in these flowers; their abdomen is then doubled, so that the tubercle with which its base is armed fits iuto the cavity near the anus."

(Kirby, *Monographia Apum Angliæ;* Latreille, *Genera Crustaceorum et Insectorum.*)

HERMÆA. [NUDIBRANCHIATA.]

HERMAPHRODITE. [MONSTER.]

HERMASIA, a genus of Plants belonging to the natural order *Paronychiaceæ*. It has 5 sepals; 5 filiform petals iuserted with the 5 stamens on a perigynous ring; 2 stigmas nearly sessile; fruit 1-seeded, indehisceut, membranaceous; leaves opposite. The species are insignificant plants. Three have beeu recorded as natives of Great Britain. One, *H. hirsuta*, is a doubtful native; the other two are very rare.

H. glabra has a prostrate herbaceous stem, with clusters of sessile flowers coalescing on the lateral hranches into a slightly leafy spike. It has been found in Suffolk and Liucolnshire iu Englaud, and iu West Kerry, Ireland.

H. ciliata. The sepals are tipped with a large bristle; the clusters of flowers are distinct, sessile, and axillary. It has been found at Lizard Point, Cornwall.

HERMINIUM, a genus of Plants helonging to the natural order *Orchidaceæ* and the tribe *Ophrydineæ*. The periauth is bell-shaped, segments all erect; lip 3-lobed, tumid beneath at the hase, without a spur; glands of the stalks of the polleu-masses exserted, naked. *H. monorchis*, the Musk-Orchis, is a British species. The stem is about six inches high, and the spike of flowers is dense and slender; the sepals are ovate and greenish. (Babington, *Manual.*)

HERMIT-CRAB, the common English name for the well-known crustaceans that occupy the empty turbinated shells of testaceous mollusks. [PAGURUS.]

HERNANDIA. [HERNANDIACEÆ.]

HERNANDIA'CEÆ, a natural order of iucomplete Exogeuous Plants. It has monœcious or hermaphrodite flowers, with an involucellum in the pistilliferous and hermaphrodite flowers; a petaloid calyx, tubular, 4-8-parted, deciduous; definite stamens inserted into the calyx iu two rows, of which the outer is often sterile, with the anthers bursting longitudinally; the ovary superior, 6-celled, with a pendulous ovule and peltate stigma; a drupaceous fruit with one seed, which is pendulous; the embryo is iuverted, without albumeu; the cotyledons somewhat lobed, shrivelled, and oily. Tho species are trees with alternate entire leaves, and flowers arranged iu axillary or terminal spikes or corymbs.

This order has heen constituted hy Blume. It contains ouly two genera, *Hernandia* and *Inocarpus*. These were sometimes referred to *Myristicaceæ*, from which they differ in the absence of albumen from their seeds. Their longitudinal authers distinguish them from the *Lauraceæ*, in which order they have also been placed. Their affinity is undoubtedly with *Thymeleaceæ*, from which they differ only in their drupaceous fruit, lohed cotyledons, and the iuvolucel to some of the flowers.

Hernandia, the typical genus of this order, was named after Hernandez, a naturalist sent out to Mexico by Philip II. of Spain; and it is said to havo been given to these plants, which have large leaves and little flowers, in allusion to the great opportunities afforded to this naturalist and the little use he made of them. The characters of this genus are the same as the order.

H. sonora is a tall erect tree, with cordate peltate leaves, yellowish panicled flowers, a large iuflated succulent calyx, with a small roundish entire mouth. It is a native of tho various parts of the East aud West Indies, and has obtained its naue 'sonora' from the noise made by tho wind in whistling through its persisteut iuvolucels. The bark, the seed, and the young leaves of this treo are slightly cathartic. Rumphius says that the fibrous roots chewed and applied to wounds infected with the Macassar poisou, act as an effectual cure. The juice of the leaves is employed as a depilatory. It destroys the hair wherever it is applied, and this without producing paiu. The wood of this species is very light, and Aublet says that the wood of *H. Guianensis* takes fire readily from a flint and steel, and may he used as tinder. Several species of *Hernandia* are mildly purgative.

(Lindley, *Natural System;* Lindley, *Flora Medica;* Burnett, *Outlines of Botany.*)

HERNSHAW, or HERONSHAW, a name for the Common Heron. [ARDEA.]

HERON. [ARDEA.]

HERON'S-BILL. [ERODIUM.]

HERPESTES (Illiger), a genus of Digitigrade Carnivorous *Mammalia* allied to the Civets. It is the *Ichneumon* of Lacépède, Geoffroy, and others; the *Mangusta* of Olivier and others; and the Mangouste of the French.

It has the following characters:—Feet short, with 5 demi-palmated toes, armed with claws which are slightly retractile; tongue furnished with horny papillæ; ears small; a voluminous simple pouch, which does not contain odoriferous matter, and at the bottom of which the vent is pierced. Body very much elongated; tail long, strong at its base. Hairs of the fur annulated. Dental formula:—

$$\text{Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{6-6}{6-6} = 40.$$

The following cut (F. Cuvier) exhibits the dentition generally of the Civets, Ichneumons, Gennets, and *Paradoxuri*; for, though there are particular differences, they are not sufficient in the opinion of F. Cuvier to demand separate illustrations of the dental system of those groups. [VIVERRIDÆ.]

Teeth of Ichneumon (*Herpestes*).

Mr. Bennett has noticed some peculiarities in the dentary system of these animals. In *H. fasciatus* and *H. Gambianus* he found the following arrangement:—

$$\text{Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{5-5}{5-5} = 36.$$

The incisors were small, simple, and regular; the canines of moderate size; the first two false molars of the normal form; the third carnassier of rather small size, compared with its analogue in genera more decidedly carnivorous; and the last two, in both jaws, tuberculous. The rudimentary false molar mentioned by F. Cuvier was, Mr. Bennett observes, wanting in both these species; nor could its absence be owing to the age of the specimens examined as he remarks, for he tells us that some were evidently young animals, though arrived at adult age. Its entire absence was further confirmed by the situation of the teeth respectively in the reciprocal position of the jaws, the first inferior false molar filling up the entire vacant space between the corresponding superior tooth and the canine of the same jaw. "This system," writes Mr. Bennett, "differs considerably from that ascribed to *Herpestes* by F. Cuvier ('Dents des Mammifères,' i. 99), but agrees in all respects with the description of M. Desmarest. The following however is equally foreign to the accounts of both these authors, and, were not all the other characters so perfectly accordant with those of *Herpestes*, would decidedly indicate a new genus. Indeed it so stands in my notes under the name of *Mungos*, but with a note of interrogation, as I have only been able to examine a single specimen.

"*Mungos* (?) *vitticollis* (*H. vitticollis*, Bennett). Dental formula:—

$$\text{"Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{6-6}{7-7} = 42$$

"The incisors and canines have nothing remarkable either in form or number. The first false molar in either jaw is tuberculous; the second and third consist of one large conical fang in the centre, and a smaller tubercle on each side of it; then follows the carnassier, and after it two tuberculous teeth in the upper and three in the lower jaw. The first of these in the upper jaw is large and triangular; the second short and broad, its latitudinal dimensions more than doubling its longitudinal; the three of the lower jaw are small, simple, rather distant from each other, and of cylindrical form. This is a system of dentition which as far as I am aware is altogether peculiar, and if confirmed by the examination of other specimens will undoubtedly form the type of a new genus. Perhaps further and more rigid examination may even detect different species from the different localities, as specimens have arrived for the Society from Travancore and Bombay, and one from Madras, at the British Museum."

The species of the genus *Herpestes* are found in Asia and Africa.

Arrangement and Natural History.—Linnæus, in his last edition of the 'Systema Naturæ,' gives one species of Ichneumon under the name of *Viverra Ichneumon*, his genus *Viverra* being placed between the Cats (*Felis*), and Weasels (*Mustela*). It stands as the first species of the genus, and three varieties are noticed, one of them with a query whether it may not be a distinct species. The first of these varieties is evidently the celebrated Egyptian Ichneumon (*Ichneumon Pharaonis* of Geoffroy, *Herpestes Pharaonis* of Desmarest and others).

Gmelin gives three species, namely—*Viverra Ichneumon* (the Egyptian), *V. Mungo*, and, apparently, *V. cafra*.

Pennant places it among the 'Weesels.'

Cuvier gives the form (Les Mangoustes) a position between *Paradoxurus* and *Ryzæna* (the Suricates).

Dr. Gray arranges the Ichneumons (*Herpestes*, Illiger) under the *Felidæ*, in his fourth sub-family *Viverrina*, between *Genetta* (Cuvier) and *Crossarchus* (F. Cuvier).

Dr. Fischer places the form, under the name of *Mangusta*, between *Mephitis* and *Crossarchus*: he enumerates nine species.

M. Lesson, in his 'Manuel,' arranges it, under the name of *Ichneumon*, between *Genetta* and *Crossarchus*.

Mr. Swainson's '*Viverinæ*,' Musk-Weasels (*Viverrinæ*), form the first sub-family of his family *Mustelidæ*. *Herpestes*, which is placed between *Cynictis* and *Viverra* (Linnæus), is the second genus of that sub-family.

H. Ichneumon, the Ichneumon (*Ichneumon Pharaonis*, *Viverra Ichneumon*, *a*, of Linnæus). The fur a mixture of chestnut-brown and yellow, each hair being annulated with those two colours; the feet and muzzle black or deep chestnut; the tail terminated by a tuft of long hairs.

This appears to have been one of the sacred animals of the ancient Egyptians; and we read in Herodotus (ii. 67) that the *Ichneutæ* (ἰχνευταί), which the best critics consider to be synonymous with Ichneumons, were, as well as dogs, buried "in holy repositories." There is no good reason to doubt that it is the Ichneumon (Ἰχνεύμων) of Aristotle ('Hist. Anim.,' ix. 6; vi. 20, 35), Diodorus Siculus, Strabo, Ælian, and others; and as little that it is the *Ichneumon* of Pliny. Aristotle (ix. 6) relates, that when the Ichneumon sees the serpent called the Asp or Aspic (Ἀσπίς), he does not attack it till he has called to his assistance other ichneumons, and in order to defend themselves from the venomous bites of the snake, they cover themselves with mud by rolling on the earth after having dipped themselves in the water.

Pliny ('Hist. Nat.,' viii. 24), gives a somewhat similar account. Diodorus and Strabo relate a much more marvellous feat; nor is Pliny slow to lend his aid in spreading the wonderful tale, how, when the crocodile is lulled asleep with open jaws, the Ichneumon darts like a weapon down his throat and gnaws his entrails ("erodit alvum"). ('Hist. Nat.,' viii. 25.) It may be thought hardly worth while to refute such a fable; but it was long entertained as credible, and it may not be amiss to turn to Sonnini's observations on this point, more especially as they contain some interesting remarks on the habits of the animal. "Much," says Sonnini, who speaks of the Ichneumon as one of those animals which the Egyptians have domesticated, "has been written concerning it, and much of this writing has been fabulous. It was one of the animals held sacred in ancient Egypt. Honours were rendered to it on its death; it was maintained with the greatest solicitude during life; funds were set apart for its support; they served up to it, as to cats, bread steeped in milk, or fish of the Nile cut down into morsels; and it was generally forbidden to kill any of the race. Object of the worship of a celebrated people, the pretended protector of the most singular country in the world against a scourge the most grievous to an agricultural nation, a stranger and unknown in our climates—what a field for the production of the marvellous! Accordingly it has not been spared. The greater part of travellers have seen the Mangouste without examining it; and with their minds prejudiced by the stories which the ancients and the moderns have spread respecting it, they have successively copied their relations." Sonnini then, after a compliment to Buffon, and a statement that he had had it in his power to observe the Mangouste in its native country and in its state of liberty, proceeds as follows:—"With very great dispositions to familiarity, the Mangoustes are not altogether domestic in Egypt. Not only do they now rear none in their habitations, but the inhabitants have not even the recollection that their ancestors reared any. Most probably then those which Belon and Prosper Alpin assert that they had seen domesticated were merely a few individuals preserved rather as objects of curiosity than for any useful purpose; for if they hunt away rats and mice, they likewise seize upon the poultry; and this appetite would more than overbalance the good which they could do in purging the houses of noxious animals, which cats would destroy more certainly and with less inconvenience. Having some resemblance in their habits to weasels and polecats, they feed upon rats, birds, and reptiles. They ramble about the habitations of men; they even steal into them, in order to surprise the poultry and devour their eggs. It is this natural fondness for eggs which prompts them frequently to scratch up the sand with the intention of discovering those which the crocodiles deposit there, and it is in this manner that they prevent, in reality, the excessive propagation of these detestable animals. But it is absolutely impossible to abstain from laughing, and not without reason, when we read of their leaping into the extended mouths of the crocodiles, of their sliding down into their belly, and not returning till they have eaten through their entrails.* If some Mangoustes have been seen springing with fury on little crocodiles presented to them,† it was the effect of their appetite for every species of reptiles, and not at all that of a particular hatred, or of a law of nature, in virtue of which they would have been specially commissioned to check the multiplication of those amphibious animals, as many people have imagined.‡ It had been equally reasonable to say that nature placed Mangoustes on earth merely to prevent the too great propagation of chickens, to which they are far more hostile in reality than to crocodiles. And what proves more clearly that men have been mistaken in ascribing such intentions to nature respecting Mangoustes is this—in more than half of the northern part of Egypt, that is to say, in that part comprised between the Mediterranean Sea and the city of Siout, they are very common, although there are no crocodiles there; whilst they are more rare in Upper Egypt, where the crocodiles are, in their turn, more numerous. The Mangoustes are nowhere more multiplied than in Lower Egypt, which, better cultivated, more inhabited, more humid, and more shaded, presents also more abundantly the means of supplying them with prey and with food, and, I again repeat it, crocodiles never appear there."

Egyptian Ichneumon (*Ichneumon Pharaonis*).

That Belon saw this Ichneumon in Egypt there can be no doubt. That accurate observer, in the 'Portraits,' gives a figure of it superscribed "Portrait de l'Ichneumon, que les Egyptiens nomment Rat de Pharaon." Beneath is the following 'quatrain:'—

> "Voy le portrait du Rat de Pharaon,
> Qui chasse aux Rats, comme fait la Belette:
> Au demeurant fort cauteleuse beste,
> Qui autrement est nommée Ichneumon."

Hasselquist mentions the *Viverra Ichneumon*, the Ichneumon of the Nile, as met with in Upper and Lower Egypt, living, during the inundation of the Nile, in gardens and near the villages, but, in the dry season, as dwelling in the fields and near the banks of the river. He says that it creeps slowly along, as if ready to seize its prey, and that it feeds on plants, eggs, and fowls, killing the latter in the night, when it frequents the villages. He states that in Upper Egypt it searches for the eggs of the crocodile, which lie hid in the sand on the shore, and eats them, preventing by that means the increase of that dangerous animal. "The Ichneumon," he continues, "may easily be tamed, and frequently goes about the houses like a cat. Mr. Barton, who has been the English consul nineteen years in Egypt, has kept a tame one for several years. It makes a growling noise, and barks when it is very angry. The Arabians call it Nems. The French in Egypt, who give everything they don't know names of their own making, have called this Rat de Pharaon, which Alpin and Belon have followed, and called it *Mus Pharaonis* (the Mouse of Pharaoh). The resemblance it has to a mouse (*Mus terrestris*) in regard to the colour and hair might have induced ignorant people who know nothing of natural history, to call it a mouse; but I cannot conceive why they should call it 'Pharaoh's Mouse.' The Egyptians were too intelligent in the time of Pharaoh to call it a mouse, having knowledge enough to give true descriptions and significant names to all natural bodies; nor is it at this day called Phar by the Arabs, which is the name for mouse, but they call it Nems. What is related concerning its entering the jaws of the crocodile is fabulous." Hasselquist travelled during the years 1749-50-51-52: Sonnini's travels commenced in 1777, and terminated in 1780. In the Arabic used in the neighbourhood of Tangier, whence two specimens were sent by Mr. Drummond Hay to the Zoological Society of London, *Herpestes Pharaonis* is called Serro.

* Sonnini's notes. See almost all the ancient authors, and, among the moderns, Maillet, Jauna, and others.

† Maillet, 'Descr. de l'Egypte.'

‡ Maillet, &c.

Mr. Bennett, in his account of a specimen of *Herpestes griseus* kept in the Tower, says that on one occasion it killed no fewer than a dozen full-grown rats, which were let loose to it in a room sixteen feet square, in less than a minute and a half.

The story of the *Ichneumon Mungo*, or *Mungos* (*Viverra Mungo* of Gmelin), having recourse to the plant Hampsddu Tanah, or Mungo-root, as an antidote when bitten by serpents in its encounters with them, will be found in the 'Amœnitates Exoticæ' of Kæmpfer, who says (p. 574) that he had one of these animals which slept with him, and followed him about like a dog through the city and fields.

H. badius, the Ratlamuchi, is a native of South Africa. Dr. A. Smith, in the work above quoted, says that *H. badius* appeared restricted to sandy districts abounding in brushwood, and in these was occasionally seen running from one copse to another. He states that it is extremely shy, and flies with great rapidity on the approach of man to its hiding-places. Nothing except the remains of insects were found in the stomachs of those which were procured by the expedition; but Dr. Smith adds, that, if the natives are to be believed, *H. badius* feeds with avidity also upon lizards, snakes, mice, &c. Lucan and Rumphius both notice the skill of the Ichneumon in seizing serpents by the throat so as to avoid injury. Lucan, who names it *Pharias*, describes its attack on the Egyptian asp elegantly and at length (iv. 724).

Dr. J. E. Gray states that there are two very distinct varieties of this species. The one described by Dr. Smith is of a red bay, the hairs being of a uniform colour except a few just over the shoulder-nape, which have a black subapical ring. The other has most of the hairs of the back and sides with long white tips edged below with a black band, giving the back a grizzled appearance.

The following species are given in the 'British Museum Catalogue:'—

H. Widdringtonii, the Andalusian Ichneumon. South of Europe; Sierra Morena.

H. Caffer, Cape Ichneumon. South of Africa.

H. Mutgigella, the Mutgigella. Abyssinia.

H. Smithii, Dr. Smith's Ichneumon. Cape of Good Hope.

H. apiculatus, Brown-Tipped Ichneumon. Cape of Good Hope.

H. Javanicus, the Garangan. Java.

H. griseus, the Moongus. India; Nepaul.

H. Nyula, the Nyula. India; Nepaul.

H. paludosus, Brown Ichneumon. Cape of Good Hope.

H. brachyurus, Malacca Ichneumon. Malacca.

H. punctulatus, Spotted Ichneumon. South Africa; Natal.

This last species has been recently described by Dr. J. E. Gray, who says it most nearly approaches *H. Mutgigella.*

HERPETOLOGY (from Ἑρπετὸν and λογὸς), the branch of science which treats of the structure, habits, and classification of Reptiles. [REPTILE; ALLIGATOR; CROCODILUS; AMPHIBIA; OPHIDIA; CHELONIA; ICHTHYOSAURUS; PLESIOSAURUS; PTERODACTYL; SAURIA; BOIDÆ.]

HERRERITE, a Mineral occuring in reniform masses. Cleavage in three directions, affording rhomboidal fragments with curved faces. Colour pistachio- emerald- and grass-green; streak yellowish-gray. Hardness 4·0 to 4·5; brittle. Lustre vitreous to pearly, and shining on fresh surfaces; translucent. Specific gravity 4·3. It is found at Albarradon in Mexico. The following is an analysis by Herrera:—

Carbonic Acid	31·86	
Peroxide of Nickel	12·32	
Tellurium	55·58	
		99·76

This mineral is probably a mixture rather than a definite compound.

HERRING. [CLUPEIDÆ.]

HERSCHELLITE, a Mineral which occurs in attached hexagonal crystals, associated with *Phillipsite*, in the cavities of trap, and also in granular *Olivine*. Primary form a rhomboid; cleavage not ascertained. Fracture conchoidal. Hardness 4 to 4·5. Specific gravity 2·11. Translucent or opaque; colour white. Found at Aci Reale in Sicily. [CHABAZITE.]

HE'SIONE, the name of a genus of Dorsibranchiate *Annelida*, with a short but rather stout body, composed of a few ill-defined rings. A very long cirrhus, which probably executes the function of branchiæ, occupies the upper part of each foot, which has also another lower one and a packet of fine bristles. The proboscis of *Hesione* is large, and without either jaws or tentacles.

HESPERIDIUM, one of those fruits which, in common botanical language, is confounded with the word *Bacca* [BACCA], but which indicates a different structure. It has a tough separable rind, the seeds hardly lose their attachment when ripe, and the cells readily separate through the dissepiments. Of this nature is the fruit of the orange, which is the type of the *Hesperidium.* [FRUIT.]

HESPERI'IDÆ (Stephens), a family of Lepidopterous Insects of the section *Lepidoptera diurna* of Latreille. They have the following characters:—Antennæ terminated by a distinct club, generally with a minute hook at its extremity; tibiæ with two pairs of spurs, one at the apex, and the other near the middle; claws very small, bifid; body thick; wings small, the posterior pair with a groove to receive the abdomen. The larvæ are pubescent, or naked, and have a large head; pupa smooth, inclosed in a web.

These little butterflies have a large head, and a thicker body and smaller wings than the more typical species; they are moreover at once distinguished from them by their possessing two pairs of spurs, or spines, to the legs; their flight is short and in frequent jerks; hence they have received the name of Skippers.

H. sylvanus is about one inch and a quarter in width; the wings are of a rich brownish-yellow above, with the outer margins deep-brown; the anterior wings are spotted towards the apex with yellow, and have an oblong black dash near the base; the posterior wings have some indistinct spots.

This butterfly, which is very common in various parts of England, and is chiefly found on the borders of woods, will afford an example of the tribe of which we are treating.

There are several other species of the family *Hesperiidæ* found in this country, of which the *Thymele alveolus* may be noticed. This is a little black butterfly with numerous silver-like spots, and is known by the English entomologists by the name of the Grizzled Skipper.

HESPERIS (from 'Hesperus,' the evening), a genus of Plants belonging to the natural order *Cruciferæ*, and the tribe *Sisymbreæ*. The flowers emit a sweet fragrance during the night, and hence the genus derives its name. The pods are quadrangular, or sub-compressed, the valves keeled and somewhat swerved, the seeds in a single row. There are only three species enumerated, and none of these are made use of by man but as ornamental and sweet-scented plants.

H. matronalis, Dame's Violet, is the only British species; it has an erect branched stem, ovate lanceolate leaves, and large handsome lilac fragrant flowers. The ladies of Germany have pots of this plant placed in their apartments; hence it has been called Dame's Violet. Parkinson calls it Queen's Gilliflower; and Gerard, Damask Violet.

All the species thrive best in a light rich soil, and require the same treatment as most other tardy garden-plants.

(Don, *Dichlamydeous Plants*; Babington, *Manual*.)

HETEROBRANCHIA'TA, M. De Blainville's name for the fourth order of his *Acephalophora*.

The 1st Family (Ascidians) is divided into two tribes: 1, Simple Ascidians, of which *Bipapillaria* and *Fodia* are examples. [BIPAPILLARIA; FODIA.] 2, Aggregated Ascidians, an example of which is *Botryllus*. [TUNICATA; BOTRYLLIDÆ.]

The 2nd Family consists of the Salpaceans, and is also divided into two tribes: 1, the Simple (*Biphora*, &c.); 2, the Aggregate (*Pyrosoma*). [SALPA.]

HETERO'CERCAL, the term chosen by M. Agassiz to express a peculiar form of the tails of fishes, which affords a very obvious, and, as far as yet appears, a very correct indication of the geological age of formations. Among existing fishes the tail is either simple, as in the eel, bifurcate, as in the salmon, expanded to a round figure, as in the wrasse, or unequally bilobate, as in the shark. It is to this latter irregular form of tail that the term Heterocercal is applied: the others, by way of distinction, are called Homocercal.

Eel.

Salmon.

Wrasse.

Shark.

The peculiarity of the Heterocercal Fishes is that the vertebral column runs along the upper caudal lobe: in the other forms of tail it is symmetrically placed with respect to the posterior finny expansion. M. Agassiz has found this peculiarity of the tail, which is least common among living fishes, and confined to particular groups, to belong to every species of fishes, of whatever group, and however differing in other respects, which occur in strata older than the Oolitic system, while in and above that system Homocercal forms appear. It is therefore a characteristic of geological time; and among the conjectures as to the relations of this form to physical conditions of the surface, or laws of the animal economy, we prefer the opinion that it is one among several marks of the sauroid character of the fishes which lived in early geological periods. Some of the fishes of the Oolitic Rocks exhibit a slight inequality of the lobes of the tail, and some difference in the arrangement of the scales thereon, but without (we believe) the characteristic continuation of the vertebral column into the upper lobe. These may be thought to mark the gradual transition from the Heterocercal to the ordinary types of structure. *Lepidosteus*, with sharks, and other cartilaginous fishes of the existing creation, which were ranked by Linnæus, as 'Amphibia Nantes,' thus appear the few surviving representatives of organic forms which, in earlier periods of the history of the globe, were exclusively predominant.

(Agassiz, *Recherches sur les Poissons Fossiles*.)

HETERO'CERUS, a genus of Pentamerous Coleopterous Insects established by Bosc. Latreille places it in his second section of his family *Clavicornes*, and forms of it a tribe under the name of *Acanthopoda*, on account of the flattened broad limbs armed with spines. These beetles have small oval depressed bodies, and eleven-jointed antennæ, the last six articulations forming a cylindrical club. They live in sand or mud, by streams or among marshes, burrowing in the ground by means of their spinous tibiæ. When disturbed or alarmed they come out of their holes. The larvæ live in the same situations with the perfect insects. Several species are found in Britain.

HETEROCLIN. [MANGANESE.]

HE'TERODON, M. De Blainville's name for a genus of Dolphins. The term *Heterodon* had been applied by M. De Beauvois to a genus of serpents placed by Cuvier under his great genus *Coluber*. [CETACEÆ.]

HETEROGANGLIA'TA. The *Heterogangliata* of Professor Owen comprise all the *Mollusca* of Cuvier, with the exception of the *Cirripedia*.

HETEROGYNA. [HYMENOPTERA.]

HETERO'MERA, the second section of Coleopterous Insects in the arrangement of Latreille, including such as have five articulations in the first four tarsi, and four in the two posterior. They are all vegetable feeders. Latreille divided the *Heteromera* into four groups:

1st, the *Melasoma*, dusky or black insects, for the most part apterous and having hard elytra, which are often anchylosed. Their jaws are furnished with a hook, their claws are simple, and their eyes are oblong and depressed, a character which indicates nocturnal habits. They live in sand, or under stones, and often in cellars and vaults. They are very tenacious of life, living many months after being transfixed by a pin and placed in the cabinet. Doubtless this is owing to the quantity of fat in their bodies, which much exceeds that found in allied insects, and enables them to subsist for a long period without food. They are found in all parts of the world. The genera *Pimelia*, *Blaps*, and *Tenebrio* are types of as many tribes among the *Melasoma*. The Darkling Beetle, *Blaps mortisaga* [BLAPS], and the Meal-Worm, *Tenebrio molitor*, are familiar British examples.

2nd, the *Taxicornes*, insects without hooked jaws, with more or less square bodies, hard elytra, wings, short antennæ, and feet adapted for running, furnished with simple claws. They live under the bark of trees, or in the fungi parisitical on their trunks. A few live on the ground under stones. The genera *Diaperis* and *Coryphus* are types of tribes in this division.

3rd, the *Stenelytra*, which differ from the preceding in the structure of the antennæ, those organs being perfoliate or clavate in the *Taxicornes*, but simple among the insects of the present section. In other respects they are similar. The genera *Hylops*, *Cistella*, *Dircæa*, *Œdemera*, and *Myctera*, are types of tribes. They mostly inhabit wood. The *Œdemeræ* are found on flowers: they fly well.

4th, the *Trachelides*, beetles having triangular or heart-shaped heads, remarkable for being pedunculated. The neck is not retractile. Their bodies are soft, and furnished with wings, protected by flexible elytra. The jaws are not furnished with hooks, and the claws are bifid. *Lagria*, *Pyrochora*, *Mordella*, *Anthecus*, *Horia*, and *Meloe* are types of tribes in this division. In the tribe of *Cantharidea*, of which *Meloe* is the type, are found the Blistering Beetles, which were probably the insects known to the ancients under the name of *Buprestis*, and regarded as poison to cattle and even to man. [CANTHARIDÆ.]

HETEROMYS, a genus of Animals belonging to the order *Rodentia*. The genus is described as having the cheek-pouches of the Hamsters, the general form of the body and tail of the Rats properly so called, and the dorsal flattened spines of *Echimys*, Geoff. (*Loncheres*, Illiger). The dental system is unknown; feet with six callosities below, and five toes, the internal toe very small. (Lesson.) *H. Thompsonii*, Lesson (*Cricetus anomalus*, Desm.; *Mus anomalus*, Thompson; *Dasynotus anomalus*), the Spiny-Pouched Rat. It has the habits and is of the size of a rat. It is a native of the island of Trinidad. (See *Linn. Trans.*, vol. xi. p. 161, t. 10.)

HETEROPODA (Lamarck), the fifth order of the Gasteropodous *Mollusca* according to Cuvier's arrangement. They are distinguished from all other *Mollusca* by their foot, which, instead of forming a horizontal disc, is compressed into a vertical muscular lamina, which they use as a fin; and on the edge of which, in several species, is a sucker in the form of a hollow cone that represents the disc of the other orders. It embraces the genera *Carinaria*, *Atlanta*, and *Firola*. [ATLANTA; CARINARIA.]

HETERO'PORA, a genus of *Polypiaria*, proposed by De Blainville to include species of the genus *Ceriopora* of Goldfuss, which have unequal cellules. From the Chalk of Maestricht. (*Manuel d'Actinologie*.)

HETEROPTERA. [HEMIPTERA.]

HETEROPUS. [MACROPODIDÆ.]

HETEROSITE. [MANGANESE.]

HEUCHE'RA, a genus of Plants named in honour of John Henry de Heucher, professor of botany at Wittemberg, and the author of the 'Hortus Wittenbergensis.' This genus belongs to the natural order *Saxifragaceæ*, and consists of about sixteen species. It has a permanent 5-cleft calyx with an imbricated æstivation; undivided somewhat unequal petals; 5 stamens; 2 styles, very long, distinct, the length of the stamens, eventually diverging; the capsule crowned by the withered flower, at the lower part united to the calyx, 1-celled, dehiscing between the styles. The species are herbs with leafless stems, radical leaves, and racemose or panicled flowers.

H. Americana, Alum-Root, has rough scapes and leaves, and the whole plant pubescent; the leaves on long petioles, somewhat 5-7-lobed, toothed; the inflorescence elongated, panicled; the lobes of the calyx short, obtuse; the petals lanceolate, the length of the calyx; the stamens much exserted. This plant is a native of North America, where it has obtained, on account of its astringent properties, the name of Alum-Root. It contains tannin, and it is to this principle that its astringent character is to be ascribed. The other species contain tannin, but are not used for any purpose in the arts or medicine.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica.*)

HEULANDITE, a Mineral occurring crystallised and massive. Primary form an oblique rhombic prism. Cleavage parallel to the oblique diagonal of the prism, very distinct. Fracture uneven, slightly conchoidal. Hardness 3·5 to 4. Brittle. Colour white, brown, gray, yellow, and red. Translucent, transparent. Lustre vitreous, pearly on the cleavage planes. Streak white. Specific gravity 2·2. The massive varieties are granular. It is found in Scotland, Ireland, Iceland, and the Faroe Islands, usually lining cavities in trap rocks.

Before the blow-pipe it fuses with ebullition and phosphorescence into a white opaque globule. It does not gelatinise in acids.

The following are analyses by Thomson and Rammelsberg:—

	Thomson.	Rammelsberg.
Silica	59·145	58·2
Alumina	17·920	17·6
Lime	7·652	7·2
Water	15·400	16·0
	100·117	99·0

Lincolnite is a form of this mineral.

HIANS, Lacépède's name for the Grallatorial Bird called the Open-Beak or Open-Bill, *Anastomus* of Illiger.

HIATELLA. [PYLORIDIA.]

HIBBERTIA. [DILLENIACEÆ.]

HIBISCUS, so named from one of the Greek names (ἱβίσκος) of the Mallow, a genus of Plants belonging to the natural order *Malvaceæ*.

The species, upwards of 100 in number, of this genus, are chiefly herbaceous, though of a large size, but a few are perennial and arboreous. They abound in the hot parts of Asia and America, and also in Africa and the tropical islands; a few extend into Europe, North America, and to the Cape of Good Hope. *H. Trionum*, which occurs in Europe, is also found in Cashmere.

The genus is characterised by having an exterior many-leaved calyx; carpels united into a five-celled capsule; valves with the partitions in their middle; cells many-seeded, or very rarely containing only a single seed. The species are remarkable, like the family to which they belong, for abounding in mucilage, and for the tenacity of the fibre of their bark, whence several are employed for many economical purposes in the different countries where they are indigenous. The abundance of mucilage in some of the species renders them useful as articles of diet, as the unripe fruit of *H. esculentus*, the Okro or Gombo of the West Indies, which is employed both for thickening soup and as a vegetable; so in India *H. longifolius*, there called Ram Turai, is similarly employed, and much approved of by many Europeans, but objected to by others on account of its clamminess. The calyxes of *H. Sabdariffa* as they ripen become of a red colour and are pleasantly acid, whence in the West Indies the plant is called Red Sorrel. The calyxes are employed there, as well as in India, for making tarts; and a decoction of them, sweetened and fermented, is described in Browne's 'Jamaica' as a cool and refreshing drink, much used in many of the sugar islands. *H. Syriacus* and *H. Rosa Sinensis* are known as ornamental plants; the flowers of the latter are employed for blackening the eyebrows, as well as leather, both in India and China.

The species of *Hibiscus* are chiefly useful for the tenacity of their fibre, and hence several are employed in rope-making. Thus *H. cannabinus* is cultivated everywhere in India in the rainy season for this purpose, and its fibre is often imported into Europe as a substitute for hemp. It is known by the name Sun in Northern India, Ambaree in Western India, and Mesta Pat in Bengal. In the island of Otaheite rope and string are manufactured from the bark of *H. tiliaceus*, which is also made into matting of a white colour, and of different degrees of fineness. Forster states that the bark is also sucked as an article of diet, when the bread-fruit fails there: it is also so employed in New Caledonia. Indeed the mucilage which all these plants contain will no doubt afford some nourishment. In the West Indies, the whips with which the slaves were lashed were made from the fibres of *H. arboreus* (Mohoe or Mohaul). The bark of so many species of this genus being used for its tenacity, it is impossible to enumerate all. Dr. Roxburg particularly recommends the cultivation in India of *H. strictus*, in consequence of its long, fine, and strong fibres, of a beautiful glossy white appearance, and as likely to be an advantageous substitute for such as are already cultivated for this purpose.

Hibiscus Abelmoschus, so called from Hab-al-Mooshk, the Arabic name of its musk-scented seeds, is now often named *Abelmoschus moschatus*, and formed into a new genus. Its seeds are said to be added to coffee in Arabia, and are in India employed as a cordial medicine. The plant abounds in mucilage, and is employed in the process of clarifying.

HIBO'LITHUS, one of De Montfort's subdivisions of *Belemnites*.

HIBOU. [STRIGIDÆ.]

HICKORY. [CARYA.]

HIERA'CIUM, a genus of Plants belonging to the natural order *Compositæ*. The heads are many-flowered, the involucre imbricated with many oblong scales. Fruit terete, angular, and furrowed, with a very short crenulated margin. There are nineteen British species of this genus, but none of them are valuable on account of the properties they possess.

H. Pilosella has a leafless single-headed stem; elliptic-lanceolate or lanceolate leaves, hairy above, glabrous beneath. The flowers are of a pale lemon colour with a red stripe on the back. It is found on dry banks and elevated places.

H. alpinum has lanceolate leaves narrowed into a foot-stalk, entire or toothed; the involucre is covered with long silky hairs, and the florets externally hairy and of a bright yellow colour. It is found on rocks in Great Britain.

(Babington, *Manual of British Botany.*)

HIERAX. [FALCONIDÆ.]

HIERO'CHLOE, a genus of Grasses belonging to the *Phalarideæ*. It has two glumes, nearly equal, membranous, 3-nerved, about as long as the flowers; 3 flowers, the lower with 3 stamens, the upper palea with 2 keels, the upper flowers with both stamens and pistils; the stamens 2, the upper palea with 1 keel. One species of this genus, the *H. borealis*, has been found in Great Britain: it has an erect panicle, glabrous pedicels, and flowers without awns. The stem is about a foot high. It has only been found in Scotland. (Babington, *Manual of British Botany.*)

HIERO-FALCO, Cuvier's generic name for the Gyrfalcons. [FALCONIDÆ.]

HIGHTEA, a genus of Fossil Plants from the Isle of Sheppey. (Bowerbank.)

HIMANTHALIA. [FUCACEÆ.]

HIMA'NTOPUS, the generic name for the Long-Legged Plover, Longshanks, or Stilt. [SCOLOPACIDÆ.] The term is also applied by Müller to a genus of *Microzoaria*.

HINNITES. M. Defrance gave this name to a few fossil species of *Conchifera Monomyaria*, which occur in supracretaceous strata; one (*H. Dubuissonii*, of Sowerby) is found in the English Crag.

HIPPA. [HIPPIDES.]

HIPPA'LIMUS, a genus of *Zoophyta* proposed by Lamouroux. Goldfuss supposes that it may be included in his genus *Scyphia*. It is fungiform and pediculated, with pores on the upper surface only, and a deep central pit. From the blue marls of the department of Calvados.

HIPPELAPHUS. [CERVIDÆ.]

HIPPIDES (Latreille), *Hippa Tribe*, Hippians of Milne-Edwards, a family of *Crustacea*. Milne-Edwards thus describes these Crustaceans belonging to his family of *Pterygura*. The tribe is composed of a small number of anomurous crustaceans which appear to be especially framed for burrowing in the sand, and which present extraordinary forms. The carapace is longer than it is wide, and very convex transversely, presenting always on each side a great lamellar prolongation, which more or less covers the base of the feet; it is truncated posteriorly, and appears to be continuous with the anterior portion of the abdomen, which is very wide and lamellar laterally. One of the pair of antennæ is always very long. The external jaw-feet do not present a conformation like that which is observable in the greater part of the crustaceans treated of in the prior part of Milne-Edward's system; they have neither flagrum (fouet) nor palp, and their last three joints are very well developed. The sternum is linear, and the feet are imperfectly extensile; those of the first pair are monodactylous, or subcheliform, and those of the two or three succeeding pairs are terminated by a lamellar joint proper for burrowing. The posterior feet are filiform, semimembranous, recurved forwards, and hidden between the lateral parts of the carapace and the base of the preceding feet. The penultimate ring of the abdomen is always furnished with a pair of false feet, terminated by two more or less oval ciliated blades or laminæ; but these appendages have a forward curvature, and are not applied against the seventh segment so as to form with it a fan-shaped caudal-fin, as in the *Macrura*. The vulvæ are on the first joint of the third pair of feet. The branchiæ are disposed on a single line and inserted by a peduncle which rises near the lower third of their internal surface.

This tribe is divided into three genera, which Milne-Edwards distributes as follows:—

			Genera.
Tribe of Hippians.	External antennæ large, short, and terminated by a multi-articulate rudimentary filament.	Anterior feet subcheliform.	*Remipes.*
		Anterior feet cylindrical, monodactylous, and not at all subcheliform.	*Albunea.*
	External antennæ very large, and terminated by a stout and very long filament.		*Hippa.*

Albunea (Fabricius).—Most analogous of any of the tribe to the *Ranina*, as well by their general form as by the disposition of their feet. Their carapace, which is straight from before backwards, and convex transversely, is only a little prolonged above the base of the feet; it is terminated anteriorly by a nearly straight border, which occupies its whole width; it is of an oval shape, posteriorly and strongly notched for the insertion of the abdomen. A small mesial point represents the rostrum. The ocular peduncles are large and lamellar, whilst the eyes, situated on their external border, are extremely small. The internal antennæ are very large, and they are terminated by a single multi-articulate filament longer than the body, slightly flattened and ciliated on its edges. The external antennæ, inserted nearly on the same line as the internal, are large, short, and terminated by a small stem composed only of from seven to eight small joints. The external jaw-feet are more or less pediform; their second and third joints are almost cylindrical, and the terminal portion formed by the three last joints is sometimes as long, and almost as large, as the basilary portion. The feet are short; the first pair are terminated by a large hand rather subcheliform than cheliform, the moveable finger applying itself to its anterior border, the lower angle of which scarcely projects, and consequently does not really constitute an immoveable finger. The three following pairs are nearly of the same form, and terminate in a falciform joint. The posterior feet are almost filiform. The fist ring of the abdomen is small, and received in a notch of the carapace; the second is, on the contrary, very large, and presents on each side a considerable lamellar prolongation, which rides a little on the carapace. The third and fourth abdominal segments diminish progressively, but are nearly of the same form as the second; while the fifth, sixth, and seventh are very narrow, and present no lateral prolongation; the sixth supports a pair of false natatory feet, terminated by two oval laminæ; and the seventh has the form of a nearly circular lamina. (Milne-Edwards.)

Albunea Symnista may be taken as an example. The length of the carapace is 10 lines. It inhabits the seas of Asia.

Albunea Symnista.

Remipes (Latreille).—Carapace nearly regularly oval, convex, and less than once and a quarter as long as it is wide; front rather large and truncated; orbits semicircular, and their external angle much more projecting than the front. The ophthalmic ring is covered above by the front, but is not surrounded by the carapace; the ocular peduncles are composed of two moveable portions, one basilary, which is stout and short, the other terminal, cylindrical, slender, carrying at its extremity a very small imperfectly retractile cornea; the eyes, in fact, can scarcely be turned backwards, as in the greater part of the Decapods, but advance and recede a little by the motion of the basilary portion of their peduncle. The internal antennæ are inserted below the base of the ocular peduncles, and are very large; their basilary portion is composed of three joints nearly of the same size, and their terminal portion consists of two long filaments which are multi-articulate, stout, and directed forwards. The external antennæ are inserted within the internal, nearly on the same line, and under the latero-anterior edge of the carapace; they are short but very large; their first joint is much wider than it is long; the second and the third are nearly of the same dimensions, and the succeeding joints diminish rapidly in volume. The buccal frame is not closed anteriorly. The external jaw-feet are wide and short; their first joint is nearly globular, and carries neither palps nor flagrum; the second joint, which is so large in the *Brachyura*, is rudimentary here; and it is the third, which, becoming very large and nearly oval, constitutes solely the species of operculum formed ordinarily by the second and third joints united; the three last joints form a sort of large claw, which applies itself against the anterior border of the third joint. The jaw-feet of the second pair are equally destitute of the flagrum, but have a flabelliform palp; it is the same with the anterior jaw-feet; their palp is lamellar, dilated anteriorly and disposed nearly as in the *Oxystomes*. The jaws of the second pair present nothing remarkable; those of the first pair are very small. The mandible, which is strongly dentilated, is furnished with a palp composed of two small lamellar joints, separated from the body of the mandible by a large membranous furrow; the sternum is linear. The anterior feet are long; their second and third joints are enlarged; but the last three are cylindrical; and the last, which is nearly as long as the preceding one, is slightly flattened, pointed, and incapable of being bent back upon it. The two following pairs are large, and terminated by a large hastiform lamina; the fourth pair are held by a small nearly conical joint. The fifth pair are slender, long, and membranous, and are bent back upon the lateral prolongation of the carapace. The last thoracic ring, which supports these appendages, is complete above, moveable, and not covered by the carapace, so that it might be easily taken for the first abdominal segment. The abdomen is very large, and presents on each side a lamellar oval prolongation which rides upon the carapace; its anterior border is notched for the lodgement of the second abdominal ring, which is oval; the third and fourth segments diminish progressively in volume; the fifth and sixth are equally small, but are soldered together; and the seventh has the form of a great triangular lamina, the length of which exceeds that of all the rest of the abdomen. The first three rings in the female are furnished with simple oviferous filaments; the fourth and fifth rings are without appendages, while the sixth ring carries a very large pair of false natatory feet, terminated by two raised oval plates which are ordinarily bent forwards. (Milne-Edwards.)

Remipes testudinarius may be given as an example. The length of the carapace is about 15 lines. It inhabits the coasts of Australia.

Remipes testudinarius.

Hippa (Fabricius).—When Fabricius established the genus it was much more extensive in its limits, and at present it only contains those Hippians whose external antennæ are terminated by a long and stout multi-articulate filament. Body oval, or rather ellipsoid, being rather less wide forward than backward. Carapace truncated posteriorly, very convex transversally, and presenting towards the middle a transversal curved furrow, which indicates the posterior tenuity of the stomachal region; its latero-anterior border is concave, but its latero-posterior border is very convex. The rostrum is small and triangular, and on each side of its base is a notch which exposes the insertion of the ocular peduncles and the internal antennæ, and which is bounded externally by a projecting tooth which advances above the internal edge of the great antennæ. The ophthalmic ring, which is covered in its mesial part by the rostrum, is of a horse-shoe shape, and its two extremities are exposed; the ocular peduncles, inserted at its extremity, are composed of three pieces, and of these the two basilar, which are very short, are bent under the carapace in the form of V, and the last, which is slender, cylindrical, and very long, advances between the internal and external antennæ, and terminates by a small pyriform enlargement which carries the cornea. The internal antennæ are of moderate size, and their basilary joint, which is cylindrical and a little curved downwards, is hardly larger than the succeeding one, which is furnished on the external side with a strong tooth directed forwards; the third joint is short, and gives insertion to two multi-articulate stemlets (tigelles). The external antennæ are very large, but easily escape observation, for they are ordinarily bent backwards and hidden almost entirely between the mouth and the external jaw-feet. The first joint of their peduncle is small and but little apparent; the second is large and armed anteriorly with two spiniform teeth, the external of which is much the strongest; the two succeeding joints are small, and form by their union a globular mass, whence springs a last peduncular joint, which is cylindrical, and supports in its turn the multi-articulate terminal filament, which last is very large, nearly of the length of the carapace, and fringed externally with a double row of long hairs. The external jaw-feet are of considerable size and operculiform, but their first two joints are very small, and it is the third only which presents that disposition; the last three joints form a long, delicate, and lamellar appendage, which is inserted in a notch of the external angle of the preceding joint, and is bent back under its internal edge, but does not constitute a claw as in *Remipes*. The palp of the two pairs of succeeding jaw-feet is terminated by a lamellar enlargement. The feet are short, and hidden under the carapace; the first pair are stout and applied against the mouth, terminating with a ciliated nearly oval lamina. The tarsus of the two succeeding pairs of feet is lamellar and hastiform, and that of the fourth pair is stout, conical, and very short. The posterior feet, which are long, membranous, and very slender, are bent back between the lateral part of the carapace and the base of the preceding feet. The last thoracic ring is not free and exposed as in *Remipes;* but the first joint of the abdomen is nearly of the same form, and the succeeding rings present also the disposition already noticed in these crustaceans. (Milne-Edwards.)

Hippa Emerita is the best example. The length of this species is from 1 inch to 15 lines. It inhabits the coasts of Brazil.

Hippa Emerita.

HIPPOBOSCA. [HIPPOBOSCIDÆ.]

HIPPOBOSCIDÆ, a family of Dipterous Insects belonging to the section *Pupipara* or order *Homaloptera*, containing the Forest-Flies, which exhibit such remarkable variations in their typical structure that they have been regarded by some authors as forming a distinct order. The head is received into a cavity in front of the thorax; it is divided transversely into two parts, the anterior or smaller of which supports the mouth and two small tubercles, almost imbedded at the lateral angles, being rudimental antennæ. The mouth is composed of two curved setæ, inclosed in a tubular canal, covered by two narrow elongated coriaceous plates, regarded by Latreille as palpi. The ocelli are wanting. The body is short, flat, and very coriaceous; the wings are either large or entirely wanting; the nervures of the anterior margin are very strong, but they are effaced behind. In the winged species a pair of balancers are also present. The legs are very strong, and terminated by robust curved claws, which are toothed beneath. The abdomen is composed of a continuous leathery-like membrane, capable of very great distension, which peculiarity is owing to the remarkable circumstance that the young of these insects are singly nourished within the body of the parent, where they not only acquire their full size, but actually assume the pupa state, under which form, like very large eggs, they are deposited by the female. This egg-like cocoon is at first soft and white, nearly as large as the abdomen of the parent fly; but by degrees it hardens, becomes brown, of a rounded form, and often notched at one end, which is covered by a shining kind of cap, which is detached on the insect's assuming the perfect state. This cocoon is moreover entirely destitute of annular incisions, in which respect it differs from those of other Dipterous Insects. It is composed of the uncast skin of the larva, beneath which the insect becomes a real inactive pupa, with the limbs of the perfect insect laid along the breast, as in other species which undergo the strict coarctate species of transformation. M. Réaumur was the first to discover these curious particulars; and he was so anxious to observe the development of the insect from these singular eggs, that he carried them in his pocket by day and took them to bed with him at night, in order that they might have a uniform degree of warmth; great was his surprise therefore when, instead of grubs as he expected, perfect flies were produced.

These insects are interesting in their habits. They live exclusively upon quadrupeds and birds; the horse is especially subject to the attacks of one of these species, hence called *Hippobosca equina*. This species is the type of the genus *Hippobosca*, in which the eyes are large and distinct, being placed at the sides of the head; the antennæ are in the shape of turbercles with three dorsal setæ; the wings are large. Mr. Curtis observes that these flies move swiftly, and like a crab, sideways or backwards; they are very tenacious of life, and live principally on horses, attaching themselves to the belly between the hind thighs and under the tail, where they are less protected by hair. It is remarked by Latreille that the ass fears them most, and that horses suffer very little from them. In the New Forest they abound in a most astonishing degree. Mr. Samouelle says, "From the flanks of one horse I have obtained six handsful, which consisted of upwards of a hundred specimens. They abound most on white and light-coloured horses."

The other genera are:— *Ornithomyia*, *Craterina*, *Oxypterum*, *Hæmobora*, *Melophagus*, *Feronia*, *Lipotepna*, and probably *Braula*. Of these the first three are British, and are found upon various birds, the *Craterina hirundinis* depositing its egg like a cocoon in the nest of the swallow, where it receives all the necessary warmth; for which it repays the poor swallow by sucking its blood. The wings in this genus are very long and narrow. The genus *Melophagus* comprises a single species, *M. ovinus*, which is destitute of wings, and attacks the sheep. It is of a dark reddish colour, with the abdomen whitish. It is commonly called the Sheep-Louse, and is so tenacious of life that Ray states that it will exist in a fleece twelve months after it is shorn, its excrements even giving a tinge to the wool, which is very difficult to be discharged.

HIPPOBRO'MA (from ἵππος, a horse, and βρῶμα, food), a genus of Plants belonging to the natural order *Lobeliaceæ*. It has the limb of the calyx 5-parted with linear segments; the tube of the corolla long, straight, entire, with the limb 5-parted, nearly equal; the stamen-tube projecting, completely monadelphous and syngenesious; the stigma sloped, the capsule 2-celled, 2-valved, many-seeded.

H. longiflora is the only species. It is an herbaceous plant, with short axillary pedicels, mucronate or coarsely toothed leaves, with long slender white flowers. It is a native of Jamaica, St. Domingo, Cuba, and Martinique, in damp places and by the side of streams. This is one of the most poisonous of plants. If the juice only accidentally touches the lips or eyes it produces a burning inflammation. Horses are violently purged after eating it.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica.*)

HIPPOCAMPUS. [SYNGNATHIDÆ.]

HIPPOCEPHALOI'DES. By this name Plott and other writers understood the inner casts of certain equivalved *Conchifera*, especially *Trigonia*.

HIPPOCRA'TEA, a genus of Plants belonging to the natural order *Hippocrateaceæ*, so named after Hippocrates, and which might therefore be expected to contain many useful or medicinal plants. But it is not so. The species consist of moderate-sized trees, which are found in the hot parts of the world, as in the tropical parts of America, in Sierra Leone, the warmer parts of India, and the Island of Timor. The genus is characterised by having the calyx 5-leaved, but very small; petals 5, usually hooded at the apex; stamens 3, anthers 1-celled, opening transversely at the apex; carpels 3, samaroid, bivalved, valves keeled and compressed; seeds winged from the funiculus being widely expanded. The fruit of some of the plants of the family is eatable; but the seeds of one species only of *Hippocratea* are mentioned as being of any use; those of *H. comosa*, being oily and sweet.

HIPPOCRATEA'CEÆ, a small natural order of Exogenous Plants remarkable for the presence of three monadelphous stamens in a pentapetalous flower. The fruit consists of from one to three cells, and is frequently extended at the back in a membranous manner, so as to resemble the samara, or key of the ash-tree. The species are woody, and often climbers; they inhabit Africa, the Mauritius, and the tropical parts of America; in general they are of no importance for economical or medical purposes. The fruit of *Tonsella pyriformis* is eaten in Sierra Leone. The nuts of *Hippocratea comosa* are oily and sweet. They are called in the French West India Islands Amandier du Bois. In Brazil other species have eatable fruits. The order has 6 genera and 86 species. They are related to *Chailletiaceæ*, *Celastraceæ*, *Malpighiaceæ*, and *Aceraceæ*.

HIPPOCRE'PIS (from ἵππος, a horse, and κρηπίς, a shoe, on account of the curved shape of its pods), a genus of Plants belonging to the natural order *Leguminosæ*, the tribe *Hedysareæ*. It has diadelphous stamens, an acute style; the legume curved, with numerous 1-seeded joints; the seeds cylindrical or compressed, oblong, curved, fixed to the middle part of the joint, and therefore the umbilicus is in the middle of the curve. The species are herbs, or under-shrubs, with unequally pinnate leaves and yellow flowers, which are sometimes solitary and axillary, sometimes sessile, but usually disposed in umbels on the tops of the axillary peduncles.

Hippocratea.
1, a flower expanded; 2, a section of the same, showing the ovary.

H. Balearica, Minorca Horse-Shoe Vetch, is a shrubby erect plant, with the peduncles longer than the leaves, bearing an umbel of flowers at the apex, the legumes glabrous, a little arched. It is a native of the Island of Minorca. It is a pretty plant, worthy of cultivation, but requires the greenhouse in winter. It grows well in a soil composed of loam and peat; and cuttings strike readily under a hand-glass.

H. comosa, Common Horse-Shoe Vetch, has the pods umbellate, their joints rough, curved, neither dilated nor bordered, glabrous; the peduncles longer than the leaves. It is a native of Europe, and is found on dry chalky banks in Great Britain. It is also found in the north of Africa.

There are seven or eight more species of Horse-Shoe Vetch. They are all worth cultivation on account of their beauty. The perennial species are adapted for rockwork and banks, and may be propagated by dividing the roots. The annual species should be grown from seeds, which may be sown early in spring.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*.)

HIPPOGLOSSUS, a genus of Fishes belonging to the family *Pleuronectidæ*. The two eyes are on the right side. The jaws and pharynx are armed with sharp and strong teeth; the body elongated. The species are known by their being stouter and longer than those of the genus *Platessa* and other *Pleuronectidæ*.

H. vulgaris, the Holibut, Halibut, or Fletan, is the only British species. It is a very frequent fish in the northern fisheries, and is common on the coasts of Norway, Iceland, and Greenland. They are obtained in large quantities by the inhabitants of the Orkneys. In the Northern seas they are sometimes caught weighing 500 lbs. They are found around the coasts of Ireland, and are often seen in the London markets. The form of the body is elongated, the surface smooth, covered with small oval-shaped soft scales; the lateral line arched over the pectoral fin; the colour composed of different shades varying from light brown to dusky brown; the surface of the under side perfectly smooth and white.

(Yarrell, *British Fishes*.)

HIPPO'LYTE, the name of a genus of *Crustacea* belonging to the tribe of Palemonians. [PALEMONIDÆ.]

HIPPOMANE, a genus of Plants belonging to the natural order *Euphorbiaceæ*, and tribe *Hippomaneæ*. The tribe *Hippomaneæ* is characterised by solitary ovules, apetalous flowers in spikes, and bracts one- to many-flowered. The genus *Hippomane* embraces the famous Manchineel-Tree.

H. Mancanilla, the Manchineel-Tree, is a plant which has as bad an American reputation as that of the Upas-Tree in the Indian Archipelago. It is a tree of very considerable size, and of a handsome aspect, belonging to the natural order *Euphorbiaceæ*, and among the most poisonous of all known vegetable productions. The leaves are alternate, ovate-acute, serrated, and shining, with a roundish depressed gland between the blade and the petiole. The flowers are small, unisexual, and arranged on slender axillary spikes, the lowermost only being female, all the others male. The male flowers grow in clusters, and have each a small calyx of two sepals, containing a tetrandrous column of stamens. The females have a calyx of three sepals, a round ovary crowned by six or seven reflexed stigmas, and containing as many cells. When the fruit is ripe it is a fleshy yellowish-green round body, very like an European crab-apple. The tree is common in the West India Islands, although pains have been taken to extirpate it. In some places it forms thick woods, as upon Sandy Island, near Tortola, to the exclusion of all other vegetation, for not a blade of grass will grow beneath its branches. The whole plant abounds in a milky juice of the most venomous description: dropped on the skin it produces a sensation of severe burning, followed by a blister; and the fruit, when bitten, causes dangerous inflammation of the mouth. This is denied by some of the West Indian settlers, but is undoubtedly true, according to the elder Jacquin, and to the more recent testimony of Sir Robert Schomburgk, who suffered severely from having tried the experiment of eating the fruit. Jacquin however asserts that to sleep beneath the shade of the Manchineel-Tree is not dangerous, as is commonly reported. But Sir Robert Schomburgk says that if rain passes through the branches and drops upon the skin of a person below them, it produces severe inflammation, and that the dew which falls at night causes the same effects, as he saw in certain cases which came beneath his own observation; but he adds that it acts differently upon different persons, he himself not suffering any inconvenience from rubbing the juice on the skin. But while the dangerous qualities of this tree are thus undoubted, it is very uncertain whether the poisonous quality which, it is believed in the West Indies, the land-crabs acquire from the Manchineel-Tree is really owing to that cause. Jacquin denies it, and Sir Robert Schomburgk could obtain no proof that it is so; all that is certain is, that land-crabs are frequently found under the shade of manchineel woods, and that those animals are often poisonous. The wood of this tree is represented to be of fine quality, handsome, and well suited for cabinet-makers' purposes.

Manchineel-Tree (*Hippomane Mancanilla*).
1, a ripe fruit; 2, a transverse section of the same; 3, a male flower; 4, a female flower; 5, an ovary.

HIPPO'NÖE, a genus of Dorsibranchiate *Annelida*, considered by Messrs. Audouin and Milne-Edwards to approach the genus *Amphinome*. *Hipponöe* is deprived of a caruncle and has only a single packet of bristles to each foot, and a single cirrhus.

HIPPO'PHAË, a genus of Plants belonging to the natural order *Elæagnaceæ*. It has diœcious flowers with ovate scaly bracts. The stameniferous flowers have a perianth of two leaves adhering by their points; the stamens have four very short filaments; the pistilliferous flowers have the perigone tubular and cloven at the summit; the style is short, the stigma elongated; the nut 1-seeded, clothed with the large coloured berry-like perigone.

The only species of this genus is the *H. rhamnoides*, Sea-Buckthorn, which is a small shrub found on the east and south-east coasts of Great Britain, and other parts of Europe. The acid berries yielded by this plant are often eaten as a salad both in this country and in France. This plant also yields a colouring matter, which is used for dyeing yellow. Although in this country the berries are innocuous, they seem to exert a deleterious influence, or are supposed to do so, in some of the countries of the south of Europe. They are said to be a favourite food with the Tartars, and the fishermen of the Gulf of Bothnia eat them with their fish.

(Babington, *Manual of British Botany;* Burnett, *Outlines of Botany.*)

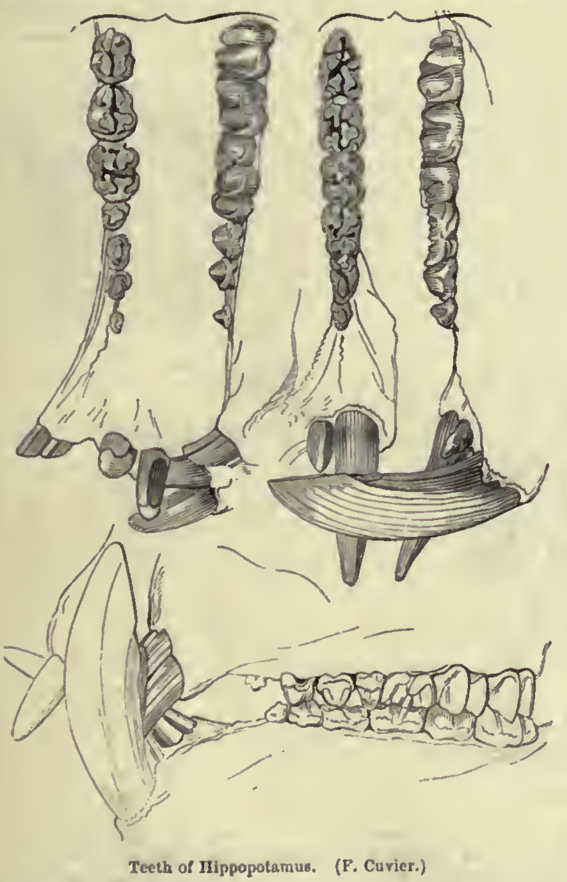
HIPPO'PODA, a genus established by Messrs. Quoy and Gaimard for a marine floating Mollusk which M. De Blainville considers identical with *Protomedea* of Lesueur's manuscripts, and places under his (M. De B.'s) *Physograda*. [ACALEPHÆ.]

HIPPOPO'DIUM, a fossil genus of *Conchifera Dimyaria* proposed by Mr. J. Sowerby in the 'Mineral Conchology of Great Britain.' It includes only one British species, *H. ponderosum*, which is found in the Lias.

HIPPOPOTAMUS (Ἵππος and ποτάμιος), the Roman name for the River-Horse, and retained by modern zoologists as the generic appellation of the animals of that Pachydermatous form.

Dental Formula:—Incisors, $\frac{4}{4}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{7-7}{6-6} = 38$.

Cuvier remarks that there is no animal that requires to be more studied at different ages than the Hippopotamus, in order to acquire a perfect knowledge of the molar teeth, which change their form, their number, and their position; and, in his 'Ossemens Fossiles,' he goes into minute details of those changes.



Teeth of Hippopotamus. (F. Cuvier.)

In the upper jaw the first incisor is conical, straight, and a little worn on its internal side; the second is equally conical, but curved inwards. The canine tooth is short, and cut, as it were, obliquely, in consequence of its abrasion against its opposite. The four molars which succeed the canine are strictly false molars. The first is very small, is shed as the animal advances in age, and is not reproduced; it is separated by an interval from the rest of the molar teeth. These, nearly of the same size, are also shed during the youth of the animal, are replaced by others, and the first teeth are more complicated than the second. When these, the true and permanent molars, are worn by use, they exhibit the form of a trefoil on their crowns. The three last resemble each other generally: they are composed of four large tubercles approximated in pairs, and conical before the points are worn by attrition consequent on mastication. After the first effects of abrasion they each present, by the contour of the enamel, the figure of a trefoil, or, in other words, three lobes disposed more or less regularly in the form of a triangle; but as the abrasion proceeds and the tooth is farther worn down, they exhibit the form of a cross with a disc in the middle.

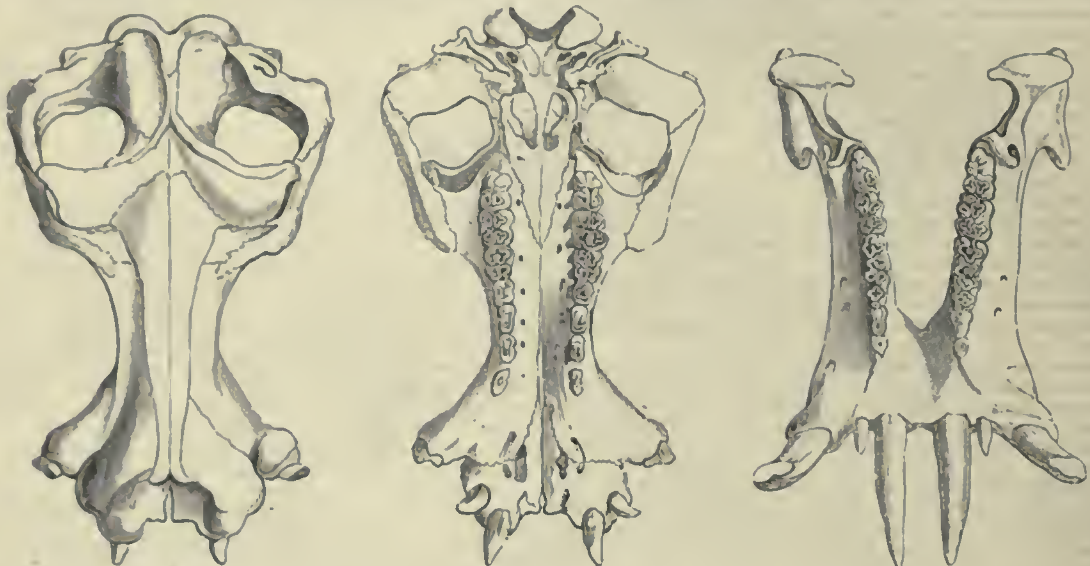
In the lower jaw the first incisor is long, subcylindrical, terminated in a point, and a little worn on its external side. The second is of the same form as the first, but much smaller. The canines are enormous tusks sharpened into a somewhat chisel-like edge, the polished and abraded internal surface of which presents a shape inclined to elliptical. The molars form a continuous series; the first and the second are false molars, the first being the smallest, and dropping as the animal advances in age, never to be replaced. The four succeeding teeth exhibit the same general forms as those of the upper jaw. The first, which is smaller than the others, has an anterior isolated tubercle: the succeeding teeth are nearly of the same size, and have also an isolated tubercle, but it is posterior.

Cuvier makes the first section of his second family of Pachydermatous Mammifers (Ordinary Pachyderms) consist of those which have four, three, or two toes; and these he separates into two great genera, the *Hippopotami* and the Hogs [SUIDÆ]. The *Hippopotamidæ* are further characterised generically as having on all their feet four toes, which are nearly equal and terminated by small hoofs (sabots), an immensely massive body destitute of hair, very short legs, a belly trailing against the ground, an enormous head, terminated by a large tumid muzzle which incloses their great anterior teeth, a short tail, and small eyes and ears. Their stomach is divided into many compartments. They live in rivers, on roots and other vegetable substances, and are ferocious and stupid. The genus is placed by Linnæus among his *Belluæ*, between *Equus* and *Sus*. Dr. J. E. Gray brings it under *Elephantidæ*, his third family of the fifth order, *Ungulata*, as a genus of his sub-family *Hippopotamina*, and has suggested that the form is allied to the *Halicoridæ*.

The anatomy of these creatures is in accordance with their bulk and unwieldiness.

The skeleton of the *Hippopotamidæ* approaches that of the Ox and of the Hog; but it presents differences which distinguish it from that of any other animal. The skull, whilst in the connection of the bones and the arrangement of the sutures, it bears great similitude to that of the *Suidæ*, has its own peculiarities, which render its form extraordinary.

The number of vertebræ are 7 cervical, 15 dorsal, 4 lumbar, 7 sacral, and 14 coccygial = 47. The atlas and the axis, besides the ordinary articular facets, have each two others also towards their dorsal aspect; but taken as a whole, the cervical vertebræ approach nearest to those of the Hog. There is nothing very remarkable about the rest of the vertebræ, except that their bodies are rather flat. There are 7 true and 8 false ribs of a side = 30, nearly as much arched as those of the Rhinoceros, but distinguishable from them, as well as from those of the Elephant, in as much as they are much wider and flatter at the part nearest to the vertebræ than at the opposite end. The anterior part of the sternum is compressed into a ploughshare-like shape and very much prolonged into an obtuse point below the first rib. The rest is depressed, and the number of pieces is seven. The scapula may be easily distinguished from those of the Rhinoceros and Elephant, being larger than that of the first and less than that of the second, and also differing in form. In its general aspect this bone reminds the observer a little of the scapula of the Hog, but approaches nearer to that of the Ox in the more essential characters of the spine and articulating surface. The humerus bears a singular resemblance to that of the Ox; while there is some similitude to that of the Hog, which is however less in proportion towards the bottom. The radius and ulna are anchylosed at an early age, leaving on the outside only a rather deep furrow which occupies only three-fourths of the length of the radius, and on the inside a simple aperture towards the upper fourth part. These bones of the fore-arm resemble those of the Ox very much, but those of the latter are more elongated, and the articular facets of the lower head of the bone are, in the last-named animal, less oblique. There are in the carpus points of resemblance to the Hog; but its characters distinguish it both from that quadruped and the Ox. In the metacarpus all comparison with that of the Hog ceases. The pelvis is easily distinguishable from those of the Elephant and Rhinoceros, from the smaller width of the ilia in the Hippopotamus, and other differences. The Ox perhaps approaches it more closely in these parts; but, besides other discrepancies, the lower part of the pelvis and especially the oval holes are much more elongated in the Hippopotamus. The sacrum is very large, but the bones of the pubis project but very little. The femur, which possesses a ligamentum teres, is well-shaped and straight, the shaft nearly equal throughout, regularly cylindrical anteriorly. The great trochanter, which is compressed laterally, does not exceed the height of the head of the bone; the small trochanter is moderate: there is no third, as in the Rhinoceros, the Tapir, and the Horse. But its principal resemblance is to the femora of the great ruminants; though the upper head of the bone is much more detached and more spherical, and the lower head is much wider, especially behind. These differences will assist in distinguishing it from the femur of the Ox; that of the Giraffe, which, being of the same size, might more readily be mistaken for it, may be known by its more approximated upper head, its relatively larger condyles, and the more elevated and pro-

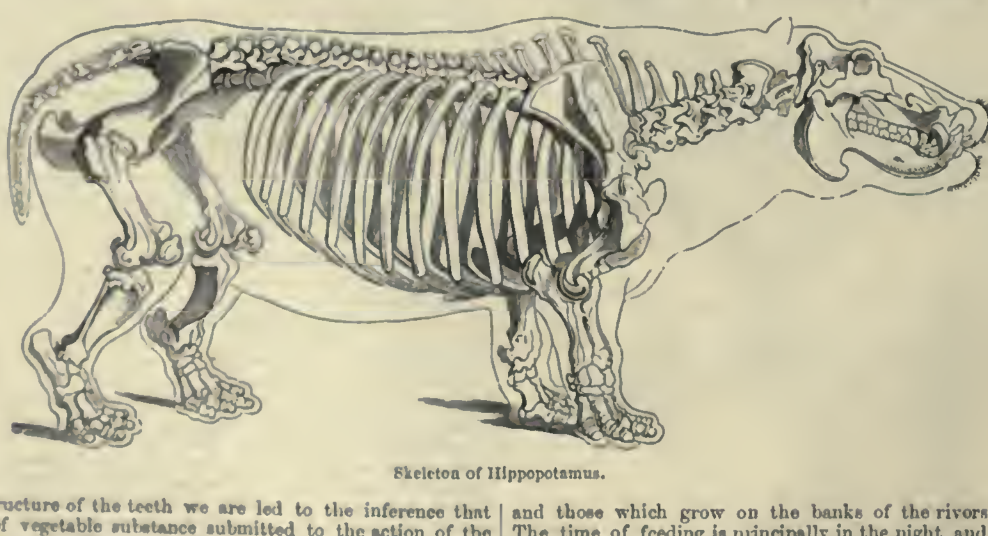


a b c

Skull of Hippopotamus.

a, seen from above; *b*, seen from below; *c*, lower jaw seen from above.

jecting internal edge of the lower articulating surface. The femur of the Hog more resembles that of the Hippopotamus in the upper part, but much less below; and its dimensions prevent the possibility of a mistake. The tabia is short and stout, almost beyond that of any other quadruped, especially at the extremities. It approaches nearest to that of the Ox, but the latter is more elongated, and differs in other respects. The tibia of the Hog is also more elongated in comparison, and offers other discrepancies. The fibula is very slender, and is throughout very distant from the tibia, except at the two extremities. The malleolar bone is anchylosed to the lower extremity. The tarsus is framed principally on the plan of that of the *Suidæ*.



Skeleton of Hippopotamus.

From the structure of the teeth we are led to the inference that the quantity of vegetable substance submitted to the action of the digestive organs of the *Hippopotamidæ* must be very great in proportion to the nourishment extracted from the mass. The principle on which the jaws and teeth are constructed seems to be a principle for rudely tearing and dividing, but not comminuting, the hard and tough vegetables which form the staple food of the animal. The jaws are so constructed that the process executed by them is more a bruising than a grinding process. The food therefore when transmitted to the stomach has undergone but little alteration, and that organ is employed in extracting from the coarse and ill-prepared load the greatest amount of nutritive matter. The stomach of a full-grown Hippopotamus is said to be capable of containing five or six bushels, and the large intestine is of a size commensurate with such a capacity, for it is stated to be eight inches in diameter. The Hippopotamus mentioned by Mr. Burchell ('Travels in South Africa') was considered to be only half grown, but three bushels, at least, of half-chewed vegetables were taken from its stomach and intestines.

The time of gestation of the Hippopotamus is stated to be nine months; but this does not seem to be accurately ascertained. The birth takes place on the land; and on the slightest alarm both parent and young take to the water. Thunberg, during his visit to Caffraria (1773) was assured by an eye-witness that he, having watched, when on a hunting party, one of these animals which had gone up from a neighbouring river to calve, lay still with his company till the calf was produced, when one of the party fired and shot the mother dead. The Hottentots immediately rushed from their hiding-place to take the calf alive, but its instinct saved it, for it made for the river, and escaped. The male specimen now (1854) in the Gardens of the Zoological Society, Regent's Park, was with difficulty caught, though only two days old. The food of the Hippopotamus consists of water-plants and those which grow on the banks of the rivers which it haunts. The time of feeding is principally in the night, and these enormous animals, when in the neighbourhood of cultivated lands, do incalculable damage, not only from the quantity that they actually consume, but the still greater quantity that they spoil and lay waste by their crushing bulk. As they are able to remain beneath the surface of the water for some time, there must be some muscular arrangement for closing the nostril, such as we see in the Seals. Hasselquist, on the authority of 'a credible person' who lived twelve years in Egypt, states: "1, that the hide of a full-grown Hippopotamus is a load for a camel. 2, that the River-Horse is an inveterate enemy to the Crocodile, and kills it whenever he meets it. 3, that the River-Horse never appears below the cataracts in Egypt,* wherefore the inhabitants of Upper Egypt only can give any account of it. The Egyptians, he adds, very seldom bring the hide of it to Cairo; and, he continues, it is impossible to bring thither the living animal. 4, the River-Horse does much damage to the Egyptians in those places he frequents. He goes on shore, and in a short space of time destroys an entire field of corn or clover, not leaving the least verdure as he passes; for he is voracious, and requires much to fill his great belly. They have a curious manner of freeing themselves, in some measure, from this destructive animal: they remark the places he frequents most, and there lay a large quantity of peas; when the beast comes on shore, hungry and voracious, he falls to eating what is nearest him, and filling his belly with the peas, they occasion an insupportable thirst; he then returns immediately into the river, and drinks upon these dry peas large draughts of water, which suddenly causes his death; for the peas soon begin to swell with the water, and not long after the Egytians find him dead on the shore, blown up, as if killed by the strongest poison. 5, the oftener the River-Horse goes on shore, the better hopes have the Egyptians of a sufficient swelling or increase of the Nile. 6, the Egyptians say, that they can almost distinguish the food of this animal in his excrements." Some parts of this relation (that regarding the peas, for instance) may be considered as bordering upon the marvellous, but there are others which there seems to be no good reason for doubting. The alleged enmity to the Crocodile can hardly be considered to be well founded.

In Professor Smith's 'Journal' (Tuckey's 'Narrative of an Expedition to explore the River Zaire, usually called the Congo, in South Africa') we find it stated that they "landed in a beautiful sandy cove at the opening of a creek behind a long projecting point. It is called Sandi-Sundi. An immense number of Hippopotami were seen here. In the evening a number of Alligators were also seen." This association would be hardly consistent with hostility. Captain Tuckey also says, "The Hippopotamus and Alligator seem to be numerous." The usual mode of capturing the animal is by a pitfall, by the natives at least, but the colonists near the Cape use the rifle. The two killed by Zerenghi, in the year 1600, frequented the neighbourhood of the Nile, near Damietta. He stationed men upon the Nile, who, having seen two of these animals go out of the river, made a large ditch in the way through which they passed, and covered it with thin planks, earth, and herbage. In the evening, when returning to the river, they both fell into the ditch. Zerenghi immediately hastened to the place with his janizary, and they killed both the beasts by pouring three shot into the head of each with a large arquebus. They almost instantly expired, he adds, after uttering a cry which had more resemblance to the bellowing of a buffalo than to the neighing of a horse. Captain Tuckey observed Hippopotami with their heads above the water, "snorting in the air." In another part of his 'Narrative,' he says, "Many Hippopotami were visible close to our tents at Condo Yanga, where we were obliged to halt, and to wait some time for a canoe to pass. No use firing at these animals in the water; the only way is to wait till they come on shore to feed at night. During the night they kept a continual grunting like so many hogs, but none of them came on shore, though we had a constant watch on the beach." Sparrman, who gives a ludicrous account of the terror which seized him and some of his companions on the rush of one of these animals towards him from the river, thus describes the noise made by one of these 'sea-cows' at Great Fish River:—"At half an hour after eight, it being already very dark, a sea-cow began at intervals to raise its head above the water, and utter a sharp, piercing, and, as it were, very angry cry, which seemed to be between grunting and neighing. Perhaps this cry may be best expressed by the words 'heurb, hurb, heoh-heoh:' the two first being uttered slowly, in a hoarse but sharp and tremulous sound, resembling the grunting of other animals; while the third, or compound word, is sounded extremely quick, and is not unlike the neighing of a horse. It is true, it is impossible to express these inarticulate sounds in writing to any great degree of perfection; but perhaps one may make nearer approaches to it than one can to the gutturopalatial sounds of the Hottentot language." Le Vaillant had an opportunity of watching the progress of a hippopotamus under water at Great River. "This river," says he, "contained many hippopotami; on all sides I could hear them bellow and blow (mugir et souffler). Anxious to observe them, I mounted on the top of an elevated rock which advanced into the river, and I saw one walking at the bottom of the water (marcher et se promener au fond de l'eau). But I remarked that its colour, which when it is dry is grayish, and when it is only humid and moist appears bluish, seemed then to be of a deep blue. I killed it at the moment when it came to the surface to breathe. It was a very old female, and my people in their surprise, and to express its size, called it the 'grandmother of the river.'" ('Second Voyage.') Mr. Barrow, in his journey into the interior of Southern Africa, when he reached the mouth of the Great Fish River, saw towards the evening a vast number of Hippopotami (Sea-Cows of the Dutch) with their heads above the surface. Several paths made by these animals led from various parts of the river to a spring of fresh water about a mile distant. To this spring they went in the night to drink; the water of the river for some distance from the mouth being salt. According to Dampier and others, the Hippopotamus, when wounded or irritated, is violently ferocious, and has been known to sink a boat by its bite.

For a long time it was considered that there was but one species of living Hippopotamus; but some naturalists are of opinion that there are at least two. Before we enter into this part of the subject we shall give a slight sketch of the history of the Hippopotamus from the time of the ancients.

If the Hippopotamus be the Behemoth of Job (ch. xl.), we must refer to the well-known verses 15 to 19, both inclusive, as the earliest description of the animal. But the identity is by no means satisfactorily ascertained. The vulgate uses the term Behemoth, and the Zürich version translates the word by 'Elephas.' In the edition of the Bible, 'imprinted at London by Robert Barker, printer to the King's most excellent Majestie' (1615), Behemoth is the word in the text, with the following annotation:—"This beast is thought to bee the elephant, or some other which is unknowen." Bochart, Ludolph, Scheuchzer, and many others hold that the Hippopotamus is the animal meant; while not a few of the learned have written in support of the Elephant. Cuvier and others think that though we may believe with Bochart that the Hippopotamus is intended, the description in the book of Job is too vague to characterise it. Good comes to the conclusion that some extinct pachydermatous genus was probably represented by the term; and some have lately even gone so far as to contend that Behemoth and the Iguanodon of geologists are identical!

Herodotus (ii. 71) gives a most incorrect description of what must be regarded, from the context and other evidence, as the Hippopotamus. This description is borrowed almost entirely by Aristotle, who has not however given to the animal a horse's tail, which Herodotus bestowed upon it; adding, correctly enough, that its size was that of the largest oxen.

Aristotle ('Hist. Anim.,' book ii. chap. vii.) thus describes the Hippopotamus:—"The Hippopotamus of Egypt has a mane like a horse; a bifurcated hoof like the ox; a flat visage or muzzle; an astragalus like the animals with cloven feet; projecting teeth which do not show themselves much; the tail of a hog; the voice of a horse; and in size it resembles an ass. Its skin is of such a thickness that spears are made of it." Now, there is enough in this curious description to lead to the conclusion that Aristotle meant no other than the Hippopotamus; there is also quite sufficient to show that he never saw the animal, and that he trusted to the wild accounts of others. We trace however the descriptions of Herodotus and Aristotle in many of the figures of the animal which were published after the revival of letters; for it is worthy of remark that notwithstanding the highly erroneous descriptions of ancient authors, some of whom must, one would think, have had an opportunity of seeing the animal, the portraits of it by ancient artists on coins, &c., are, almost without exception, far from bad representations of the animal. But to return to the ancient authors.

Diodorus (book i.) comes much nearer to the truth in his description, at least as to the size of the Hippopotamus; for he says that it is five cubits in length, and in bulk approaches to that of the Elephant. The teeth are not badly characterised by the same author; but he still leaves to the animal the cloven hoof and the horse's tail.

Pliny says of it (book viii. 25), after treating of the Crocodile and *Scincus*, "Major altitudine in eodem Nilo belua hippopotamus editur," and he gives it the bifid hoofs of the ox, the back, mane, and neigh of the horse, a flattened muzzle, the tail and teeth of the boar, adding, that though they are hooked they are less noxious—"ungulis bifidi quales bubus, dorso equi, et jubâ, et hinnitu, rostro resimo, caudâ et dentibus aprorum, aduncis, sed minus noxiis." In short he seems to have followed with very little exception the account given by Aristotle, without attending to that of Diodorus. Pliny adds, that helmets and bucklers are made of its skin, which are impenetrable unless they are softened by moisture, and he speaks of its feeding on the crops "depascitur segetes," and its caution in avoiding snares. In his 9th book and 12th chapter, on the covering of aquatic animals ('Tegmenta Aquatilium'), the varieties of which he enumerates, he says, "Alia corio et pilis teguntur, ut vituli et hippopotami;" thus making it hairy like the seals, which we take to be meant by 'vituli;' and yet, with all this monstrous error, he himself (book viii. 26) speaks of M. Scaurus as being the first who had shown the hippopotamus, together with five crocodiles, at Rome, during his ædileship; finishing the account however by making the former animal a master of one department in the art of healing, in consequence of his habit of letting blood by pressing the vein of his leg against some very sharp stake when his obesity requires such relief. We know moreover that Augustus exhibited one of these animals on occasion of his triumph over Cleopatra. (Dion., book li.). We shall only further refer to the account of Achilles Tatius (book iv. 2), which is, notwithstanding some errors, perhaps the most correct; and shall proceed to notice that, under the later emperors, a considerable number of Hippopotami were introduced into the Roman shows. Thus Antoninus exhibited some, with crocodiles, tigers, and other

* That it was found in Lower Egypt in the year 1600 appears by Zerenghi's account above given. Hasselquist travelled in the years 1749-52.

animals. Commodus showed five on one occasion, and killed some of them with his own hand. Heliogabalus and the third Gordian also exhibited Hippopotami. These demands seem to have produced their effect; for according to Marcellinus Ammianus (book xxii. 15) and others, the race of Hippopotami had disappeared from Egypt since the time of the emperor Julian. Favourable circumstances however must have operated to restore it, as we collect from the account of Zerenghi above alluded to and others. That the animal was sacred, in some parts at least, appears from Herodotus (book ii., 'Euterpe'): "Those which are found in the district of Papremis are sacred, but in other parts of Egypt they are not considered in the same light." * Sonnini ('Travels in Upper and Lower Egypt'), who quotes this passage, and also one from Pausanias (book iv. 33), goes on to state that these animals laid waste whole countries by ravages as fearful as their size was enormous, and that they were equally formidable to man with the crocodile. From the terror which they inspired, they were, he asserts, generally looked upon as the symbol of Typhon, that giant who had spread death and destruction among the deities which were worshipped in that quarter; they were, he adds, of course the emblem of mischance and of cruelty, and the particular worship of them at Papremis must have been practised solely with the view of appeasing or averting their rage.

We have mentioned that with few exceptions, if not with one only, the representations of the ancient artists have been found faithful to nature when compared with the descriptions of ancient naturalists and authors. The exception is the figure copied by Hamilton ('Ægyptiaca,' pl. xxii.) from one of the caves of Beni-Hassan, in which the feet are represented as cloven, and the lower tusks are so enormous as to render it impossible that they should be covered by the lips, whereas the largely developed muzzle and its consequent concealment of the tusks are portrayed upon most of the ancient figures and coins. We do not consider the figure found by Belzoni as an exception, because, as the author of the amusing book on Egyptian Antiquities observes, the designer sometimes placed on one animal a part taken from another, and that mentioned by Belzoni was a calf with the head of a Hippopotamus. Though the details of the teeth and feet are not correct in the figure on the plinth of the statue of the Nile formerly in the Vatican, and afterwards taken to the French Museum, its general contour is good; and the animal occurs in other sculptures and in mosaics very characteristically represented. Some of these, that of the Vatican above mentioned, for instance, may have given rise to the story of the enmity borne towards the crocodile by the Hippopotamus, which in that sculpture holds a crocodile in its mouth. On medals and coins of the Roman emperors the Hippopotamus often appears, sometimes with the crocodile, sometimes without. Those of the emperors Trajan, Hadrian, and Philip, or rather of Marcia Otacilia Severa, Philip's wife, will occur to some of our readers.

In more modern times we have the descriptions of Isidore of Seville, Vincent de Beauvais, Albertus Magnus, James of Vitry, and all more or less fabulous; but Abdallatif gives a very good account of the animal. Belon and Gillius however seem to have been the first among the moderns who actually saw, or at least who have recorded that they saw the animal alive. They both saw it at Constantinople, and perhaps they saw the same. Sonnini seems to doubt whether the animal which Belon saw was a hippopotamus ('Travels in Upper and Lower Egypt,' vol. iii.), and quotes Matthiolus, who speaks very slightingly of Belon; but a perusal of that accurate observer's account will, we think, satisfy the most scrupulous that he saw a living Hippopotamus; he even alludes to the differences between the figures of that animal on ancient works of art and the specimen which he had before his eyes, and rectifies the error in the figure on the plinth of the statue of the Nile, which has five toes instead of four. Of the teeth indeed he only remarks that they approach to those of a horse. Gesner does little but quote Belon; and without detaining the reader with the descriptions of Zerenghi, who is above alluded to, which were good, or the compilation of Aldrovandus, who did not use the figure of Zerenghi, but another sent to him from Padua (Cuvier thinks, by Prosper Alpinus), or the good description and more accurate representation given by Fabius Columna, we come to Ludolph, who, in his "History of Ethiopia,' gives an entire figure on a large scale. This is the best which had been hitherto published; but the teeth are exaggerated, and a great deal too much exposed, and the ears are rather long. Below this is a figure of "the sea-horse, putting up his head above the water; thence called the river-horse by the Greeks." The head and neck alone are visible; but the exaggeration and exposure of the teeth are continued, and the draftsman, by lengthening the neck, head, and ears has given a much more horse-like character to the figure. Thevenot, in his 'Voyage to the Levant,' very fairly describes an individual killed in his time (1658) near Girgeh, and taken to Cairo.

The date of the last of these authors is 1689, but in 1735 the work of Prosper Alpinus was published, and obscured the subject again by giving a representation of two stuffed skins, the one of a large female animal, and the other of her fœtus, which he had seen in the house of the Pasha of Cairo. These were the skins of two Hippopotami, but the skulls had been withdrawn, and the absence of the projecting teeth led Prosper to the conclusion that he had at last found in this, which he took for a distinct creature, the animal represented by the ancient artists, forgetting, or more probably not knowing, that when the Hippopotami of the present day keep their mouths closed no tooth is visible.

We need not detain the reader with a reference to the figures and descriptions given by other zoologists, as Grew, A. Jussieu, Daubenton, Pallas, Buffon, &c., but shall come at once to Linnæus, and this will bring us to the question of the geographical distribution of the genus, and of the number of species.

Linnæus, in his last edition of his 'Systema Naturæ,' gives only one species, *Hippopotamus amphibius*, and places its habitat "in Nilo et Bambolo Africæ, et ad ostia fluviorum Asiæ."

Africa appears to be the only quarter of the globe in which this form exists; and though Onesicritus (Arrian, 'Indic.,' c. 6) places the Hippopotamus in the Indus, Strabo (690, 707, Casaub.) seems to prefer the testimony of Aristobulus in contradiction of the fact, and Pausanias (iv. 34) agrees with Strabo. Cuvier, who has collected almost all the learning on this subject, well observes that no traveller of credit has reported that it has been found on the continent of India. He remarks that Buffon gave no credence to the testimony of Michael Boyn, who states China to be one of the localities; he observes that it is nearly without authority that Linnæus supposes the animal to occur at the mouths of the rivers of Asia, and is of opinion that M. Faujas appears to be well authorised in denying that it is to be found on the continent of India.

Marsden includes the Hippopotamus among the animals of the islands of Sumatra and Java; but Cuvier ('Ossemens Fossiles') enters into an interesting discussion, well worthy of the perusal of the reader, to show that Marsden is mistaken; and in addition to his arguments, he brings forward the fact that Messrs. Diard and Duvaucel, who travelled over a considerable part of Java and Sumatra in different directions, could not find a Hippopotamus, though they succeeded in obtaining two species of Rhinoceros and a Tapir. Upon the whole evidence at present known, it seems to be established that the geographical distribution of this pachydermatous form is confined to the great rivers and lakes of Africa.

We now come to the question of how many species of Hippopotamus at present exist.

M. Desmoulins ('Journal de Physiologie,' &c., par F. Magendie, tome v.) gives osteological reasons, drawn principally from the differences in the skull, for distinguishing at least two species of Hippopotamus. And upon the whole it must be allowed that he appears to be borne out in his position that the distinctions between the two species, one of which he designates as the Hippopotamus of the Cape (*H. Capensis*), and the other as the Hippopotamus of Senegal (*H. Senegalensis*), are as strong as those on which Cuvier founded his specific separation of the Fossil Hippopotamus from that of the Cape. M. Desmoulins is further of opinion that it is not impossible that the Hippopotamus of the Nile differs specifically from the other two. The external differences do not appear to be considerable, if any. M. Desmoulins indeed remarks, that of 40 Hippopotami seen by M. Caillaud in the Upper Nile, two or three were bluish-black, all the others reddish; and M. Desmoulins even hints that there may be two species in that river. The latter adds that of the two Hippopotami of the Cape possessed by the Paris Museum, one is black, the other reddish; but he considers that the numerical disproportion observed between the individuals of the two colours in the Nile can hardly admit of a sexual solution. We have examined several skulls of Hippopotami, and some of them certainly present many striking differences; but it should be remembered that safe inferences as to specific distinction can only be drawn from a very extensive examination of skeletons, combined with unquestionable data as to the locality, age, and sex of the subjects examined.

With regard to the supposed two Nilotic species, there is reason for considerable doubt; nor is much weight to be attached to the alleged difference of colour. The animal in the water and out of it presents a very different appearance; and, to say nothing of the possibility of a difference in the case of sex, there is every probability that some change in the colour may take place as the animal advances in age. We have seen the remark of Le Vaillant as to the difference of colour when the skin is dry, when it is only moist, and when the animal in full life is walking at the bottom of the river.

It need hardly be observed that the Romans must have derived their Hippopotami from Northern Africa; and as we have given Sparrmann's description, among others, of the noise made by the southern animal, we may be excused perhaps for remarking that Burckhardt ('Travels in Nubia') describes the voice of the Hippopotamus as a harsh and heavy sound, like the creaking or groaning of a large wooden door. This noise, he says, is made when the animal raises its huge head out of the water and when he retires into it again. We may also add, with regard to the alleged disappearance of the Hippopotamus from Lower Egypt, that, as Cuvier remarks, the French

* The following is the entire passage:—"Hippopotami are held sacred in the Nome of Papremis; but they are not held sacred by the rest of the Egyptians. Their nature and form are these: the animal is four-footed, bisulcated, with hoofs like those of an ox, a flat nose, a horse's mane, prominent teeth, and the tail and voice of a horse. In size it is as large as the greatest ox. The skin is so thick that when dried the shafts of darts are made of it."

savans attached to the expedition to Egypt, who ascended the Nile above Syene, did not meet with one.

We now come to an interesting period in the history of the Hippopotamus, its arrival in Europe in modern times, and its appearance for the first time within the historical period in Great Britain. On the 11th of December 1849 Mr. Mitchell communicated to the Zoological Society, at its evening meeting, the fact that a live Hippopotamus had been secured for the Gardens in Regent's Park. He then read the following extract from a letter, addressed to him by the Hon. C. A. Murray, dated Cairo, November 16th, 1849:—

"It is with the greatest satisfaction that I communicate to you the intelligence that I have succeeded in obtaining for the Society a live Hippopotamus. It is now in a yard at the back of my house, and apparently in perfect health: you cannot be more anxious than I am that I may be able to keep it through the winter, and send it to you safe in the spring. It is only five or six months' old, and still lives entirely on milk. I think a fresh importation of cows will be necessary in Cairo, as our little monster takes about thirty quarts of milk daily for his share already. H. H. Abbas Pasha has been most liberal in having the animal brought here at his own expense from the White Nile. A lieutenant and a party of ten Nubian soldiers formed his escort; a boat was built on purpose for him, and the viceroy sent him to my house in charge of the chief officer of his palace. I may also mention that, by his Highness's orders, another officer with a party of soldiers, is still out on the White Nile charged with the duty of securing a young female for us, so that I am not without hope of sending you the pair together."

In another letter the same gentleman writes—

"The Hippopotamus is quite well, and the delight of every one who sees him. He is as tame and playful as a Newfoundland puppy; knows his keepers, and follows them all over the court-yard: in short, if he continues gentle and intelligent, as he promises to be, he will be the most attractive object ever seen in our garden, and may be taught all the tricks usually performed by the elephant."

had then been born about two days. It was so small that, in his delight at having accomplished the pasha's order, he seized it in his arms, and would have carried it to the boat, which waited on him, had not the slimy exudation which is lavishly poured forth from innumerable pores in the skin of the young Hippopotamus rendered it so slippery, that he was entirely unable to retain his hold. The animal, having thus slipped from his grasp, all but escaped into the Nile, where the mother doubtless was lying near at hand. The hunter, however, with the presence of mind which characterises a good sportsman, seized his spear, and with the sharp side-hook, which has been in fashion in Egypt for three thousand years or more, he succeeded in arresting the headlong plunge of his prize, without inflicting greater injury upon him than a skin-wound, which is marked by the scar upon his ribs to this day.

"The long voyage down the river was successfully accomplished in a boat which had been built for the purpose by the viceroy's order, and 'Obaysch,' as they named the Hippopotamus from his birth-place, was safely delivered, in November 1849, after a journey of four months, into the care of the Hon. C. A. Murray, through whose powerful influence the viceroy had been prevailed on to exert his power and assist the Society in an object for which all exertions of their own had failed.

"Obaysch spent his first winter in Cairo, under the charge of his present intelligent keeper, Hamet Saaffi Canaana, a Nubian Arab whom Mr. Murray engaged for the purpose. In May 1850 proper preparations were made, with the obliging co-operation of the directors, in the Peninsular and Oriental Steam Navigation Company's ship Ripon, for the transport from Alexandria, and on the 25th of that month the first Hippopotamus which had breathed on English soil since the deluge was landed successfully on the quay at Southampton, and liberated in the Gardens, from his travelling house, at ten o'clock the same evening. On emerging from the door of it he followed Hamet, who has scarcely ever left him during the whole voyage from Cairo, into the building which had been prepared for him, and instantly

Hippopotamus.

The animal referred to in the above letter arrived in England on the 25th of May. The following account of its capture and habits in the Gardens is taken from Mr. Mitchell's 'Popular Guide' to the menagerie of the Society. A house and two tanks have been expressly built for the accommodation of this animal:—

"Since the imperial exhibitions in the Circus at Rome, no living Hippopotamus has been imported into Europe, except the young male which the Society possesses. The difficulty of obtaining such an animal may be conjectured from the fact, that after the viceroy of Egypt had determined to present one to the Society, it became necessary for his Highness to despatch an expedition to the Upper Nile for the purpose of making the capture, and that success was only achieved after two thousand miles of the river had been ascended. In the month of July, 1849, the chief huntsman of the party, in searching the reedy margin of an island in the White Nile, called Obaysch, at last discovered a little Hippopotamus calf, which, as he conjectured,

indulged in a long-continued bath. The ten hours which elapsed between his removal from the steamer at Southampton, and his arrival in the Regent's Park, is the longest period during which he has ever been without access to water.

"The slow respiration of the Hippopotamus enables him to remain for long intervals beneath the surface, and the organisation both of the ears and nostrils are beautifully adapted for this condition of his existence. The enormous size to which these animals grow has been recorded by every African traveller, and is sufficiently indicated by the skulls which are found in almost every museum. An adult male in good condition, measuring five feet at the shoulder, would certainly have three times the present bulk of Obaysch, who has most probably grown quite as fast under the treatment he has experienced as he would have done in his native river.

"The principal food of the Hippopotamus in his natural state appears to be young grass, green corn when it is to be obtained, browse of shrubs, and probably some of the great water-plants which abound in the African rivers.

"Obaysch consumes about one hundred pounds weight daily of hay, chaff, corn, roots, and green food. For the first year he was fed almost entirely on cow's milk and Indian corn-meal finely ground; and there is no doubt whatever that any of the great animals, technically called Pachyderms, such as the Elephants and Rhinoceros, might be reared by residents in Africa with perfect success in the same manner. The African Elephant and the African Rhinoceros are still wanted for the Society's collection.

"The Hippopotamus now only exists in Africa; it is found in the rivers of the south and west, as well as in the Nile; and there is also in some of the western rivers a pigmy species, of whose skull a cast was presented to the Society by the late Dr. Morton of the United States."

A hippopotamus has also been recently exhibited in the Jardin des Plants in Paris, but it died a few months after its arrival.

On Saturday, July 22nd, 1854, a second specimen, a female, of this interesting animal was safely deposited in the Gardens of the Zoological Society. At this date it was about four months old, and weighed above a ton. It was fed by its keeper opening its mouth with his hand, which he thrust down its throat, covered with milk and corn-meal. It was ascertained that this creature was not insensible to music, and when any one of the musicians on board the vessel in which it was brought, played his instrument near it, she invariably raised her head in the attitude of listening. The keeper, also an Arab snake-charmer, was in the habit of exciting the attention of his charge by a kind of musical call, which it answered by vibrating its great bulk to and fro with evident pleasure, keeping time to the measure of his keeper's song.

The uses of the Hippopotamus to man are certainly not many, but when we look at the enormous ripping chisel-like canines of the lower jaw, and the lower incisors formed for uprooting, we cannot but think that such an animal must be an active agent in clearing rivers from the greater water-plants which might in time, if left undisturbed, go far to convert the running stream into a sluggish swamp. With regard to minor details, the flesh of this Wasser Ochs is much esteemed as an article of food. In the first catalogue of the African Museum we read that it is much in request both among the natives and the colonists, and that the epicures of Cape Town do not disdain to use their influence with the country farmers to obtain a preference in the matter of Sea-Cow's Speck, as the fat which lies immediately under the skin is called when salted and dried. Nor are the whips which are made of the skin of the Hippopotami of the Nile thought lightly of in the neighbouring countries. They are said to be made by cutting the fresh skin into triangular strips some five or six feet in length: one extremity of the strip is pointed, and it gradually widens till the breadth at the opposite extremity is equal to the intended circumference of the bulk of the whip. The strip is then rolled up so as to form a sort of conical pipe, is firmly tied to keep it in place, and dried in the sun. When all is finished a light and elastic whip is produced. But there is no part of the hippopotamus in more request than the great canine teeth, the ivory of which is so highly valued by dentists for making artificial teeth. No other ivory keeps its colour equally well;* and these canine teeth are imported in great numbers to this country (where more are sent in the first instance than anywhere else perhaps) for this purpose, and sell at a very high price. From the closeness of the ivory, the weight of the tooth, a portion only of which is available for the artificial purpose above mentioned, is heavy in proportion to its bulk; and the article fetches, or did fetch, upon an average, about thirty shillings, more or less, per pound. One of the specific distinctions pointed out by M. Desmoulins is the comparative abrasion of the canines in the supposed two species; and we would call the attention of the curious who deal in these teeth to this circumstance and the papers above quoted.

Fossil Hippopotami.

The remains of several species of Hippopotamus have been found which are now extinct. Amongst others, the following have been recorded:—*H. antiquus*, *H. minor*, *H. medius*, and *H. minimus*. These have been found in the tertiary beds of Europe. A larger species than any of these has been found in Great Britain, and identified by Professor Owen with *H. major*, Cuv. The following notice of this species occurs in his 'History of British Fossil Mammals:'—

"In glancing retrospectively towards the dawn of the scientific investigation of fossil remains, one is struck with the early introduction of the idea that the Hippopotamus had contributed to those found in the temperate latitudes of Europe: this amphibious quadruped seems in fact to have been the first to which large fossil bones and teeth were referred, after the notion that they were relics of giants of the human species began to be exploded.

"Thus the learned Saxon scholar Somner acquaints us that some who had seen the Chatham fossils were of opinion that they were bones of a river-horse; and the antiquarian Douglas misinterpreted in like manner the jaw and teeth of a rhinoceros, much of the ingenious speculations in his 'Dissertation on the Antiquity of the Earth' being based on the assumption that the fluviatile deposits at Chatham, in the instance which he describes, had yielded 'hippopotamic remains.' 'When we consider,' he says, 'the great distance from the Medway to the Nile, or other rivers near the tropics where these kind of animals are now known to inhabit, and when we have no authority from the Pentateuch to conclude that any extraordinary convulsion of nature had impelled animals at that period from their native regions to countries so remote, so we have no natural inference for concluding that the deluge was the cause of this phenomenon. Taking into consideration the geological features of the stratum of the river soil, he concludes 'that, as the hippopotamus is known to be the inhabitant of muddy rivers like those of the Nile and the Medway, it should therefore argue that this animal was the inhabitant of those regions when in a state of climature to have admitted of its existence.'

"This conclusion is essentially correct, though based in the present instance on wrong premises: neither the organic remains from Chatham, any more than those from Chartham, having appertained to a 'river- or sea-bred creature.' The genus of land-quadrupeds to which these fossils actually belonged is nevertheless at the present day as much confined to the tropics as the hippopotamus. No long time elapsed before true hippopotamic remains were found in the same deposits which had yielded the bones and teeth of the rhinoceroses. It was most probably from fresh-water marl that the entire skull of the hippopotamus was obtained, which is stated in Leo's 'Natural History of Lancashire' to have been found in that county under a peat-bog, and from which work Dr. Buckland has copied the figure given in plate xxii., fig. 5, of the 'Reliquiæ Diluvianæ.' From the indication of the second pre-molar in this figure we may, I think, discern the greater separation of that tooth from the third pre-molar, which forms one of the marks of distinction between the fossil and recent hippopotamus. Mr. Parkinson, in the third volume of his 'Organic Remains,' 4to., 1811, p. 375, treating of the Hippopotamus, says, 'In my visits to Walton, in Essex, I have been successful in obtaining some remains of this animal.' These fossils are now in the museum of the Royal College of Surgeons, and are referrible to the extinct species subsequently determined by Cuvier in the second edition of the 'Ossemens Fossiles,' under the name of *Hippopotamus major*. The first specimen, cited by Mr. Parkinson as 'an incisor of the right side of the lower jaw,' is the great median incisor, which when entire must have been 18 inches in length. It has lost much of its original animal matter, and is considerably decomposed. This tooth may be distinguished from the straight inferior tusk of the Mastodon by its partial investment of enamel; or when this is lost, as in the decayed specimen from the till at Walton, by the fine concentric lines on the fractured surface of the ivory, the corresponding surface in the tusk of the Mastodon presenting the decussating curvilinear striæ. The second specimen from Walton is thus described by Mr. Parkinson:—'The point of an inferior canine tooth or tusk, measuring full nine inches in circumference, and having seven inches in length of triturating surface.' From the great size of this tooth it is very likely to have belonged to the same animal to which the preceding tooth belonged. Besides the longitudinal striæ and grooves observable in the enamel of its sides and inferior parts, it is characterised by strong transverse rugous markings, which are placed at nearly regular distances of about two inches, and are observed to exist in the same manner on the fragment which joins to it. The third specimen described in that work is a fragment of the left lower canine tusk of a young hippopotamus; it had scarcely come into use, and the pulp cavity extends to near the apex of the conical and unworn crown. From the absence of the transverse rugous markings in the enamel, and the roundness of the circumference of this first-formed portion of the tusk, Mr. Parkinson was induced to suspect that it might have belonged to the small hippopotamus; but similar modifications are observable in the recently-protruded tusk of the young African hippopotamus, and are doubtless due to the immaturity of the individual of the fossil species which yielded this small tusk.

"Mr. Parkinson says, 'Remains of the Hippopotamus have been found, I am informed, in some parts of Gloucestershire,' and prior to the publication of the third volume of the 'Organic Remains,' Sir Everard Home had deposited in the museum of the College of Surgeons a tooth—the third pre-molar, right side upper jaw—of the *Hippopotamus major*, Cuv., which had been dug up in a field called Burfield, in the parish of Leigh, five miles west of Worcester. Mr. Strickland's valuable observations on the fluviatile deposits in the valley of the Avon, have confirmed these indications of the remains of the hippopotamus in that locality, and have thrown much light on the conditions under which the extinct species of that now tropical genus of Pachyderms formerly existed in the ancient waters that deposited those sands. Mr. Parkinson lastly cites the remarkable discovery by Mr. Trimmer of the remains of the hippopotamus in the fresh-water deposits at Brentford, an account of which Mr. Trimmer afterwards communicated to the Royal Society, with excellent figures of the principal fossils of the hippopotamus and of those of the mammoth, rhinoceros, and a large deer therewith associated.

"These specimens were collected in two brick-fields; the first about half a mile north of the Thames at Kew Bridge, and with its surface about 25 feet above that river at low water. The strata here are:—1st, sandy loam, from six to seven feet, the lowest two feet slightly

* Pausanias (viii. 46) mentions the statue of Dindymene, whose face was formed of these teeth instead of elephant's ivory.

calcareous; this yields no organic remains. 2nd, sandy gravel a few inches thick, with fluviatile shells and a few bones of land animals. 3rd, loam, slightly calcareous, from one to five feet; between this and the next stratum peat frequently intervenes in small patches of only a few yards wide and a few inches thick: here bones and horns of ox and deer occur, with fresh-water shells. 4th, gravel containing water; this stratum varies from two to ten feet in thickness, and is always deepest in places covered by peat; in it were found the remains of the mammoth, teeth of the hippopotamus, and horns and teeth of the aurochs. This stratum like the fresh-water deposits at Clacton, with similar mammalian fossils, rests upon the Eocene London clay, the fossils of which are, as Mr. Trimmer correctly observes, 'entirely marine.'

"The first stratum in the second brick-field is a sandy loam, calcareous at its lower part, eight or nine feet thick, in which no organic remains were observed. In the second stratum, consisting of sand, becoming coarser towards the lowest part, and ending in sandy gravel from three to eight feet, 'were found always, within two feet of the third stratum, the teeth and bones of the hippopotamus, the teeth and bones of the elephant, the horns, bones, and teeth of several species of deer and ox, and the shells of river fish. The remains of hippopotami are so extremely abundant, that in turning over an area of 120 yards in the present season,' (1812) 'parts of six tusks have been found of this animal.' Mr. Trimmer adds, that 'the gravel stones in this stratum do not appear to have been rounded in the usual way by attrition, and that the bones must have been deposited after the flesh was off, because in no instance have two bones been found together which were joined in the living animal; and farther, that the bones are not in the least worn, as must have been the case had they been exposed to the wash of a sea-beach.'

"When the flesh and ligaments of dead hippopotami decomposing in African rivers have been dissolved and washed from its bones, these will become detached from one another, and may be separately imbedded in the sedimentary deposits at the bottom of the river without becoming much water-worn in their course previous to entombment. Although therefore the bones of the Brentford hippopotamus were imbedded after the flesh was off, the individual to which they belonged might not have been transported from any great distance, the phenomena being perfectly in accordance with the fact that the animal had lived and died in the stream with the fresh-water mollusks, the shells of which characterise the sedimentary deposit in which its bones were subsequently buried.

"All the well-observed phenomena attending the discovery of hippopotamic remains, have concurred in establishing the truth of the conjecture of Douglas, that such animals, though now tropical, were formerly inhabitants of these regions. Additional arguments, as novel as ingenious, in support of the same conclusion have been deduced by Dr. Buckland, from his examination of the cave of Kirkdale, and of the remains of the quadrupeds, including the hippopotamus, which he discovered in that remarkable depository of organised fossils. Of the great amphibious Pachyderm, he cites six molar teeth, and a few fragments of canine and incisor teeth, 'the best of which are in the possession of Mr. Thorpe of York.'

"'These teeth of the hippopotamus therefore, like the teeth of the mammoth, associated with them in the Kirkdale Cave, prove that they were young and inexperienced individuals that had fallen into the clutches of the co-existing predatory *Carnivora*, which made that cave their lurking place, and perfectly coincide with the conclusions which Dr. Buckland thus enunciates:—'The facts developed in this charnel-house of the antediluvian forests of Yorkshire, demonstrate that there was a long succession of years in which the elephant, rhinoceros, and hippopotamus had been the prey of the hyænas, which, like themselves, inhabited England in the period immediately preceding the formation of the diluvial gravel; and if they inhabited this country, it follows as a corollary that they also inhabited all those other regions of the northern hemisphere in which similar bones have been found under precisely the same circumstances, not mineralised, but simply in the state of grave-bones imbedded in loam, or clay, or gravel, over great part of northern Europe, as well as North America, and Siberia. Fossil remains of the hippopotamus have been found in some abundance, and in a more perfect state than those in the fluviatile deposits of the valley of the Thames and Avon, in the formation of clay and sand with lignite beds, also of fresh-water origin, that overlie the Norwich Crag upon the eastern coast of Norfolk.'"

Remains of the extinct Hippopotamus have been found in other caves in England besides Kirkdale, as at Kent's Hole, Torquay, and at Durdham Common. The shells which were found by Mr. Strickland with the remains of this animal, indicate that no great difference of temperature existed from that which we find at the present day. The remains of *H. major* are not uncommon along the European shore of the Mediterranean. No remains of it have been found in any part of Asia. In the fossils from the Sewalik Hills, found by Dr. Falconer and Captain Cautley, there is a representative of the hippopotamus with six incisive teeth in the lower jaw. For this form the subgeneric name *Hexaprotodon* has been proposed. We have no evidence of the Hippopotamus having existed upon our planet anterior to the pliocene division of the tertiary period; and the ancient extinct species, like that of the recent form, seems to have been confined to the eastern hemisphere.

HIPPOPUS. [TRIDACNIDÆ.]

HIPPOTHE'RIUM, the name of an extinct species of *Mammalia* allied to the Horse, found and described by Professor Kaup, from the strata of sand at Epplesheim, near Altzey, about 12 leagues south of Mayence, referrible to the second or Miocene period of the Tertiary Formation.

HIPPOTHOA, a genus of Animals belonging to the family *Polyzoa*. It is characterised by a confervoid polypidom, adherent, and creeping, calcareous, irregularly branched, the branches frequently anastomosing, formed of elliptical cells linked to each other at the extremities; aperture lateral near the distant end. Dr. Johnston enumerates three British species, *H. catenularia*, *H. divaricata*, and *H. sica*. They are found encrusting shells and other objects in deep water.

HIPPOTIGRIS. [EQUIDÆ.]

HIPPU'RIS (from ἵππος, a horse, and οὐρα, tail, from the resemblance of the stem to a horse's tail), a genus of Plants belonging to the natural order *Haloragaceæ*. [HALORAGACEÆ.] It has the calyx-limb very minute, obsoletely 2-lobed; no petals; one stamen; a filiform style lying in a channel of the anther; the stigma simple, acute; the fruit nucumentaceous, 1-celled. Three species of this genus have been described. Of these, *H. vulgaris*, the Common Mare's-Tail, is found abundantly throughout Europe and North America. It has linear leaves, 6-12 in a whorl, and callous at the point. It is found in ditches and lakes. In deep water the submersed leaves are flaccid and pellucid, and not callous at the points. This plant is very common in Great Britain in stagnant waters and slow streams. (Babington, *Manual of British Botany*.)

HIPPURITES, a name given by Knorr and Schroeter to a Fossil Coral (*Cyathophyllum ceratites*, Goldfuss) of the Eifel Transition Limestone. Guettard also used this title for a lamelliferous coral.

By Lamarck, Defrance, and other writers, this name is given to a somewhat problematical group of fossils found in limestones of the Oolitic age which flank the Alps in the Untersberg, near Salzburg, at Regensburg, &c., in the Chalk of Perigord, Alet, &c.

Lamarck places *Hippurites* with *Belemnites*, and *Orthoceratites* among the *Cephalopoda*. ('Conchyliologie: Nouv. Dict. des Sciences Nat.') Latreille takes nearly the same view as Lamarck. ('Familles Naturelles' du 'Règne Animal.') Rang, referring to *Batolites* and *Raphanistes* of Montfort, and *Amplexus* of Sowerby (which is certainly a lamelliferous coral), introduces the genus among the acephalous *Rudista*, according to the views of De Blainville.

The structure of the *Rudista* has been studied by M. Ch. Desmoulins and M. Deshayes, and the location of *Hippurites* in that group may, on their competent authority, be definitively adopted. Considered as a bivalve shell, whose valves are excessively unequal, one may be described as cylindrical, conical, or curved; the other as flat, or tumid externally, and operculiform. The laminæ of the large valve are sometimes separated, as in some spondyli, and subject to such convolutions on one part of the circumference as to cause the appearance of longitudinal siphons immersed in the shell. Those are arguments, but very insufficient ones, for comparing *Hippurites* with *Cephalopoda*. The shell is fibrous, or rather formed of prismatic cells, of a 6-sided figure, in a longitudinal direction, which have been compared to the cellular structure of the shells of *Balanus*. The shells are sometimes attached side by side, as two portions of a coral. The internal cavity is far from corresponding to the external figure of the shell, and the cast in this cavity has been called *Birostrites*.

The abundance of these fossils in certain calcareous bases of the Chalk or top of the Oolitic formation in the Pyrenees, the Untersberg near Salzburg, the Bellunese, &c. is extraordinary, so that particular strata receive from the circumstance the name of Hippurite Limestone.

HI'PTAGE, a genus of Plants of the family of *Malpighiaceæ*, better known by the name *Gærtnera*, given it by Schreber in honour of the celebrated Gærtner; though the name assigned by himself, as prior, is now alone admitted. The genus contains only two species: one, *H. Madablota*, figured by Sonnerat under the latter name ('Voy.' ii. t. 135), which is common in the forests of many parts of India; the other, *H. obtusifolia*, is found in China, but commonly cultivated as an ornamental plant in India. Both species are remarkable for their great size as climbers, ascending to the tops of the loftiest trees, and hanging down in elegant festoons of white flowers.

HIRCUS. [CAPREÆ.]

HIRLING, a local name for the Salmon Trout. [SALMONIDÆ.]

HIRUDINE'LLA, a name given by M. Bory to a genus of *Microzoaria*.

HIRUDINIDÆ. [ANNELIDA.]

HIRUNDINIDÆ, a family of Birds belonging to the order *Insessores*, and the division *Fissirostres*. They include the species of birds known by the name of Swallows and Martins. Many of these are inhabitants of the British Islands. The following are the forms described in Yarrell's 'History of British Birds:'—

Hirundo.—Beak very short, depressed, and very wide at the base;

upper mandible curved downwards at the point; the culmen elevated; nostrils basal, oval, partly covered by membrane; legs short; toes slender, three in front, one behind; claws curved; wings long and pointed.

H. rustica, the Swallow, the Chimney-Swallow.

H. urbica, the Martin, the Martin-Swallow, the House-Martin.

H. riparia, the Sand-Martin, the Bank-Martin.

Cypselus.—Beak very short, triangular at its base, wide, concealed, depressed, gape extending beyond the eyes; upper mandible hooked at the point; nostrils longitudinal, near the ridge of the beak, open, the edges raised, and furnished with small feathers; tarsi very short; toes four, all directed forwards and entirely divided; claws short, strong, and curved; wings very long; the first quill-feather a little shorter than the second.

C. apus, the Swift, the Swift Swallow, the Common Swift.

C. alpinus, the Alpine Swift, the White-Bellied Swift.

For an account of the other members of the family, see SWALLOW TRIBE.

HISINGERITE. [THRAULITE.]

HISTOLOGY (ἱστὸς and λογὸς), that department of science which embraces the facts relating to the ultimate structure of the parts of plants and animals. These facts have been usually comprehended under the term General Anatomy, but more recently it has been found convenient to use the term Histology. It is only recently that this word could be needed, for the observations upon which the science is founded have only been made since the extensive employment of the microscope. It may be said to have originated with Marcellus Malpighi (1628-94) and Anton von Leeuwenhoek (1622-1723) at the time when magnifying glasses were first constructed of such a kind as to be useful in observing the structure of plants and animals. The ultimate composition of organised bodies was unknown to ancient observers, as well as those who lived in the middle ages. It is true that Aristotle and Galen speak of homogeneous and heterogeneous parts of the body; and Fallopius, at the beginning of the 16th century, defined still more accurately the idea of what are now called the tissues of the body, yet the more minute structure of these parts was entirely hidden from these observers. Even after the time of Malpighi and Leeuwenhoek little was done towards unravelling the intimate structure of the tissues till the beginning of the present century. We can only point to such men as Fontana, Muys, Lieberkühn, Hewson, and Prochaska, as having engaged in isolated observations upon the structure of various parts of the body. It was not till the year 1801 that a connected view of the tissues of the human body was given to the world, in such a form as to lay the foundations of what is now called the science of Histology. The 'Anatomie Generale' (Paris, 1801) of Bichat was in fact the first attempt to treat the subject of Histology scientifically. It was not so much that Bichat contributed new observations on this subject, as that he systematically arranged what had hitherto been done, and called attention to the importance of the subject, and to the fact that it lay at the foundation of all physiological and pathological inquiries.

In the direction of botany, the present century witnessed the observations of Robert Brown, who was the first to draw the attention of botanists to the importance of minute observations on the tissues of plants. One of the earliest attempts at a systematic arrangement of the tissues of plants was made by Slack, in the 39th volume of the 'Transactions of the Society of Arts,' in a paper on the Elementary Tissues of Plants and on Vegetable Circulation. Observations upon the cellular and vascular structure of plants multiplied, and a greater value and interest was given to these than they had before possessed by the observations of Schleiden on the origin and development of the cells of plants in his paper on Phytogenesis, published in Müller's 'Archiv fur Anatomie und Physiologie,' Part ii., 1838. He here pointed out, that in the formation of vegetable cells, small sharply-defined granules are first generated in a granulous substance, and around them the cell-nuclei (cytoblasts) are found, which appear like granulous coagulations around the granules.

The results of these observations were communicated in 1837 to Schwann, who, struck with the resemblance between the cells of animals and those of plants, conceived the idea that the same history of development would be found true of the parts of animals that had been discovered by Schleiden in the parts of plants. From this time the science of Histology made rapid progress, and we cannot more appropriately present its present condition than in the language of Professor Kolliker, in his introduction to his 'Manual of Human Histology:'—

"In the year 1838 in fact the demonstration by Dr. Th. Schwann of the originally perfectly identical cellular composition of all animal organisms, and of the origin of their higher structures from these elements, afforded the appropriate conception which united all previous observations, and afforded a clue for further investigations. If Bichat founded Histology more theoretically by constructing a system and carrying it out logically, Schwann has by his investigations afforded a basis of facts, and has thus won the second laurels in this field. What has been done in this science since Schwann has been indeed of great importance to physiology and medicine, and in fact of great value in a purely scientific point of view, inasmuch as a great deal which Schwann only indicated or shortly adverted to, as the genesis of the cell, the import of the nucleus, the development of the higher tissues, their chemical relations, &c., has received a further development, but all this has not amounted to a step so greatly in advance as to constitute a new epoch. If, without pretensions to prescience, it be permitted to speak of the future, this condition of Histology will last as long as no essential advance is made towards penetrating more deeply into organic structure, and becoming acquainted with those elements of which that which we at present hold to be simple is composed. If it be possible that the molecules which constitute cell-membranes, muscular fibrils, axile fibre of nerves, &c., should be discovered, and the laws of their apposition and of the alterations which they undergo in the course of the origin, the growth and the activity of the present so-called elementary parts, should be made out, then a new era will commence for Histology, and the discoverer of the law of cell-genesis, or of a molecular theory, will be as much or more celebrated than the originator of the doctrine of the composition of all animal tissues out of cells.

"In characterising the present position of Histology and of its objects, we must by no means forget that, properly speaking, it considers only one of the three aspects which the elementary parts present to observation, namely, their form.

"Microscopical anatomy is concerned with the understanding of the microscopic forms, and with the laws of their structure and development, not with any general doctrine of the elementary parts.

"Composition and function are only involved so far as they relate to the origin of forms and to their variety.

"Whatever else respecting the activity of the perfect elements and their chemical relations is to be found in Histology, is there either on practical grounds, in order to give some useful application of the morphological conditions, or to complete them, as, from its intimate alliance with the subject, it is added only because physiology proper does not afford a due place for the functions of the elementary parts.

"If Histology is to attain the rank of a science, its first need is to have as broad and certain an objective basis as possible. To this end the minuter structural characters of animal organisms are to be examined on all sides, and not only in fully-formed structures, but in all the earlier periods from their first development.

"When the morphological elements have been perfectly made out, the next object is to discover the laws according to which they arise, wherein one must not fail to have regard also to their relations of composition and function. In discovering these laws, here as in the experimental sciences generally, continual observation separates more and more, among the collective mass of scattered facts and observations, the occasional from the constant, the accidental from the essential, till at last a series of more and more general expressions of the facts arises, from which in the end mathematical expressions or formulæ proceed, and thus the laws are enumerated.

"If we inquire how far Histology has satisfied these requirements, and what are its prospects in the immediate future, the answer must be a modest one. Not only does it not possess a single law, but the materials at hand from which such should be deduced are as yet relatively so scanty, that not even any considerable number of general propositions appear well founded. Not to speak of a complete knowledge of the minuter structure of animals in general, we are not acquainted with the structure of a single creature throughout, not even of man, although he has been so frequently the object of investigation; and therefore it has hitherto been impossible to bring the science essentially nearer its goal. It would however be unjust to overlook and depreciate what we do possess; and it may at any rate be said that we have acquired a rich store of facts, and a few more trustworthy propositions. To indicate only the more important of the former, it may be mentioned that we have a very sufficient acquaintance with the perfect elementary parts of the higher animals; and that we also understand their development, with the exception of the elastic tissue, and of the elements of the teeth and bones. The mode in which these are united into organs has been less examined; yet on this head also much has been added of late, especially in man, whose individual organs, with the exception of the nervous system, the higher organs of sense, and a few glands (the liver, blood-vascular glands), have been almost exhaustively investigated. If the like progress continue to be made, the structure of the human body will in a few years be so clearly made out, that, except perhaps in the nervous system, nothing more of importance will remain to be done with our present modes of investigation. With Comparative Histology it is otherwise: hardly commenced, not years but decades will be needed to carry out the necessary investigations. Whoever will do good work in this field must, by monographs of typical forms embracing their whole structure from the earliest periods of development, obtain a general view of all the divisions of the animal kingdom, and then by the methods above described strive to develop their laws.

"As regards the general propositions of Histology, the science has made no important progress since Schwann; however, much has been attained by the confirmation of the broad outlines of his doctrines. The position, that all the higher animals at one time consist wholly of cells, and develop from these their higher elementary parts, stands firm; though it must not be understood as if cells, or their derivatives, were the sole possible or existing elements of animals. In the same way, Schwann's conception of the genesis of cells, though considerably modified and extended, has not been essentially changed, since the cell-nucleus still remains as the principal factor of cell-development and of cell-multiplication. Least advance has been made in the laws which regulate the origin of cells and of the higher elements; and our acquaintance with the elementary processes which take place during the formation of organs must be regarded as very slight. Yet the right track in clearing up these points has been entered upon; and a logical investigation of the chemical relations of the elementary parts and of their molecular forces, after the manner of Donders, Dubois, Ludwig, and others, combined with a more profound microscopical examination of them, such as has already taken place with regard to the muscles and nerves, and further, a histological treatment of embryology, such as has been attempted by Reichert, Vogt, and myself, will assuredly raise the veil, and bring us step by step nearer to the desired though perhaps never-to-be-reached end."

In accordance with the plan of this work, the Histology of each separate organ of the body will be found in the general article devoted to that organ.

The tissues or textures of the body enumerated in the article ANATOMY will be found under their respective names; and in the articles TISSUES, VEGETABLE, and TISSUES, ANIMAL, will be found an account of the relations and general physiology of the textures of the body.

Necessary aids to the study of Histology are the microscope and books. Under the article MICROSCOPE, in ARTS AND SC. DIV., the nature of that instrument and the mode of using it will be described, as well as the various forms adapted for histological purposes.

We refer here to some of the more important works and papers to be consulted on this subject.

Kölliker, *Manual of Human Histology*; Sharpey, *General Anatomy*, in Quain's *Elements of Anatomy*; Beale, *The Microscope, and its Application to Clinical Medicine*; Todd and Bowman, *Physiological Anatomy*; Gerber, *Elements of the General and Minute Anatomy of Man and the Mammalia*; Goodsir, *Anatomical and Pathological Observations*; Hassall, *Microscopic Anatomy*; Bowman, *On the Structure of Voluntary Muscle* (*Phil. Trans.*, 1840); Kiernan, *On the Structure of the Liver* (*Phil. Trans.*, 1835); Mandl, *Manuel d'Anatomie Générale*; Mohl, *On the Vegetable Cell*; Owen, *Lectures on Comparative Anatomy*; Quekett, *Lectures on Histology*; Schleiden, *Principles of Scientific Botany*; Schleiden and Schwann, *Microscopical Researches* (Sydenham Society); *Cyclopædia of Anatomy and Physiology*; Robin, *Histoire Naturelle des Végétaux Parasites*; Carpenter, *Principles of Physiology, General and Comparative*.

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HOAZIN. [CRACIDÆ.]

HOBBY. [FALCONIDÆ.]

HOCCO, a name employed by Buffon, Latham, and others, to designate some of the Curassow Birds. [CRACIDÆ.]

HOE. [SQUALIDÆ.]

HOG. [SUIDÆ.]

HOG-MEAT. [BOERHAAVIA.]

HOG-PLUM. [SPONDIACEÆ.]

HOLASTER, a genus of Fossil *Echinidæ*, proposed by M. Agassiz to include species once ranked as *Spatangi*. *Spatangus subglobosus* (Leske), *S. planus* (Mantell), and *S. hemisphericus* (Phillips), are examples. The species occur almost exclusively in the Chalk Formation. [ECHINODERMATA.]

HOLCUS, a genus of Grasses belonging to the tribe *Avenew*. It has 2-flowered glumes, the lower perfectly awnless, the upper usually stameniferous, with a dorsal awn; the paleæ hardening on the fruit. There are two British species of this genus. *H. lanatus* has the upper glume obtuse, apiculate; the awn smooth, except for a short distance from the tip. It grows in meadows and pastures. *H. mollis* has the upper glume acute, and the awn rough throughout its whole extent. It grows in thickets or open places on a light soil. The *H. cernuus* of Willdenow, and the *H. sorghum* of Linnæus are now referred to the genus *Sorghum*. [SORGHUM.] Fraas refers the Μέλινη of Theophrastus ('Hist. Plant.,' viii. 1, 3, 7, 10) to these grasses, and not to the *Setaria Italica*, as had been done by previous authors.

(Babington, *Manual of British Botany*; Fraas, *Synopsis Plant. Floræ Classicæ.*)

HOLETUA. [TRACHEARIA.]

HOLIBUT. [HIPPOGLOSSUS.]

HOLIGARNA, a genus of Plants belonging to the natural order *Anacardiaceæ*. The berries of *H. longifolia* are manufactured in India into a well-known black varnish.

HOLLY. [ILEX.]

HOLLY, SEA. [ERYNGIUM.]

HOLLYHOCK. [ALTHÆA.]

HOLMESITE. [CLINTONITE.]

HOLOCANTHUS. [CHÆTODON.]

HOLOCENTRUM (Agassiz), the name of a genus of Fossil Ctenoid Fishes from Monte Bola. [FISH.]

HOLOCENTRUS, a genus of Fishes belonging to the family *Scomberidæ*. *H. niger* of Lacépède is the *Centrolophus pompilius* of Cuvier and Valenciennes. [CENTROLOPHUS.]

HOLO'PTYCHIUS (Agassiz), the name of a genus of Fossil Ganoid Fishes from the Carboniferous Limestone of Burdie House near Edinburgh, and other localities. [FISH.]

HOLO'STEUM (from ὅλος, all, and ὀστέον, a bone, an antiphrasis applied to this plant because it is soft and unlike bone), a genus of Plants belonging to the natural order *Caryophyllaceæ*, and the sub-order *Alsineæ*. It has 5 sepals; 5 petals, toothed at the end; 3, 4, or 5 stamens; 3 styles; a subcylindrical many-seeded capsule, opening at the end, with 6 teeth. The species of this genus are herbs with nothing to recommend them for use or cultivation. One species, *H. umbellatum*, is British. It has umbellate flowers, pubescent viscid peduncles, the pedicels reflexed after flowering, the leaves acute, elliptical, or elongate. It is not a common plant, but has been found on old walls and dry places at Norwich, Bury St. Edmunds, Eye, and Yarmouth. (Babington, *Manual of British Botany.*)

HOLOTHURIA. [HOLOTHURIADÆ.]

HOLOTHU'RIADÆ, a family of Animals belonging to the order *Echinodermata*.

Linnæus, in his last edition of the 'Systema Naturæ' (the 12th), gives the following definition of his genus *Holothuria*, which he places under his *Vermes Mollusca*, between *Tethys* and *Terebella*:—"Body free, naked, gibbous; vent (anus) terminal. Tentacles numerous at the other extremity (tentacula plura in alterâ extremitate). Mouth situated among the tentacles." He records 9 species. Gmelin, in his edition (13th), increases the species to 23.

The following is Lamarck's definition of *Holothuria*:—"Body free, cylindrical, thick, soft, very contractile; with a coriaceous skin, which is most frequently papillose. Mouth terminal, surrounded with tentacula divided laterally, subramose, or pinnated. Five calcareous teeth in the mouth. Vent at the posterior extremity." He gives 10 species of *Holothuria*; but he separates other *Holothuriæ* of authors into the genera *Fistularia* and *Priapulus*. These three genera are preceded by *Actinia*, and followed immediately by *Sipunculus*. The place therefore assigned by Lamarck to *Holothuria* is among the Radiated Animals, in his third section of which, the Fistulides, he has arranged the tribe.

Cuvier gives the *Holothuriæ* a position among the Pedicillated Echinoderms, making them follow the *Echinidæ*. *Priapulus* is placed by him in the next order, the Footless Echinoderms. He gives a good outline of the anatomy, referring to the excellent work of Tiedemann.

M. De Blainville's *Echinodermata* form the first class of his *Actinozoa*, and the first order of that class consists of the *Holothuridea*, which are followed ('Actinologie,' 1834) by the *Echinidea*, his second order. M. De Blainville thus defines the *Holothuridea*:—

"Body more or less elongated, sometimes subvermiform, soft or flexible on all sides, provided with tentaculiform suckers, often numerous, very extensible, completely retractile, and pierced by a great orifice at each extremity. Mouth anterior, at the bottom of a sort of funnel or prebuccal cavity, sustained in its circumference by a circle of fibro-calcareous pieces, and provided with a circle of arbuscular appendages, more or less ramified. Vent terminating in a sort of cloaca opening externally by a large terminal orifice. Generative organs terminating externally by a single mesial orifice at a little distance from the anterior extremity, and nearly marginal."

M. De Blainville observes that Bianchi appears to have been the first who came to the conclusion that this form ought to be approximated to the *Echini*, and in fact names one species, *Echinus coriaceus*; an opinion which was adopted by Blumenbach and most of the modern zoologists, when they made the *Holothuriæ* a division of their Echinoderms with the *Echini* and *Asteriæ*; some however, following the idea of Pallas, consider that they should be placed near the *Actiniæ*.

The author last quoted remarks that the organisation of these animals is not yet completely known, notwithstanding the labours of Bohatsch, Müller, Vahl, Forskahl, Monro, Tiedemann, and Delle Chiaje. In addition to these names we would call the attention of the reader to the drawing and description of *Holothuria tremula*, Linn., left by John Hunter. The drawing is beautifully engraved, and, with the description, will be found in the 1st vol. of the Descriptive and Illustrated Catalogue of the 'Physiological Series of Comparative Anatomy, contained in the Museum of the Royal College of Surgeons in London,' pl. iii. The following parts are distinctly made out, namely:—1, The mouth, in which the bristle is introduced. 2, Appendicula cæca, which surround the mouth, or fauces, into which they enter, and which Mr. Hunter supposes to be salivary glands and ducts. 3, A large one, lower down, just at the beginning of the intestinal canal. 4, The whole tract of the intestinal canal, which is of considerable length. 5, The dilated part of the intestine, or rectum, or what seems to answer the same purpose as the dilated part of the gut at the anus in a bird. 6, The anus. The use of the parts to which we next have to advert, though the parts themselves are most clearly demonstrated, seems to have been more the subject of conjecture with Mr. Hunter. 7, Two branching bodies almost like a tree, which consist of a duct with its branches, and which open into the dilated part of the rectum. These Mr. Hunter suspects to be the kidneys, from their opening similar to the kidneys in birds, turtles, &c. There are small oblong bodies near the opening of the principal trunk into the rectum. 8, A vast number of hollow round tubes, all entering into one duct, which opens at the head. These will be best seen in another plate which will be published in the fasciculus of the catalogue relating to generation. 9, Vessels which seem to have neither beginning nor end, somewhat like the vena portarum: "they appear," adds Mr. Hunter, "to be collecting at one end while they are ramifying at the other; but which is the collecting end, and which the ramifying, I do not know; however it is possible one end is the absorbing system, the other the arterial. Whenever there is a heart one commonly can make out the motion of the blood from and to that viscus; but where we are deprived of that guide it becomes difficult to determine." 10, A distinct vessel from the former. These parts are indicated in the plate.

The preparation No. 984 (Physiological Series—Gallery) in the museum of the Royal College of Surgeons, is the specimen of *Holothuria tremula* laid open, and the alimentary canal and generative tubes turned aside to show the respiratory organs, which have been injected. These organs consist of two elongated, hollow, ramified processes, commencing by a common orifice from the closed cavity, and extending towards the opposite end of the body. One of them is in more immediate connection with the alimentary canal, and is abundantly supplied by ramifications of the intestinal vessel, the contents of which are thus brought into necessary communication with the sea-water introduced into the tubular branchia from the cloaca. The other gill is more closely attached to the parietes of the body, and probably serves to aërate the vessels of that part. ('Cat.,' vol. ii.) To this Professor Owen adds, that in the description of the *Holothuria* above quoted, Mr. Hunter attributes to these organs a more limited share in the great excretory functions than they undoubtedly perform, regarding them, from their connection with the cloaca, as analogous to the kidneys of the higher animals. Distinct urinary organs are not however, observes the Professor, developed until we arrive at a much higher point in the scale of organisation than the *Holothuria* and its congeners attain to; the preparation is therefore placed in the respiratory series.

In his 'British Star-Fishes,' Professor E. Forbes makes the following general observations on this family:—

"A *Holothuria* may be regarded in one light as a soft Sea-Urchin, in another as a radiated animal, approximating the Annelides. The radiation of the surface is more or less complete in all the genera of *Holothuriadæ*: the internal organisation is mostly bilateral. The skin is usually soft and leathery; in a few genera strengthened by calcareous or horny spines. Five avenues of suckers separate the body into as many longitudinal segments, which in the majority are of equal or nearly equal dimensions. In some the suckers are developed only on one side, so that the animal when creeping presents in a manner a back and a belly. The suckers are similar to those of the true star-fishes and sea-urchins. Besides progression by means of these suckers, the *Holothuriadæ* move as Annelides, by the extension and contraction of their bodies. They have a mouth and an anus, each terminal, and placed at opposite extremities of their bodies. The mouth is surrounded by plumose tentacula, the number of which, when they are complete, is always a multiple of five; but as these animals are singularly subject to the loss or absence of parts in individuals of the various species, much confusion has arisen from the establishment of supposititious species from characters founded on abnormal numbers of the parts.

"The tentacula are ramose cirrhi; they can be retracted within the mouth, and sometimes when in captivity the animal will not exsert them for days together, though otherwise active. They are drawn in with the skin, and when we cut open a *Holothuria* having its tentacula retracted, we find them in the centre of a dental circle. The circle of teeth is analogous to that of the *Echini*. The œsophagus passes through it, and opens into a more or less muscular stomach, from which an intestine, often very complicated, proceeds to the posterior extremity of the body, where it opens into a funnel-shaped cloacum, into which also open the two tree-like respiratory organs. There is a vascular circle (and some say a nervous cord) surrounding the mouth, and vessels are distributed from it to various parts of the body and organs. One or more sacs of a pyriform shape depend from a vessel surrounding the pharynx, and are by many believed to be salivary organs. Mr. Goodsir has found a sac containing calcareous concretions on one side of the mouth in certain species. This he regards as a madreporiform tubercle or nucleus. The ovaries are in many species very numerous, in others very few, and unite to form a tube which opens at one side towards the upper extremity of the animal. The inner surface of the animal's skin is lined with powerful longitudinal and transverse muscles, by means of which the creature contracts its body and lengthens it out in many directions, changing its form in a wonderful manner. Sometimes the creature ejects all its viscera, or bursts the body with its convulsive contractions. It is usually stated that the *Holothuriæ* do so whenever they are taken, but such is not the case. I have never seen the animal disgorge its intestines, but specimens of many species have I seen in which there was not a trace left of the creature's bowels and other internal organs, though it seemed, when taken, alive and healthy. It is astonishing how long they can live deprived of the most essential parts of their organism. Sometimes they are found wanting the respiratory organs, and sometimes the generative tubes are deficient, and these deficiencies so frequently occur that we should be extremely shy of proclaiming differences in the internal structure of species; and when we see genera and species (as has been the case) anatomically defined from the want of respiratory trees or genital tubes, we should be extremely cautious about admitting such, and rather regard such wants as accidental deficiencies in a few specimens than as organic peculiarities.

"The *Holothuriadæ* are generally distributed through the seas of the globe, but are congregated in greatest numbers in the Eastern seas. On our shores they are rare and unattractive animals, not often seen even by the zoologist; but abroad they are very abundant and in some places used as food. Of one genus, the Trepang, many species are eaten. In Mr. F. D. Bennett's interesting 'Account of a Whaling Voyage round the World,' we are told that there are two kinds of Trepang abundant on the rocks at Raialia, and that they are very indolent animals. 'When handled,' says Mr. Bennett, 'the Trepang contracts its body in a longitudinal direction, and should its tentacles be expanded they are instantly concealed; but no noise or agitation of the surrounding water will excite these symptoms of alarm, or cause any attempt to escape. They usually lie exposed in the shallow waters, though we have very often seen them buried in beds of coral-sand, their plumy tentacles being alone exposed, and floating in the water above, apparently as a lure for prey. Some may also be observed lying on the rocks, their bodies completely encrusted with coral-sand, which may either have been accumulated by a previous burrowing, or thus used as a disguise. It would appear to be partly the instinct of the animal to take its prey in ambush, but what that prey is, as well as the entire economy of these molusca, remains a perplexing mystery. Their intestines invariably contain many hard and solid masses of madreporic rock or tree-coral, some of them more than an inch in length, and all moulded as pellets to the calibre of the intestinal canal.

"It is difficult to say how these stony bodies have been obtained by the Trepang, though it is easy to conceive that they may be rendered serviceable as nutriment, by the assimilation of the animal matter they contain. It is this animal which the Malays of the Oriental Isles seek so diligently for the supply of the China market, where it obtains a good price if well preserved.

"It is employed by the Chinese in the preparation of nutritious soup, in common with an esculent sea-weed, sharks' fins, edible birds'-nests and other materials, affording much jelly." Jæger says the intestines are extracted, the animal then boiled in sea-water and dried in smoke.

The British *Holothuriadæ* belong to four families, namely:—

1st. The *Psolidæ*, or Ascidian *Holothuriadæ*, animals approaching the *Mollusca* in their form, and having a soft circumscribed disc like the foot of a Gasteropodous Mollusc, on which the suckers are placed for progression. [PSOLIDÆ.]

2nd. The *Pentactæ*, which have the suckers arranged in five regular rows, and are more or less angular in form. [PENTACTÆ.]

3rd. The *Thyones*, which have the suckers scattered all over the surface of the body. [THYONES.]

4th. The *Synaptæ*, in which there are no suckers on the body, the oral tentacula being the only representatives of those organs. [SYNAPTÆ.]

De Blainville refers the difficulty of the distinction of the species of *Holothuriadæ* to the following, among other causes:—

1. The general form is extremely variable. When the animal is in a state of tranquillity in the enjoyment of all its faculties at the bottom of the water, it is, in the greatest number of cases at least, very much elongated, often cylindrical, and almost vermiform: on the contrary, when in a state of repose, it becomes much shorter and ordinarily more convex in the middle than at the extremities. When it is irritated, whether in or out of the water, the contractile action becomes stronger, and the animal can no longer be recognised. But it is especially when it has been plunged in spirit, that the form differs totally from that which the living animal exhibits.

2. The size, the form, and distribution of the more or less mammillated tubercles which are numerously spread over the skin, appear to M. De Blainville to offer too great a number of variations to permit of their being employed in distinguishing specific character.

3. The tentaculiform suckers, which have their exit through the pores or holes in the skin, and by means of which these animals attach themselves to submarine bodies, are, in a certain number of species, spread nearly equally over the whole superficies of the body; but in others they are accumulated on the lower surface, without order, in a determinate order, or are disposed in double series upon five longitudinal lines, as in *H. pentacta*.

4. The more or less terminal position of the two orifices may, M. De Blainville thinks, be taken into consideration advantageously.

5. Some zoologists, and among others M. Lesueur, says M. De Blainville, attach a great importance to the number of the tentacular appendages of the mouth, and to their form and mode of division; but, M. De Blainville fears, erroneously, for he has been positively assured that the most common species of the Mediterranean, *H. tubulosa*, which is found in hundreds at Toulon, varies much, both as to the number and terminal divisions of those organs.

6. It seems to M. De Blainville that a better character may be drawn from the form of the circle of the solid pieces of the mouth, which is constant, as he believes, in each species; it is however difficult to employ this test.

7. To judge from a considerable number of *Holothuriæ tubulosæ* seen by M. De Blainville, colour in these animals is very variable, in intensity at least, passing from a nearly deep black to a reddish bordering upon whitish.

8. With regard to dimensions, besides the difficulty of measuring the animals when captured, it appears that they vary considerably in size, doubtless from age.

M. De Blainville finally, after a careful analysis of the different species described by authors, joiued to his own observations upon seven or eight species in a living state, distributes these animals into the following five sections, which he considers to be sufficiently natural, and some of which may be established as genera :—

Body	Flattened, with suckers below	*Cuvieria.*
	Subprismatic, with inferior suckers . . .	*Holothuria.*
	Fusiform, with scattered suckers	*Thyone.*
	Vermiform, with pinnated tentacles . . .	*Fistularia.*
	Subpentagonal, with ambulacriform suckers .	*Cucumaria.*

A. Species whose rather short body, more convex and harder above than below, is provided with tentaculiform suckers only on that side, and with fairly developed buccal appendages; the two apertures more or less superior. (*Cuvieria*, Péron; *Psolus*, Oken.)
Ex. *H. Phantapus.* Scarborough *Ascidia* of Pennant. ('Brit. Zool.')

B. Species whose coriaceous and rather elongated body is subprismatic; tho belly sufficiently distinct from the back, and alone provided with tentaculiform suckers, scattered throughout its whole extent; the buccal appendages in general but little ramified; the mouth snb-inferior. (*Holothuria*, Lam.)
Ex. *H. tubulosa.*

C. Species whose body, in general elongated, but little coriaceous, cylindrical, or fusiform, is entirely covered with retractile papillæ, aud whose buccal appendages are very large. (*Thyone*, Oken; *Mulleria*, Fleming.)
Ex. *H. papillosa.*

D. Very soft species, but little or not at all coriaceous, very long and vermiform, cylindrical or subpentagonal, provided with cirrhiform papillæ, which are very small, scattered, and with the buccal appendages usually regularly pinnated.
Ex. *H. vittata.*

E. Species sufficiently coriaceons, smooth, in general short or moderately elongated, regularly pentagonal, with tentaculiform suckers in 10 rows, two at each ambulacral angle. (*Cucumaria*, Sea-Cucumbers.)
Ex. *H. Cucumis.*

More recently Messrs. Jæger and Brandt have given a classification of the *Holothuriadæ.* The characters upon which the system of Messrs. Jæger and Brandt rests are the following :—

1. The absence or the presence of tentaculiform suckers, which M. Braudt, as well as M. Jæger, calls fect, in common with mauy zoologists.

2. Tho resemblance or dissemblance of those organs.

3. Tho existence or absence of the posterior and internal aquiferous, branchial apparatus, which they name lungs, with good reason, because the ambient fluid penetrates therein.

4. The disposition of the tentaculiform suckers at the surface of the body, all ronnd it or on certain parts only, in regular series, of variable number or irregularly scattered.

5. The freedom or the adhesion of the respiratory aquiferous tree, divided by M. Jæger into the intestinal lung and the locomotive lung.

6. The last and least important character is drawn from the form of the tentacles which surround the buccal aperture, which leads M. Jæger to his sub-genera and tribes, and M. Brandt to his genera and sub-genera. M. Jæger forms, says M. De Blainville, in fact three groups only, which he considers as sub-genera, *Cucumaria*, *Tiedemannia* (*Fistularia*), and *Holothuria*, which he separates into six tribes, *Mulleria*, *Bohatschia*, *Cuvieria*, *Psolus*, *Holothuria*, and *Trepang*, this last being in truth held doubtful in the system of M. Braudt, as M. Jæger himself considered it.

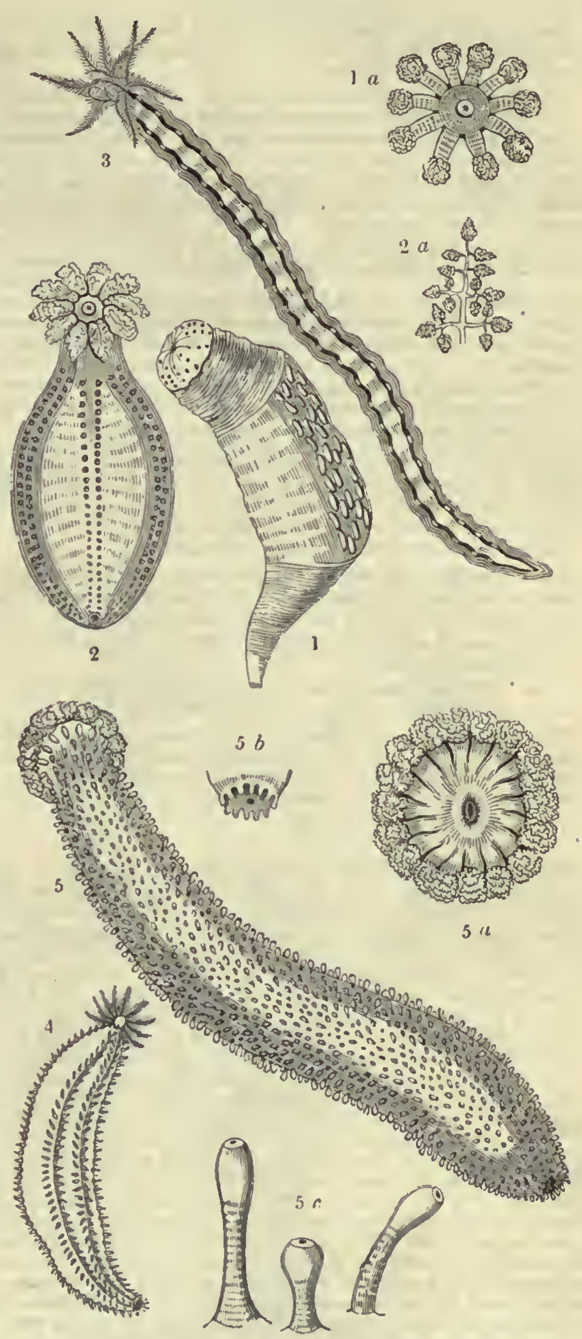
M. Brandt's divisions resolve themselves into seven groups :—

1. *Pentastichoæ*, answering to M. De Blainville's division *E* (*Cucumaria*), and subdivided according to the free or fixed state of the aquiferous tree.

2. *Sporadipodæ*, confounded by M. De Blainville with the *Holothuriæ* properly so called, from which he says they do not differ really, excepting that the tentaculiform suckers with which the body is covered are similar both above and below. This division coutains only two genera, established upou the distinction of having the tentacula sheathed or not.

3. *Hippopodæ*, comprising M. De Blainville's division *A*, separated into two genera, *Cuvieria* and *Psolus*, containing each two species.

4. The *Apneumones*, which were regarded by M. De Blainville as belonging to the genus *Fistularia* of Lamarck, to the number of four



1, *Holothuria Phantapus*; 1 *a*, its buccal appendages. 2, *Holothuria papillosa*; 2 *a*, a branch of its buccal appendages isolated. 3, *Holothuria vittata.* 4, *Holothuria Cucumis.* 5, *Holothuria tubulosa*; 5 *a*, its oral extremity; 5 *b*, its anal extremity; 5 *c*, some of the cirrhi, of the natural size.

or more, the half of which are doubtful, and coutaining only, for M. Brandt, the genus *Oncinolabes.*

5. *Schizopodæ*, which are diversiform species more or less elongated, in which the tentaculiform suckers are disposed in three or five longitudinal rows; these form but two genera, each containing one species only.

6. *Heteropodæ*, corresponding to M. De Blainville's divisions *B* and *C*, that is to say, to his *Holothuriæ* properly so called, and to his *Mulleriæ*, of which M. Brandt forms seven geuera.

All these are *Holothuriæ pedatæ*, but

7. consists of the *Non pedatæ*, forming a great part of M. De Blainville's division *D*, that is to say, the geuus *Fistularia* of Lamarck, separated into three principal genera, two of which, provided with aquiferous trees, are distinguished by the form of their body, and the third has beeu named *Synapta* by Escholtz.

M. De Blainville, iu his 'Nouvelles Additions et Corrections' to his 'Actinologie,' published in 1834, gives the followiug amended divisions, which he subdivides, retaiuing many of the generic uames of Jæger and Brandt.

A. The *Vermiform Holothuriæ* (*Fistularia*), which have the body elongated, soft, vermiform, and the tentacular suckers very small or even null. Three divisions.

1. Without suckers, tentacula pinnated. (*Synapta*, Escholtz.)
2. Without suckers, tentacula pinnatifid. (*Chirodota*, Escholtz.)
3. Very small suckers disposed in five bands. (*Onciolabes*, Brandt.)

B. The *Ascidiform Holothuriæ* (*Psolus*), whose body is, on the contrary, short, coriaceous, convex above, flattened below, with superior rather than terminal orifices.

1. Skin as it were squamous. (*Cuvieria*, Péron.)
2. Skin rugose, but soft. (*Psolus*, Oken.)

C. The ordinary or *Vertilliform Holothuriæ*, whose body is sufficiently elongated, sufficiently soft, subcylindrical, and covered throughout with tentaculiform suckers, the lowest of which are longest.

1. Vent (anus) largely open. (*Holothuria*.)
2. Vent plaited. (*Bohadschia*, Jæger.)
3. Vent closed with five teeth. (*Mulleria*, Jæger.)

D. *Holothuriæ*, whose body is more or less elongated; the lower tentacular suckers longer than the upper ones, and disposed in longitudinal series in a determined number.

1. Suckers in three rows. (*Stichopus*, Brandt.)
2. Suckers in five rows. (*Diploperideris*, Brandt.)

E. The *Cucumiform Holothuriæ*, whose body is but little elongated, more or less fusiform, pentagonal, with tentaculiform suckers forming five ambulacra, one on each angle. (Brandt.)

1. Tentacular suckers very small or null. (*Liosoma*, Brandt.)
2. Suckers very visible.
   a. Tentacles pinnated, ramose. (*Cladodactylus*, Brandt.)
   b. Tentacles pinnatifid. (*Dactylota*, Brandt.)

F. The *Sipunculiform Holothuriæ*. Body more or less suddenly attenuated backwards, of an ill-defined pentagonal form, without either ambulacra or suckers (?). Tentacles simple, short, and cylindrical, as in the *Actiniæ*. (*Molpadia*, Cuvier.)

1. *M. Holothuroides.* (Cuvier.)
2. *M. musculus.* (Risso.)

When M. De Blainville says that he has never heard that any of these animals were of much utility to mankind, but that M. Delle Chiaje does indeed inform us that the poor inhabitants of the Neapolitan coasts eat them, he appears to have forgotten the great oriental traffic carried on with some of the species, as an article of food, under the name of Trepang or Tripang, Biche-de-Mer or Beche-de-Mer. Captain Flinders fell in with a fleet of Malay proas at the English Company's Islands, north coast of Australia, near the Gulf of Carpentaria (1803), and was informed that sixty proas belonging to the raja of Boni, and carrying one thousand men, had left Macassar with the north-west monsoon, two months before, on an expedition to that coast. "The object of their expedition," writes Captain Flinders ('Voyage to Terra Australis'), "was a certain marine animal called Trepang. Of this they gave me two dried specimens; and it proved to be the Beche-de-Mer, or Sea-Cucumber, which we had first seen on the reefs of the east coast, and had afterwards hauled on shore so plentifully with the seine, especially in Caledon Bay. They got the Trepang by diving, in from three to eight fathoms water; and where it is abundant, a man will bring up eight or ten at a time. The mode of preserving it is this :—the animal is split down one side, boiled, and pressed with a weight of stones, then stretched open with slips of bamboo, dried in the sun, and afterwards in smoke, when it is fit to be put away in bags, but requires frequent exposure to the sun. A thousand trepangs make a 'picol' (of about 125 Dutch pounds); and one hundred picols are a cargo for a prow. It is carried to Timor, and sold to the Chinese, who meet them there; and when all the prows are assembled, the fleet returns to Macassar. By Timor seemed to be meant Timor-laoet; for when I inquired concerning the English, Dutch, and Portuguese there, Pobassoo (Captain Flinders's informant) knew nothing of them : he had heard of Coepang, a Dutch settlement, but said it was on another island. There are two kinds of Trepang : the black, called Baatoo, is sold to the Chinese for forty dollars the picol; the white or gray, called Koro, is worth no more than twenty. The Baatoo seems to be what we found upon the coral reefs near the Northumberland Islands; and, were a colony established in Broad Sound or Shoal-Water Bay, it might perhaps derive considerable advantage from the Trepang. In the Gulf of Carpentaria we did not observe any other than the Koro, or Gray Slug."

Captain Phillip Parker King, who quotes a part of the above passage ('Survey of the Intertropical Coasts of Australia'), found a fleet of Malay proas in the bay at Coepang (1818): it had just returned from an unsuccessful voyage on the south coast of Timor in search of trepang. Dramah, the principal raja of the fleet, gave Captain King the following information respecting the coast of Australia, which the raja had frequently visited in the command of a fleet that annually frequents its shores. The coast is called by them 'Marega,' and has been known to them for many years. A fleet to the number of 200 proas (but Captain King thinks that this number is perhaps very much exaggerated) annually leaves Macassar for this fishery; it sails in January, during the western monsoon, and coasts from island to island, until it reaches the north-east end of Timor, when it steers south-east and south-south-east, which courses carry them to the coast of Australia; the body of the fleet then steers eastward, leaving here and there a division of 15 or 16 proas, under the command of an inferior raja, who leads the fleet, and is always implicitly obeyed. His proa is the only vessel which is provided with a compass; it also has one or two swivels, or small guns, and is perhaps armed with muskets. Their provisions chiefly consist of rice and cocoa-nuts; and their water, which during the westerly monsoon is easily replenished on all parts of the coast, is carried in joints of bamboo. "After having fished along the coast to the eastward until the westerly monsoon breaks up, they return, and by the last day of May each detached fleet leaves the coast, without waiting to collect in one body. On their return they steer north-west, which brings them to some part of Timor, from whence they easily retrace their steps to Macassar, where the Chinese traders meet them, and purchase their cargoes. At this time (1818) the value of the trepang was from forty to fifty dollars a picol; so that if each vessel returns with 100 picols of trepang, her cargo will be worth 5000 dollars. Besides trepang, they trade in sharks' fins and birds' nests, the latter being worth about 3000 dollars the picol." [SWALLOW TRIBE.] To this Captain King appends a note, stating that in 1822 the value of the trepang was much less, the price having fallen to 25 dollars the picol.

In Crawfurd's 'Indian Archipelago' it is stated that the Slug, or Trepang, is sometimes as much as two feet in length and from seven to eight inches in circumference; a span long and two or three inches in girth is however the ordinary size. But the quality and value do not depend upon its size, but upon properties not discernible by those who have not had much experience in the trade. In shallow water the animal is taken out by the hand, but in deeper water it is sometimes speared. When taken, it is gutted, dried in the sun, and smoked over a wood-fire. The fishery is carried on from the western shores of New Guinea and the southern shores of Australia, to Ceylon inclusive. Indeed within the last few years it has been successfully prosecuted on the shores of the Mauritius. The whole produce goes to China. In the market of Macassar, the great staple of this fishery, not less than thirty varieties are distinguished, varying in price from 5 Spanish dollars a picol (133⅓ lbs.) to fourteen times that price, each variety being distinguished by well known names. The quantity of trepang sent annually to China from Macassar is about 7000 picols, or 8333 cwt.; the price usually varying from 8 dollars a picol to 110 and 115 dollars a picol, according to quality. There is also a considerable export of trepang from Manilla to Canton.

(M'Culloch, *Dictionary of Commerce*, article *Tripang*.)

HOMALIA'CEÆ, a small natural order of shrubby Exogenous Plants with polypetalous flowers, a row of glands in front of the segments of the calyx, many perigynous stamens, and a 2-5-styled ovary, with as many parietal placentæ as styles. The species chiefly inhabit tropical countries; they have small starry flowers, and are of no known utility. Brown considers them nearly related to *Passifloraceæ*. Lindley places them near *Cucurbitaceæ*, *Loasaceæ*, *Cactaceæ*, and *Onagraceæ*. There are 8 genera and 30 species.

1 *Homalium racemosum.* 2

1, an expanded flower; 2, an ovary with its two styles.

HO'MARUS (Milne-Edwards), a genus of Animals belonging to the order *Crustacea*. It embraces the true Lobsters. Milne-Edwards has noticed certain differences which induce him to separate the true

Lobsters (*Homarus*) from the Crawfishes (*Astacus*), and to combine the genera *Astacus*, *Homarus*, and *Nephrops* in one small group, which he designates as the family of the Astacians (*Astacidæ*). These he considers as forming the passage between the Cuirassed Macrurous Crustaceans and the Salicoques, or Shrimps, but as differing sufficiently to require separation. In the general form of the body the *Astacidæ* approximate very nearly to the Salicoques, but they have not, he remarks, like them, branchiæ composed of laminæ piled one on another; these organs being formed by an assemblage of small cylinders more or less long, and brush-like, as in the greater part of the Cuirassed *Macrura*, which the Astacians also resemble in the hardness of their tegumentary skeleton; but their sternum is not enlarged into a plastron, and the nervous ganglions corresponding with the two thoracic rings are distant, and united by rather long double cords.

The body of the Astacians is elongated and a little compressed; the abdomen is very large, but at the same time less developed in proportion to the thorax than it is in the Shrimps. The carapace terminates anteriorly by a moderate rostrum, which overhangs the base of the ocular peduncles. The antennæ are inserted nearly on the same transversal line; those of the first pair are of moderate length, their peduncle is straight, and their terminal filaments two in number. The external or second pair are much longer, and their peduncle is furnished above with a moveable plate, which is analogous to the spiniform appendage in the *Paguri*, as well as to a similar but much larger plate which is found in the Salicoques. In the Astacians this appendage is hastiform, and never entirely covers the last peduncular joint situated below, and it is even rudimentary. The buccal apparatus presents nothing remarkable; the external jaw-feet are elongated, but bent back upon the mouth; their second joint is much larger than those which succeed, and they do not assist in locomotion. The first pair of feet are very large, and terminated by a large didactylous claw; the last four pairs are of moderate length, and nearly of the same general form, excepting that the second and third pairs are provided with a small didactylous claw, and that the last four are monodactylous. The abdomen is nearly of the same size throughout, and presents on each side a lamellar prolongation, which descends so as to incase more or less completely the base of the false feet. The last segment is very wide, and forms, with the two plates of each of the appendages of the sixth ring, a great caudal fin, all the pieces of which are nearly of the same length. The external plate of this fin has a transverse joint towards its posterior third part. The false natatory feet are elongated; in the male the first pair are styliform, nearly as in the *Brachyura*, while the others are terminated by two large foliaceous plates with ciliated borders, a condition which belongs to the whole of these feet in the female. The branchiæ amount to twenty on each side. They are disposed in three rows, so as to form vertical bundles separated by flabelliform appendages, fixed to the base of the feet. These last-mentioned appendages are very large, and are only wanting in the posterior feet.

This family corresponds to the genus *Astacus* of Fabricius; and M. Milne-Edwards, adopting the division established by Dr. Leach in founding his genus *Nephrops*, further separates the Crawfishes properly so called, from the true Lobsters thus:—

Astacians.	Rostrum depressed, and armed with one tooth at most on each side. Last thoracic ring moveable.		*Astacus* (Crawfishes).
	Rostrum straight, and armed with many teeth on each side.	Eyes spherical. Last ring of the thorax soldered to the preceding.	*Homarus* (Lobsters).
		Eyes reniform. Last ring of the thorax preserving a little mobility.	*Nephrops*.

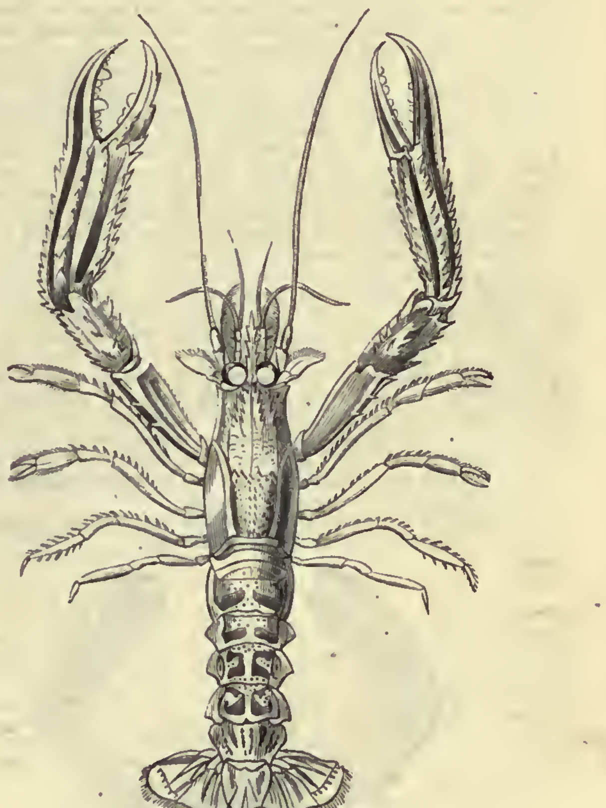
But the separation thus further carried out by M. Milne-Edwards does not depend on external distinctions only; for there are great differences in the conformation of the internal organs of generation and digestion, as compared with that of those essential parts of the animal economy in the other *Astacidæ*. Thus M. Milne-Edwards remarks, that in the Crawfishes the duodenal portion of the intestine presents on its internal surface a great number of small villosities, and is not clearly separated from the rectum, which is smooth internally; while in *Homarus* the duodenum is smooth within, the rectum is plaited internally, and there exists between these two parts of the digestive tube a kind of circular valvule; the posterior cæcal appendage of the intestine, which is seen at the extremity of the duodenum of the true Lobsters, is wanting in the Crawfishes. The liver is composed in the Crawfishes of small cæcal tubes, which are comparatively much more elongated, and its anterior lobes are less developed; the testicle is very small, and is composed of three lobes, whence spring the very long and tortuous deferent vessels, whilst in the true Lobsters these secreting organs are very much elongated, extending from the head into the abdomen, presenting no mesial lobe, but a simple commissure, and only giving rise to very short deferent canals.

The *Astaci*, which are all fluviatile, consist of the species *A. fluviatilis* [ASTACUS], *A. Bartonii*, *A. affinis*, *A. Australasiensis*, *A. Chilensis*, and *A. Blandingii* (?).

The *Homari*, which are all marine, consist of the species *H. vulgaris*, the Common Lobster [ASTACUS], *H. Americanus*, with its immense claws, and *H. Capensis*, according to M. Edwards, who considers the *Astacus scaber* of Fabricius as identical with *H. Capensis*. The species *A. cærulescens*, *A. fulgens*, *A. fulvus*, are unknown to M. Edwards, and considered doubtful by Latreille.

Nephrops (Leach).—Body more elongated than that of the Crawfishes; rostrum slender and rather long, armed with lateral teeth like that of *Homarus*. Eyes large and reniform. Lamellar appendage of the external antennæ wide, and long enough to extend beyond the peduncle situated below. Feet, first pair long and prismatic; succeeding pairs with a compressed manus. Nothing remarkable either in the abdomen or in the buccal appendages. Branchiæ disposed as in *Homarus*.

N. Norvegicus, the Norway Lobster, *Cancer Norvegicus* of Linnæus, is occasionally taken in the seas around the British Islands. It is one of the most beautiful of the larger *Macroura*. Its general colour is pale-flesh, rather darker in parts; the pubescence is light brown. It is generally considered a northern species, but Mr. Bell says he has received specimens from the Mediterranean. It is found on the coast of Norway in large quantities, and is also frequently taken on the coasts of Scotland, and sold in the Ediuburgh and other markets. It is taken in Dublin Bay, and is very common in the Dublin markets. It may also be occasionally seen in the London shops. It is said to be the most delicate-flavoured of all the *Crustacea*. Forms of the *Astacidæ* are found fossil. [CRUSTACEA.]



Norway Lobster (*Nephrops Norvegicus*).

HOME. [RAIIDÆ.]

HOMELYN. [RAIIDÆ.]

HOMOCERCAL. Fishes with symmetrical forms of tails are thus named by M. Agassiz, in contradistinction to Heterocercal. [HETEROCERCAL.]

HOMOLA. [HOMOLIDÆ.]

HO'MOLIDÆ, *Homola Tribe*. The Homolians, according to the system of M. Milne-Edwards, are the second tribe of the Apterurous family of the Anomurous Crustaceans, and their place is between the Dromians and the Raninians.

The carapace is spiny, and armed with a rostrum. Internal pair of antennæ without a pit, and incapable of being bent back upon the front. Jaw-feet pediform. Feet of the second, third, and fourth pairs very long; fifth pair very short, and of no service in progression. Sternal plastron enlarged. Claw terminating the anterior feet, composed of two fingers in the ordinary form. Tarsi of the three following feet styliform. Posterior feet more or less completely prehensile.

M. Milne-Edwards thus divides the tribe into three genera :—

Homolians having the posterior feet.	Sub-cheliform and exposed; carapace quadrilateral.		*Homola.*
	Cheliform, and hidden under the lateral parts of the carapace.	Carapace triangular; rostrum very much elongated.	*Lithodes.*
		Carapace circular; rostrum rudimentary.	*Lomis.*

Homola (Leach).—Carapace longer than wide, nearly quadrilateral; the stomachal region occupying the whole breadth of it anteriorly, and the branchial regions, though not prolonged above the base of the feet, very large; lateral portions of carapace vertical. Front narrow, and advancing so as to form a small rostrum; on each side of its base a large conic tooth directed forwards. Orbits extremely incomplete, even within, where the articulation of the ocular peduncles is naked; they are scarcely limited without, and are continued with a large oblique and very superficial pit, against which the eyes are applied. Ocular peduncles cylindrical, and divided into two portions—one internal, slender, and elongated; the other stout, short, and terminated by the eye. Internal antennæ not lodged in pits; their basilary joint nearly globular and advancing below the insertion of the ocular peduncles; the two succeeding joints very long, the third, as in the *Brachyura*, supporting two very small multiarticulate filaments. External antennæ inserted nearly on the same line as the internal; at their base a large auditory tubercle, which is sometimes extremely projecting; their first joint cylindrical, rather stout, and moderately long; the second slender and very long; the third very short; the terminal filament very long. Buccal frame quadrilateral. External jaw-feet nearly pediform, their three last joints being large, and nearly as long as the two preceding, which are hardly flattened. Sternal plastron much resembling that of the Dromians, and not containing the genital parts. Feet very long; first pair terminated by a nearly cylindrical hand, fifth pair raised upon the back and subcheliform. Abdomen very wide in the male as well as the female, and composed of seven distinct joints; in the female the first ring carries a pair of very short appendages; those of the four succeeding segments are of the same form as in the *Brachyura;* the penultimate ring has no vestige of any appendage. The vulvæ, instead of occupying a place in the sternal plastron, as in the *Brachyura*, are hollowed in the basilary joint of the third pair of feet. The disposition of the branchiæ is equally remarkable: there are 14 on each side; the first is laid across (en travers) under the base of the succeeding ones, and fixed to the base of the second jaw-foot; but the others are all directed obliquely up, and are fixed to the circumference of the vault of the sides. One is inserted at the ring which carries the jaw-feet of the second pair, two above the base of the external jaw-foot, three on each of the two succeeding rings, and two to the penultimate ring.

The species inhabit the seas of Europe.

H. spinifrons has its body covered with yellow hairs; length about 18 lines. It is found in the Mediterranean Sea.

Homola spinifrons. a, left external jaw-foot.

H. Cuvierii is the *Hippocarcinus hispidus* of Aldrovandus, and is also an inhabitant of the Mediterranean Sea.

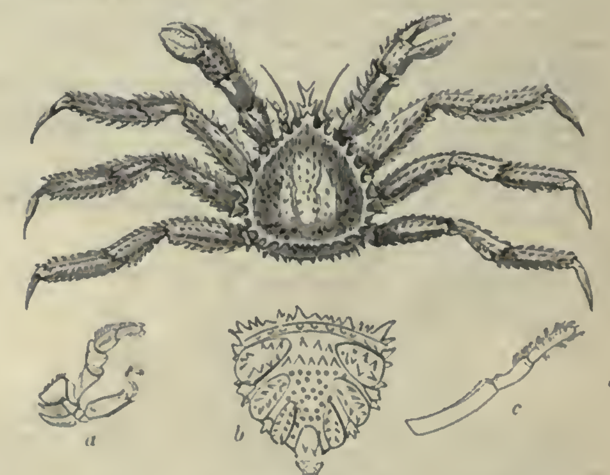
Lithodes (Latreille).—M. Milne-Edwards remarks that up to the present time the *Lithodes* have been arranged among the *Oxyrhynchi* on account of the form of the rostrum; but he asserts that it is not their place, and that they evidently belong to the *Anomura*. They bear, he says, the greatest analogy to the *Apterura*, and especially to *Homola;* but they establish the passage between these crustaceans and *Birgus*.

Carapace triangular or rather heart-shaped, its upper surface distinctly limited by a thick and spiny border. Rostrum horizontal and very long; its base covers the insertion of the eyes, and the anterior border of the carapace is very short. No orbits; but a stout conic tooth is seen at the place ordinarily occupied by the external angle of those cavities. Ocular peduncles very short. Internal antennæ inserted far from the mesial line, below and within the eyes; their first joint nearly cylindrical; the two succeeding of moderate length, and the terminal filaments of the same conformation as in the *Brachyura*. External antennæ inserted more backwards and outwards than the preceding; their basilary joint entirely mortised between a prolongation of the lateral border of the buccal frame and the anterior border of the carapace; the second carries a conic tooth externally, the last joint of the peduncle is long and slender, and finally the multiarticulate stem is rather long. The buccal frame is not distinct, except laterally, where its borders are straight. The external jaw-feet are pediform, and their second joint, which is stout and short, carries internally a strongly-toothed prolongation. The thorax presents a disposition different from that of the crustaceans which precede this genus in the system, but which is general in the succeeding family (*Pterygura*); its last ring is not soldered to the preceding, but free, and even moveable. The sternal plastron is linear between the first pair of feet, but becomes very wide afterwards, and presents complete transverse sutures between the last three segments; in the interior of the thorax there is no posterior sella turcica nor mesial apodeme, nor sternal canal. The feet of the first pair are moderate and cylindrical; the three succeeding pairs are very long and equally cylindrical; finally, those of the fifth pair are extremely small, and bent back in the interior of the branchial cavities; they are cylindrical, and terminated by a small claw with flattened and extremely short fingers. The abdomen is large, triangular, and bent back against the plastron; its basilary part is completely solidified below, but in the terminal half it is only furnished with corneo-calcareous isolated plates, which appear to represent the six last rings. In the female, oviferous filaments seem to exist only on one side of the abdomen.

As in the other Anomurous Crustaceans, the vulvæ are not situated on the sternal plastron, but occupy the basilary joint of the third pair of feet. The branchiæ are disposed as in the rest of the tribe.

L. arctica.—Length of carapace about 5 inches; colour, reddish-yellow.

It inhabits the northern seas.



Lithodes arctica (female).
a, left external jaw-foot; b, abdomen; c, foot of the fifth pair.

Lomis (Milne-Edwards).—M. Milne-Edwards remarks that the small crustacean on which he has founded this new genus has been confounded up to the present time with the *Porcellanæ*, to which it in fact bears a resemblance in its general form, but from which it differs in many important particulars, such as the conformation of the tail, the antennæ, &c. He gives the following generic character:—

Carapace depressed, narrowed anteriorly, and truncated posteriorly, it does not reach beyond the middle of the base of the third pair of feet, and the rest of the dorsal surface of the body is occupied by the base of the abdomen. The front is truncated, and armed with a small mesial tooth; there are no orbital pits, and the ocular peduncles have the form of two great triangular joints, which touch each other on their internal edge, and carry the eyes at their external angle. The internal antennæ are moderate; their first three joints are cylindrical, and terminate by two small filaments. The external antennæ are inserted on the outside of the eyes, and nearly on the same line; they are large, and terminated by a stout multiarticulate stem furnished with long hairs at its lower border. The external jaw-feet are pediform; their third joint has no noticeable dilatation, and the three succeeding joints are very stout. The sternum is large, and the last thoracic ring is not soldered to the preceding. The first pair of feet are very large, very wide, and extremely depressed; the carpus is as large as the arm, and nearly quadrilateral; the claw is stout, short, and nearly horizontal. The three succeeding pairs are short, stout, and terminated by a nearly conical joint; the fifth pair are very slender, and bent back above the others in the branchial cavity. The abdomen is very wide but lamellar, bent back below the sternum, as in the *Porcellanæ*, and presents no vestiges of appendages belonging to the penultimate ring.

M. Milne-Edwards says that he knows nothing of the manners of these small crustaceans, of which only one species is known, namely, *Lomis hirta* (*Porcellana hirta* of Lamarck). The above only is covered by very short and close-set hairs, and the hands are nearly as large as the carapace.

It is supposed to inhabit the seas of Australasia.

HOMOLONO'TUS, the name of a group of *Trilobites*, as they are generally called (*Palæaderna*, Dalman); in which the tripartite character of the dorsal crust is almost lost; for which reason Mr. Miller called it *Monolobite*. *H. Knightii* occurs in the Upper Silurian Rocks of England, aud a similar species at the Cape of Good Hope. [TRILOBITES.]

HOMO'PTERA, one of the sections into which the class *Insecta* is divided. According to Leach, Stephens, and some other authors, the section *Homoptera* is regarded as an order; but in Latreille's arrangement it forms the second of the two great sections into which the order *Hemiptera* is divided. The insects of this group are thus characterised by Latreille:—Rostrum arising from the lowest part of the head near the chest; the elytra, almost always tectiform, are of the same consistence throughout, semi-membranous, and sometimes resembling the wings; the three segments of the thorax are blended, and the first is often shorter than the following.

In the typical *Homoptera* the head is large, broader than long; the eyes are large, and there are ocelli, or simple eyes, between them; the antennæ are minute, composed of but few joints, and terminated by a seta; the rostrum is a slender jointed process, which, like that of the *Hemiptera*, lies close to the chest; the legs are of moderate size; the hinder tibiæ are usually spined; the body is convex above and flattish beneath; the wings are semi-membranous, the anterior pair often opaque, sometimes transparent, aud always of a uniform texture throughout. The larvæ are active, and resemble the perfect insect, excepting that they possess no wings; the pupæ are also active, but possess rudimentary wings.

These insects feed upon vegetable juices. The females are furnished with an ovipositor, composed of three denticulated blade-like processes, which are lodged in a groove in the abdomen. By means of this ovipositor they pierce holes in vegetables, in which they deposit their eggs. Many Homopterous Insects possess the power of leaping by means of their posterior pair of legs.

The section or order *Homoptera* may be divided into the following families, most of which are analogous to Linnæan genera, or nearly so:—

Family 1. *Cicadiidæ* (Leach) comprises those species in which the antennæ are 6-jointed, where there are three ocelli on the upper surface of the head, and where the tarsi are 3-jointed.

In these insects the wings are usually transparent, and have dark nervures; the males are furnished with an apparatus, situated at the base of the abdomen on each side, by means of which they create a monotonous musical sound. They are usually of large size (some measuring as much as 7 inches in width when the wings are expanded), and for the most part inhabit hot countries. But one species is found in England, the *Cicada hæmatodes* of authors, an insect about 2 inches in width, with transparent wings having black nervures, and their basal portion red; the anterior margin of the fore wing is also red; the body is black, but with the margin of each segment red; the legs are red, varied with black. This, which is the largest Homopterous Insect found in England, is not uncommonly met with in the New Forest, in Hampshire.

Family 2. *Fulgoridæ* (Stephens).—Antennæ 3-jointed, inserted beneath the eyes; ocelli two in number; tarsi 3-jointed.

The insects of this family have generally the fore part of the head produced, aud varying in form according to the species. They do not possess the power of creating a sound, nor do those of the following families. [FULGORA.]

The above two families constitute the section *Cicadariæ* of the 'Règne Animal.' The *Fulgoria laternaria* (Linn.) will serve as an illustration of the second. This curious insect is an inhabitant of Brazil. It is about 5 inches wide, and 2½ inches long, of a yellowish colour mottled with black, and having a large ocellated spot on each of the under wings.

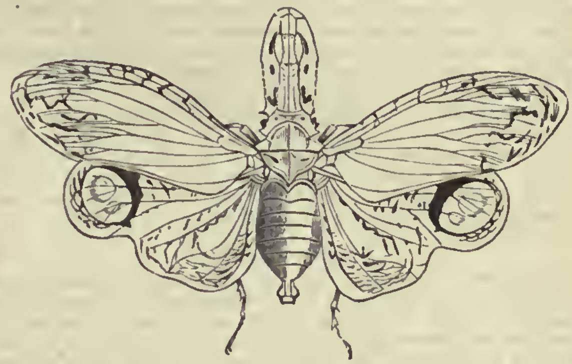
Family 3. *Cercopidæ* (Leach).—The antennæ 3-jointed; tarsus 3-jointed; ocelli two in number; antennæ situated between the eyes. [CICADELLA.]

Family 4. *Psyllidæ* (Stephens).—Antennæ with 10 or 11 joints, of which the last is terminated by two setæ; legs formed for leaping; tarsi 2-jointed; both sexes winged.

Family 5. *Thripidæ* (Stephens).—Antennæ 8-jointed; rostrum minute; tarsi terminated by a vesicular joint, and without claws.

Family 6. *Aphidæ* (Leach).—Tarsi 2-jointed; antennæ with seven joints; rostrum, in both sexes, with three distinct joints; females generally apterous. [APHIS.]

Family 7. *Coccidæ* (Leach), *Gallinsecta* (Latreille).—Tarsus with but one joint and one claw; the male sex destitute of rostrum, and possessing but two wings; the female apterous, and furnished with a rostrum; antennæ generally 11-jointed. [COCCIDÆ.]



Fulgoria laternaria, half the natural size.

HOMOPUS. [CHELONIA.]
HONEY, HONEYCOMB. [BEE.]
HONEY-BUZZARD. [FALCONIDÆ.]
HONEY-GUIDE. [INDICATORINÆ.]
HONEY-LOCUST. [GLEDITSCHIA.]
HONEY-STONE. [MELLITE.]
HONEY-SUCKER. [NECTARINIDÆ.]
HONEYSUCKLE. [CAPRIFOLIACEÆ; LONICERA.]
HONEYSUCKLE, FRENCH. [HEDYSARUM.]

HONEY-WARE, a name given to *Alaria esculenta*, known in Scotland as Badderlocks.

HONKENEJA, a genus of Plants belonging to the natural order *Caryophyllaceæ*, and the sub-order *Alsineæ*. It has 5 sepals, 5 large petals, 10 stamens alternating with glands, 3 styles and valves, aud very few large seeds.

H. peploides is a British species found on sandy sea-coasts. It has ovate-acute sessile leaves, fleshy, glabrous, and 1-nerved; the petals obovate; sepals ovate-obtuse, 1-nerved, shorter than the petals; the stems are dichotomous, procumbent, rhizomatous; the flowers proceed from the forks of the stem frequently diœcious; capsules large, globose; seeds few, and large.

HOOD-CAP. [PHOCIDÆ.]
HOODED-CROW. [CORVIDÆ.]
HOOPER. [CYGNINÆ.]
HOOPOE. [PROMEROPIDÆ.]
HOP. [HUMULUS.]
HOPEITE. [ZINC.]

HO'RDEUM, the genus of Plants to which the corn called Barley belongs. It is distinguished from *Triticum*, or the Wheat genus, by its spikelets having only one perfect floret in each, and by its glumes being somewhat unilateral and bearded; Rye, or Secale, differs in having two perfect florets to each spikelet, and in the same additional circumstances as *Triticum*. As many as 15 species of *Hordeum* are distinguished by Professor Kunth, the latest writer upon the subject; in addition to which there are many varieties. The species are found wild in various places in both the Old and New World: as many as eight inhabit America. In the application of their botanical names to the cultivated barleys there is some confusion, one writer distinguishing four species, another six, and some a greater number. It does not appear possible to determine, upon existing evidence, which of these opinions is most correct; the probability however seems to be that there are not more than four, or at the utmost six species, which may be readily distinguished by attention to the following circumstances:—The 1-flowered spikelets of Barley grow in threes, on opposite sides of the ear. If all the spikelets are perfect, the grains of corn are therefore necessarily arranged in six lines or rows; these rows may be very distinctly arranged, as in *H. hexastichum*, or they may be disposed in an irregular manner, as in *H. Ægiceras*. But if the lateral spikelets of each parcel are imperfect all along the ear, the middle spikelet alone producing a grain of corn, the grains in that case will be in two rows only, as in *H. distichum* and *H. Zeocriton*. Of these two distinct forms there are some in which the grain adheres to the paleæ, or husk, as in Common Barley, and others in which the grain is free from the husk, as in Naked Barley. It is generally supposed that barleys of the second kind are mere varieties of those of the first kind; but there is no proof of the correctness of the opinion, and probability is against it. These characters and a few others being attended to, cultivated barleys may be arranged under the following heads:—

* Two-Rowed Barleys.

1. *H. distichum* (Linn., 'Sp. Pl.,' 125). Ear cylindrical; awns almost parallel with the ear; grains adhering to the husk. This is the Common Summer-Barley of England, and that which cultivators seem to prefer; its ears are not so large as those of *H. hexastichum*, but the grains are heavier. It is commonly stated to be a native of Tartary. Colonel Chesney found it wild in Mesopotamia, upon the banks of the Euphrates.

2. *H. gymnodistichum* (Lowe's 'Elements of Agriculture,' p. 238.) Ear cylindrical; awns almost parallel with the ear; grains loose in the husk. Naked Barley, a species but little cultivated now, is of unknown origin. It is said to have been introduced into England in the year 1768; but it is reported to have preserved its characters unaltered from time immemorial in some parts of Europe.

3. *H. Zeocriton* (Linn., 'Sp. Pl.,' 125). Ears conical; awns spreading away from the ear, in a flabelliform manner; grains adhering to the husk. From the spreading direction of the awns, the ears of this barley acquire a much broader figure at the top than at the bottom, on which account it has been called Battledore Barley; it also bears the name of Sprat-Barley. It is little cultivated in England, because of the shortness of its straw; its native country is unknown.

** Six-Rowed Barleys.

4. *H. hexastichum* (Linn., 'Sp. Pl.,' 125). Ears cylindrical; awns very long, rough, and rigid, rather spreading away from the ear; grains adhering to the husk. It does not appear in what way the *H. vulgare* of Linnæus differs from this. Professor Lowe has justly remarked that there is no such thing as a barley with the grains growing in four rows, the circumstance by which Linnæus defined his *H. vulgare*, and that all such appearances are merely imperfect states of *H. hexastichum*. The native country of this species is unknown: it is the Bere, Bigg, or Winter Barley of farmers, and is particularly valuable for ripening quicker than the Common Two-Rowed Barley; its grains are however lighter, and it is considered an inferior species to the last. To northern nations with short summers it is however invaluable.

5. *H. gymno-hexastichum* (Lowe's 'Elements of Agriculture,' p. 238). Ear cylindrical; awns very long, rough, and rigid, rather spreading away from the ear; grains loose in the husk. The origin of this, the Naked Six-Rowed Barley, is unknown. It is extremely productive, and in some parts of Europe it is reckoned the most valuable of all. The French call it, on account of its good qualties, Orge Céleste.

6. *H. Ægiceras* (Royle's Manuscripts). Ears cylindrical; florets arranged in a confused manner, not in rows; awns soft, short, hooded, and bent downwards; grains loose in the husk. A most curious species, found in the northern parts of India, and probably in Tartary, as its grains have been sent to England under the name of 'Tartarian Wheat.' Its appearance is more that of wheat than of barley, and its naked grains assist the resemblance. It is however a genuine species of *Hordeum*. It appears to be a productive plant, but little is as yet known of its quality in this climate.

Of most of the species there are many varieties, the most striking of which are those called 'Black Barleys,' on account of the dark colour of their husks. They are not of sufficient importance to require particular notice, except in works treating of agriculture in great detail. [Barley, in Arts and Sc. Div.]

HOREHOUND. [Marrubium.]

HORNBEAM. [Carpinus.]

HORNBILLS, a family of Birds named after the genus *Buceros*—*Bucerida*. They constitute a family of birds, the construction of whose bill arrests the attention at first sight, and ornithologists have not been entirely agreed as to the situation which the form ought to occupy in the series.

It is not at all improbable, from the geographical distribution of the species, that some of the species were known to the ancients; but whether the *Tragopan** of Pliny and Solinus, or the *Tragopomenes* of Pomponius Mela, belonged to this genus is not clear. That the Rhinoceros Bird of Hesychius and Varinus was one of the species is not unlikely. Aldrovandus, Jonston, and Bontius† give the form the same name, as do Ray and Willughby‡, the latter of whom gives two good figures of heads. Bontius also describes one of the species under the appellation of *Corvus Indicus*, and another as *Corvus rostro-cornuto*. Petiver received the bill of one (which he figures) from Kamel, under the name of *Calao*. The description of the bird said by Jonston and others to have been killed as it was flying, when the Christians beat the Turks at the battle of Lepanto (Naupactum), agrees well with the characters of the genus.

Brisson gives the Hornbills the name of *Hydrocorax*, following, not improbably, Clusius, who speaks of one of them under the title of *Corvi Marini genus*.

Linnæus, in his last edition of the 'Systema Naturæ' (12th), places the Hornbills, genus *Buceros*, under the *Picæ*, between the Toucans (*Ramphastos*) and *Buphaga*. The feet he defines to be gressorial. Gmelin leaves *Buceros* in the same position.

Latham also places the Hornbills among the *Picæ*, Pies, with walking feet.

Lacépède removes the form far from the Toucans, placing it at the head of his *Platypodes* and in his 16th order (bill dentilated), with the Momots, in his second division of his first sub-class of birds, or those which have three anterior toes, and sometimes a hind toe, sometimes none.

M. Duméril's second family of his second order, Passereaux, or Passerine Birds, consists of the *Dentirostres*, or *Odontoramphes*, including two of the Hornbills, Momots, Plant-Cutters (*Phytotoma*).

Illiger's *Dentirostres* come between the Passerine Birds and Crows, and belong to his second order, *Ambulatores*, or Walking Birds.

Cuvier places the *Buceridæ* at the end of the Syndactylous Passerine Birds; they are immediately preceded by the Todies (*Todus*). Next to the *Buceridæ*, in his system, come the Scansorial Birds (Les Grimpeurs), headed by the Jacamars (*Galbula*, Briss.), which are followed by the Woodpeckers. He speaks of the *Buceridæ* as large birds of Africa and the Indies, whose enormous bill renders them so remarkable, and connects them with the Toucans, while their carriage and habits bring them near to the Crows, and their feet are those of the Bee-Eaters and Kingfishers.

M. Vieillot arranges the Hornbills and Momots in his family of *Prionotes*, in the second tribe (*Anisodactyli*) of his second order of birds (*Sylvicolæ*).

M. Temminck introduces the Hornbills among the Omnivorous Birds, the second order in his arrangement.

Mr. Vigors places the *Buceridæ* in the aberrant group of his *Conirostres*. *Fregilus*, in the opinion of that ornithologist, by its curved and slender bill, leads immediately to the Birds of Paradise, which, in conjunction with the *Epimachus* of Cuvier, terminates Mr. Vigors's family of *Corvidæ*, and here, Mr. Vigors thinks, we shall find the passage from the *Corvidæ* to the *Buceridæ*. He speaks indeed with considerable hesitation as to the situation of *Epimachus*, but observes that, being more united in its front toes than the *Corvidæ* in general, it holds a middle station, in respect to that character, between the two groups; while in the length and curvature of its bill it approaches, in conjunction with many of the *Paradiseæ*, to some of the extreme species of the *Buceridæ*, among which, he remarks, the *Buceros nasutus* of Dr. Latham may be instanced.

"We thus," says Mr. Vigors, "arrive at the singular family of *Buceridæ*, which seems to draw near to the preceding groups in its food and habits, as far at least as we can conclude from the very imperfect accounts which are transmitted of them. From the strength also of the formation of these birds, and the powers with which they are endowed, they seem to assert a title to a place in the vicinity of the group which is typical in the tribe. In one particular however we may detect a deviation from the more perfect structure of that type. The fore toes of all are strongly united at the base, the external being joined to the middle as far as to the second articulation; an impediment which must considerably interfere with the free action of the member. This deficiency is, on the other hand, retrieved by the superior robustness and muscular conformation of the whole limb. An analogous defect, and an analogous mode of compensating for it, is observable in the Ostrich, a bird also, it is to be observed, closely allied to the typical group of its own family; and in both instances we may pronounce the deviation from the more regular or perfect conformation to be a defect rather to the eye of the observer, an infringement upon what he would conceive to form the 'beau-idéal' of the typical character, than a defect in reality. We may here delay a moment to observe upon the causes that assign so totally remote a station from the present to the *Todidæ*, *Meropidæ*, and *Halcyonidæ*, whose gressorial feet, as they are technically called, are of precisely the same structure as those of *Buceros*. In them, the deficiency, accompanied by a corresponding weakness of the whole member, is real, and of sufficient consequence to deprive the bird of the means of using its legs and feet to advantage. The force and powers of these parts are in fact transferred to the wings, which are thus endowed with a more than usual share of strength, in order to afford the bird a more than usual assistance in the aërial mode of seeking its food which it is assigned by nature. In the *Buceros*, on the other hand, the gressorial feet are accompanied by a superior robustness, which counterbalances their inferiority in form. And hence the family may consistently maintain its station in the vicinity of the more perfectly formed and typical groups of the *Insessores* which are now before us. The tendency, already observed, which opposite points of the circle in which a series of affinities is united have to approach each other, accounts for the resemblance here pointed out between these otherwise discordant groups, and serves to explain the reason why the analogous relation between them has been mistaken for a relation of affinity by systematic writers, so far as to induce them to arrange all the gressorial birds in one connected group. Besides the genus *Buceros*, Linn., the protuberance on the bill of which varies in almost every possible shape in which fancy can embody it, the present family includes the *Momotus* of M. Brisson, which accords with the entire of that genus in its gressorial feet, and with several species of it, as the genus now stands,

* The *Tragopan* of modern zoologists is a gallinaceous bird, considered by many to be intermediate between *Meleagris* and the typical Pheasants.

† "Corvus Indicus cornutus, seu Rhinoceris Avis."

‡ Willughby terms the Hornbill "The Horned Indian Raven, or Topau, called the Rhinocerot Bird."

in the curved but somewhat shorter and more attenuated bill." [MOMOT.]

In his remarks on the succeeding order, *Scansores*, Mr. Vigors observes, that besides the deviation from the more perfect formation of the foot in the *Buceridæ*, which prepares us for the more considerable deviation that takes place in the same particular among the Scansorial Birds, the large and disproportionate bill of that family is carried on to the *Ramphastidæ*, the first family of the *Scansores*, according to Mr. Vigors.

M. Latreille arranges the Hornbills among the *Syndactyles*, the fifth family of his second order (Passereaux, or Passerine Birds), in company with the Bee-Eaters, Momots, Kingfishers, &c.

In the method of M. De Blainville, as carried out by his pupil M. Lherminier, the Hornbills appear among the Normal Birds (first sub-class), and as the 14th family, between the Kingfishers and the Toucans.

M. Lesson, in his 'Projet,' places the *Buceridæ* as the last family of his *Insessores*, or Grimpeurs, arranging it in the third tribe (*Syndactyles*) of that his first order. The other families of the tribe are the Bee-Eaters, *Meropidæ;* Kingfishers, *Halcyonidæ;* and Cocks of the Rock, *Rupicolidæ*.

Mr. Swainson arranges the *Buceridæ* among the *Conirostres*, together with the *Corvidæ*, *Sturnidæ*, *Fringillidæ*, and *Musophagidæ*. After noticing the peculiar conformation of the bill in the *Buceridæ*, he observes that in some of the species that organ is without the basal protuberances, so that they bear the nearest affinity to the Toucans, belonging to the Scansorial tribe, which is joined to the Conirostral. He considers that we have no bird which actually unites the two families in so perfect a manner as that by which the Toucans are blended with the *Fissirostres* through *Prionites;* and he remarks, that we should expect that a bird which might conduct us from the Toucans to the Hornbills would be of large size, and that it would present us with some of the gay colours peculiar to the Toucans, both in its bill and plumage; but that its feet should no longer exhibit the scansorial structure, inasmuch as that, as he has before remarked, we see, in the little power possessed by the Toucans of climbing, that nature is about to quit the scansorial structure. There is good reason to believe, he thinks, that such a bird is in existence, although at present only known to modern writers by a drawing executed in India, in the collection of Mr. Smith. Both Dr. Latham and Dr. Shaw, he adds, describe this bird under the name of the Crimson Hornbill, and he considers that the figure published by the latter carries internal evidence of its authenticity. Mr. Swainson sees in this bird the crimson colour, the long tail, and the dorsal collar, so prevalent in the genus *Pteroglossus*, joined to a miniature Toucan's bill, with a distinct band at the base, like the *Ramphastos Tucanus*, yet with the feet of a Hornbill. That this bird, and probably other annectant species, will hereafter be discovered in the vast and still unexplored regions of Central Asia, Mr. Swainson does not doubt. He speaks of the Hornbills as a small family, of which perhaps the typical form is now only known; and he looks upon them as being as much isolated as the Toucans and the Parrots. He adverts to their enormously large bills, generally furnished with an appendage or excrescence on their top, the use of which, he says, is unknown; nor has, he adds, the internal structure of this member been fully ascertained. The feet, he remarks, are generally so very short as to appear calculated only for perching. "United," continues Mr. Swainson, "to the Scansorial Birds by means of the Toucans, they would seem to represent the *Rasores;* but the structure of their feet, more imperfect than any of the families in this order, forbids the supposition. This opinion we had long entertained from theory, but it has recently been confirmed by a singular fact in their economy, communicated by an officer long resident in India. It seems that all the species of *Buceros* he has met with in a live state are constantly in the habit of throwing their food up in the air and catching it before it is swallowed." This propensity Mr. Swainson considers to be an incipient development of the fissirostral economy. We have only to add, that Mr. Swainson does not admit into the family of the *Buceridæ* the Momots (*Prionites*), which he places under a line drawn at the end of the family of *Trogonidæ*. ('Classification of Birds.')

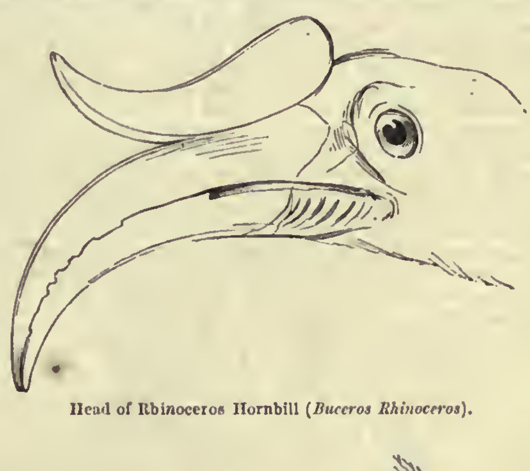
Some light will be thrown on the proper place of the bird in the animal series by the following account of the anatomy of a young *Buceros cavatus* by Professor Owen:—The tongue was very short, of a triangular form, and very smooth. The air-cells were very large, and that in front of the neck contained the œsophagus and the trachea. The œsophagus, as in the Toucan, was very wide, and of nearly equal diameter as far as the gizzard. The gizzard was thicker in its coats and of a more elongated form than that of the Toucan: its cuticular lining was very tough, and disposed in longitudinal ridges. After the duodenal fold the remainder of the intestinal canal was disposed in two similar folds, and then extended along the middle line of the back to the cloaca. There were no cæca. The coats of the intestines were stronger than is usual in birds, and the diameter of the canal was more considerable, diminishing however gradually from the commencement of the ilium, as far as the beginning of the rectum, and thence becoming wider to its termination. The whole length of the intestines was 5 feet; that of the bird, from the end of the bill to the vent, being 2 feet 2 inches, of which the bill measured 7 inches. The liver had the usual two lobes, of which the right was the largest. The gall-bladder was of considerable size. The pancreas, of an elongated slender form, had a small oval enlargement at its commencement at the lower end of the spleen, and a flattened oblong mass or head at the bottom of the duodenal fold: it accompanied the duodenum throughout its length, being folded on itself similarly to the intestine. Its secretion was conveyed into the intestine by three ducts; one from its head, which entered the duodenum at the head of the fold; the others from the elongated lobes, which terminated close together at the end of the fold between the insertions of the hepatic ducts; an arrangement corresponding with that which exists in the Heron. In the cloaca the rudimentary bladder was little more than a line in width, and the ridges bounding it above and below were confined to the back part of the cavity. The bursa Fabricii (which Professor Owen regards as analogous to the glandular pouch found in so many other classes) was of a triangular form, large, and surrounded, as usual, by a capsule of muscular fibres.

The muscles of the mandibles consisted of a digastricus, or of a muscle analogous to it, destitute, as is usual in birds, of a middle tendon, a temporal muscle of moderate size, and pterygoidei externi and interni, proportionally more developed. There is also a strong ligament occupying the place of the masseter, and a second, destined to prevent dislocation backwards, which passes from the zygoma directly backwards to the condyle, or articulate depression of the lower jaw. Disproportionate as this apparatus seems to the moving of so large a body as the bill of the Hornbill, it is yet fully adequate, the weight of that organ by no means corresponding with its size. The cavities in the bones, the arrangement of the columns supporting their parietes, and the air-cells, produce at the same time lightness and strength.

With respect to the other parts of the skeleton, Professor Owen particularly noticed the extension of the air-cells into the distal bones of the extremities. He remarked that Mr. Hunter observes how, in the Pelican, the air passes not only into the ulna and radius, but "into those bones which answer to the carpus and metacarpus of quadrupeds." In the Hornbill the air passes also into the bones corresponding to the phalanges; and in the posterior extremity that it permeates the tibiæ, tarsi, and phalanges.

Professor Owen concludes by some remarks on the affinities of the Hornbill as deducible from its anatomy. Its nearest approach is to the Toucan. The Toucan however, in the want of a gall-bladder, agrees with the Parrots; the presence of that organ in the Hornbill places the bird in more immediate relation with the Crows. The disposition of the intestines in long and narrow loops also agrees with the Raven. The tongue, so remarkably varied in form and use among the *Scansores*, resembles in the Hornbill that of the Carnivorous Birds. ('Proceedings of the Zoological Society of London,' 1833.)

Buceros.—Bill long, very large, compressed, more or less curved or falcated; base smooth, elevated, or rather surmounted by a casque or



Head of Rhinoceros Hornbill (*Buceros Rhinoceros*).

Foot of *Buceros cavatus*.

helmet-like protuberance; edges of the mandibles smooth or notched; point smooth; interior of the bill, especially the upper mandible and casque, very cellular; nostrils basal, on the surface of the beak, in a furrow, small, somewhat round, open, pierced in the corneous substance of the bill, covered at the base by a membrane. Feet short, strong, muscular; sole of the foot large. Wings moderate; the first three quills graduated; the fourth or fifth the longest. [BIRDS.]

The species of *Buceros* are found in the Old World, Africa, India and its islands, and New Guinea.

Bontius, in his description of his *Corvus Indicus* (*Buceros Hydrocorax* of Linnæus), a native of the Moluccas and Banda, says, "More Corvi nostratium graditur, indole a nostris corvis differt, quod non cadavere, sed potissimum nucibus myristicis avide vescatur; iisque insigne damnum infert. Caro eorum quoque delicata est, et assa saporem a pastu plane aromaticum habet (It walks like the crow of our countries, but differs much in disposition from our crows, inasmuch as it feeds not on carcasses, but most especially on nutmegs, and that greedily, doing a great deal of damage to them. Their flesh also is delicate, and when roasted has an aromatic flavour from their food)." Of the 'Corvus rostro cornuto' (*B. Rhinoceros* of Linnæus) he says that it lives on the carcasses and intestines of animals, and that it waits upon the hunters who kill wild cattle, boars, and stags, to gorge itself with the entrails of those animals. Willughby, in his account of 'Bontius his Indian Raven,' says, "It walks after the manner of our Raven, but differs from it in nature and disposition, in that it feeds not upon carrion or dead carcasses, but chiefly upon nutmegs, of which it is very greedy, making great destruction of that fruit, to the no small detriment of the owners. Its flesh is very delicate, and being roasted hath a plain aromatical relish, contracted from its food." Of 'The Horned Indian Raven, or Topau, called the Rhinocerot Bird,' he says, "This horned bird, as it casts a strong smell, so it hath a foul look, much exceeding the European Raven in bigness. . . . . It lives upon carrion and garbage, that is, the carcasses and entrails of animals." Both these passages are taken from Bontius, as the reader will perceive. Cuvier considers them as omnivorous—"Ils prennent toute sorte de nourriture;" and he states that they eat tender fruits, hunt mice, small birds, and reptiles, and do not even disdain carcasses. The late Major-General Thomas Hardwicke, who contributed so largely to our acquaintance with Indian animals, in treating of *B. galeatus* ('Linn. Trans.,' vol. xiv.), gives the following description of the habits of the Hornbills:—"The progressive motion of the birds of this genus, although their feet are formed for walking, is always by jumping or hopping. I have kept several species alive, and they all moved in the same manner. In a state of nature these birds, in this part of India (Malacca), live on wild fruits. In confinement they feed freely on plantains and on boiled rice. At night they perch with great security, though the largeness of the foot seems better suited to rest on the ground." M. Lesson sums up the habits of the Hornbills thus:—Those of Africa live on carrion; those of the East Indies seek for fruits, especially nutmegs, and their flesh acquires from them a delicious flavour. Their flight is performed by repeated strokes of the wings, and the air which they displace, joined to the clattering of their mandibles, occasions a great and very disquieting noise in the forests, when the cause is unknown. This noise, capable of inspiring terror, does not ill resemble those flaws of rough and sudden winds ("grains de vent brusques et subits") which arise so unexpectedly between the tropics, and blow so violently. The Europeans established at the Moluccas think that the furrows which are seen on the bill of the Hornbills are the result of age, and that each furrow signifies a year; whence the name of Jerarvogel, which they give to these birds. Mr. Swainson remarks that the Hornbills are gregarious noisy birds, generally of a very large size, and are restricted to the Old World; that they are omnivorous, feeding both on animals and vegetables; that some however seem only to partake of the latter food; while others, upon the authority of Le Vaillant, feed upon carrion. The *B. cavatus* dissected by Professor Owen was observed to be more attached to animal than to vegetable food, and would quit any other substance if a dead mouse were offered to it. This it would swallow entire, after squeezing it twice or thrice with the bill; and no castings were noticed. Professor Owen however adds that Petiver has borne testimony to its regurgitating habits.

Before we proceed to give examples of the family as it here stands, that is, as consisting of the true Hornbills alone, we may remark that if it should be clearly made out that some species live entirely on vegetable food, while others live on carrion, as has been asserted, there may be good grounds for elevating such species to the rank of genera; for such a total difference of food must in all probability be accompanied by a corresponding difference of internal structure and of general habits. M. Temminck may be considered as the author who has most successfully dissipated the obscurity in which the species were involved; and to his elaborate and beautiful works we refer the reader. We shall select as examples the following two species.

B. Rhinoceros, Rhinoceros Hornbill. This species is to be found in most collections, and though there may be some variety from age and circumstances, the bill will be generally found to be about 10 inches long and of a yellowish-white, the upper mandible red at the base, the lower black. The horn, or casque, varied with black and white.

The body black, of a dirty white below and posteriorly; tail about 12 inches, the feathers white at the base and tip, black in the middle; feet and claws obscure gray.

Rhinoceros Hornbill (*Buceros Rhinoceros*).

It is a native of India and the Indian Islands (Sunda, for instance).

B. cavatus. Throat, ear-coverts, circle round the eye, and a narrow band at the occipital edge of the protuberance of the beak, black; neck dirty straw-colour, the feathers of the back of the neck elongated; body and wings black, greater coverts and quill-feathers tipped with white; thighs, upper and under tail-coverts, white; as is the tail also, with the exception of a broad black band about three inches from the tip; beak yellowish, inclining to scarlet at the tip, under mandible black at the base; tarsi black. (Gould.)

Buceros cavatus.

The food of the *Buceros cavatus*, like that of other Hornbills, consists of fruits, berries, flesh, and even carrion; in short, it may be considered as strictly omnivorous. (Gould.)

It is a native of India, the Himalaya Mountains, Java, and most of the islands of the Indian Archipelago.

The species of *Buceros* are very numerous.

HORNBLENDE, a Mineral belonging to the group of the Anhydrous Silicates of Magnesia. An account of its general characters and formation is given under AUGITE. It is subject to numerous varieties differing much in appearance, arising from isomorphism and crystallisation. Alumina enters into the composition of some of them, and replaces part of the other ingredients.

The varieties are divided into light and dark coloured.

To the light coloured varieties belong *Tremolite* or *Grammatite.* It comprises the white, grayish, and light-greenish slender crystallisations, usually in blades or long crystals, penetrating the gangue, or aggregated into coarse columnar forms. It is sometimes nearly translucent. The specific gravity is 2·93.

The light-green varieties are called *Actinolite. Glassy Actinolite* includes the bright glassy crystals of a rich green-colour, usually long and slender, and penetrating the gangue like tremolite. *Radiated Actinolite* includes olive-green masses, consisting of aggregations of coarse acicular fibres, radiating or divergent. *Asbestiform Actinolite* resembles the radiated, but the fibres are more delicate. *Massive Actinolite* consists of angular grains instead of fibres. The specific gravity is 3·02 to 3·03. [ACTINOLITE.]

Asbestus is also included under this division. [ASBESTUS.]

To the dark-coloured varieties belongs *Pargasite,* a term which is applied to dark-green crystals, short and stout, of bright lustre, of which Parga in Finland is a notable locality.

The term *Hornblende* is applied to the black and greenish-black crystals and massive specimens. It contains a large per-centage of oxide of iron, and to this owes its dark colour. It is a tough mineral. Pargasite and Hornblende both contain alumina.

The varities of Hornblende fuse easily with some ebullition, the pale varieties forming a colourless glass, and the dark a globule more or less coloured with iron. Hornblende is an essential constituent of certain rocks, as syenite, trap, and hornblende-slate.

Actinolite is usually found in magnesian rocks, as talc, steatite, or serpentine. *Tremolite* occurs in granular limestone and dolomite; *Asbestus* occurs in the above rocks, and also in serpentine.

(Dana, *Manual of Mineralogy.*)

HORNBLENDE-SCHIST. Under this term M'Culloch ranks a variety of mineral aggregates in which hornblende abounds, and which are mostly but not universally of laminated structure. Hornblende-Schist is commonly associated with gneiss, less frequently with mica-schist, and seldom forms alone any considerable mountain masses. It follows the contortions of gneiss, and is traversed like it by granite veins. (Glen Tilt.) Hornblende is rarely associated with argillaceous slate, as in Ben Lair, in Skiddaw, Cader Idris, and near the granites of Cornwall. In these cases its origin may perhaps be due to the action of the contiguous heated granitic masses, and such rocks may be considered 'metamorphic.' They are considerably different from the Hornblende-Schists of Glen Tilt, Iona, and Ross-shire. (M'Culloch on 'Rocks.')

HORN-EEL. [AMMODYTES.]

HORNE'RA, a genus proposed by Lamouroux to include a small recent stony Polypifer, which Solander ranked among the Millepores, and Lamarck among the Retepores. Like the latter genus, it has cells on one side only: they are arranged almost in quincunx, on diagonal lines; the opposite side is slightly furrowed. (Lamouroux, 'Tableau Méthodique.')

HORNET. [VESPIDÆ.]

HORNET-MOTH. [SPHINGIDÆ.]

HORN-FISH. [SYNGNATHIDÆ.]

HORN-POPPY. [GLAUCIUM.]

HORNSTONE. [QUARTZ.]

HORSE. [EQUIDÆ.]

HORSE-CHESTNUT, the *Æsculus Hippocastanum* of botanists: it is said to derive its name from the practice among the Turks of feeding their horses on the seeds of this tree. [ÆSCULUS.]

HORSE-RADISH. [COCHLEARIA.]

HORSE-TAIL. [EQUISETUM.]

HORTIA, a genus of Plants belonging to the natural order *Rutaceæ. H. Braziliana* possesses in its bark properties resembling those of *Cinchona,* but in a less degree.

HORTULIA. [BOIDÆ.]

HOT-SPRINGS. [GEYSERS.]

HOTTO'NIA, a genus of Plants belonging to the natural order *Primulaceæ.* It has a 5-parted calyx, divided almost to its base; the seeds, with the hilum, close to one end; the stamens, 5, inserted and included in the tube of the corolla; the capsules many-seeded and 5-valved, with 10 teeth.

H. palustris has the flowers whorled, stalked, and seated upon a long solitary cylindrical common peduncle, the corolla longer than the calyx, the leaves pectinated. It is a native of Great Britain in ponds and ditches, and is called the Water-Violet. The leaves are submerged and crowded; the flowers rising above the water are of a purple and yellow colour. It is a pretty plant, but possesses no useful available properties.

(Babington, *Manual of British Botany.*)

HOUND (from the German Hund), a name generally applied in the British Islands to those varieties of the Dog which are employed in hunting the Deer, the Fox, the Hare, and the Otter, by scent. The hound employed for following depredators, and used so much in the old Border times, was called a Blood-Hound. [BLOOD-HOUND.] The Grayhound, which follows its four-footed game by the eye [GRAYHOUND], is not a hound in the proper acceptation of the term adopted by sportsmen; for that appellation is confined to those varieties of the Dog which are trained to that species of chace called Hunting, which implies that the dogs so employed follow their four-footed game by the scent principally.

In addition to the Blood-Hound,—the Stag-Hound, the old Southern Hound, the Fox-Hound, the Harrier [HARRIER], and the Beagle [BEAGLE], were the hounds of greatest note. Some of these varieties, the old Southern Hound for instance, which was slow but very sure, and with a fine deep-toned voice when it gave tongue in earnest, are gradually disappearing; and indeed the pace required now in most kinds of hunting, except otter-hunting, but especially in fox-hunting, has brought into demand a breed of hounds whose fleetness requires the best and fastest horses. The old fox-hunter of the early part of the last century would find himself 'nowhere' on a good day in Leicestershire, could he now be present. His horses and hounds were bred with a view to endurance rather than speed; and if he were to appear at a modern 'meet,' he would see that an entire revolution has taken place in the system. Whether this is an improvement is a question which will be answered differently, according as the respondent may prefer the old-fashioned slow hunting, where all the sagacities of the hound were minutely developed, not without a good deal of 'music,' or the rapidity which makes a good run now-a-days very like a race. The young, bold, and well-mounted rider will generally prefer the latter.

The Southern Hound, which is supposed to have been of very high antiquity in Britain, is large in size, strong, and of majestic aspect, long but round in the body, deep in the chest, and his ears are long and sweeping. The tone of his cry is deep, rich, and mellow. He will hunt the coldest scent, and persevere long after lighter hounds have given it up; but he is very slow. The author of 'Rural Sports' saw a pack of these hounds in Lancashire, where they were kept to hunt hares, and the least of them stood twenty-two inches. The huntsman went with a pole on foot.

As a contrast we may notice the celebrated match made between Mr. Barry and Mr. Meyuell to run a couple of each other's fox-hounds a drag, from the rubbing-house at Newmarket town-end, to the rubbing-house at the starting-post of the Beacon-course, for five hundred guineas. The match came off on the last day of September, and was won by Mr. Barry's Bluecap and Wanton, which came in very close to each other; Mr. Meynell's nearest hound, Richmond, being beat by upwards of a hundred yards. The ground was crossed in eight minutes and a few seconds; and of sixty horses that started with the hounds only twelve were up. Cooper, Mr. Barry's huntsman, came in first, but it is asserted that the mare that carried him was completely blind at the conclusion of the run. The famous Will Crane, who rode Rib, a king's-plate horse, was only in the twelfth. Colonel Thornton's Merkin, which was sold in 1795 for four hogsheads of claret, the seller to have two couple of her whelps, ran a private trial of four miles in seven minutes and half a second.

Our limits will not permit us to go into the details of this, to many, interesting subject; and we must refer the reader to Somerville's 'Chace,' Beckford's 'Thoughts upon Hunting,' 'The Sportsman's 'Cabinet,' Daniel's 'Rural Sports,' the Sporting Magazines, and, most especially, 'Nimrod,' for further information.

HOUND'S-TONGUE. [CYNOGLOSSUM.]

HOUSE-LEEK. [CRASSULACEÆ; SEMPERVIVUM.]

HOUSE-MARTIN. [HIRUNDINIDÆ.]

HOUSE-SPARROW. [PASSER.]

HOVINIA, a genus of Plants belonging to the natural order *Rhamnaceæ.* The peduncles of *H. dulcis* become extremely enlarged and succulent, and are in China in much esteem as a fruit, resembling in flavour, it is said, a ripe pear. Some species are astringent.

HOWLET. [STRIGIDÆ.]

HOYA, a genus of Plants belonging to the natural order *Asclepiadaceæ.* It has a 5-cleft rotate corolla. Coronet of appendages depressed, 5-leaved; leaflets spreading, fleshy, with the inner angle extended into a tooth lying upon the anther. Anthers terminated by a membrane. Pollen-masses fixed by the base, converging, compressed. Stigma not pointed, or scarcely so. Follicles smooth.

H. viridiflora is a native of Coromandel, Sylhet, and the Nilgherry Hills. It has opposite, stalked, broad, cordate, or ovate leaves, not sinuate at the base, pointed, membranous, smooth, from 3 to 4 inches long; petioles from 1 to 2 inches long; umbels lateral or axillary, simple, many-flowered. Flowers numerous, green, with pedicels as long as the peduncle. Corolla flat; crown of appendages turbinate, truncate. Anthers reflected over the stigma. Follicles horizontal, obtuse, about 3 or 4 inches long, and 4 inches in circumference. The root and tender stalks produce nausea, and promote expectoration. The leaves peeled and dipped in oil are used by the natives of India as a discutient in the early stages of boils; when the disease is more advanced they are employed in the same way to promote suppuration.

Several species of this genus are cultivated in our gardens on account of their elegant flowers, which, from their curious wax-like appearance, give rise to the name of Wax-Plants.

HUANUCO-BARK. [CINCHONA.]

HUMAN SPECIES. [MAN.]

HUMBLE-BEE. [BOMBUS.]

HUMBOLDTILITE. [SOMERVILLITE.]

HUMBOLDTINE, a mineral Oxalate of Iron. This substance occurs crystalline and massive; the crystalline form is undetermined. Fracture uneven, earthy. Colour brightish-yellow; devoid of lustre; opaque. Specific gravity variously stated from 1·3 to 2·13. Hardness sufficient to scratch gypsum, but is scratched by mica.

It is insoluble in water, but dissolves in nitric acid without effervescence, and imparts a yellow colour to it.

The massive variety occurs in small flattish reniform pieces, of a fine earthy structure; colour greenish-yellow.

Analysis by Rivero:—

Oxalic acid	46·14
Protoxide of iron	53·86
	—— 100.

HUMBOLDTITE. This mineral is a Boro-silicate of Lime, and is therefore a variety of *Datholite*, unless indeed it be identical with it, which has been supposed to be the case. It occurs crystallised. Primary form an oblique rhombic prism. Cleavage parallel to the oblique diagonal of the prism; fracture conchoidal. Hardness 4·5 to 5·0. Colour white and yellowish-white; streak white. Lustre vitreous, transparent, translucent; opaque. Specific gravity 2·99.

Found in the Tyrol, in the Harz, in North America, and near Edinburgh.

HUMIRIA'CEÆ, *Humiriads*, a natural order of Plants belonging to the Syncarpous group of Polypetalous Exogens. It has the following essential characters:—The calyx is in 5 divisions; the petals alternate with the lobes of the calyx and equal to them; the stamens hypogynous, four or many times as numerous as the petals, monadelphous; the anthers 2-celled, with a fleshy connective, extended beyond the two lobes; the ovary superior, usually surrounded by an auricular or toothed disc, 5-celled, with from one to two suspended ovules in each cell; the style simple, the stigma lobed; the fruit drupaceous, with five or fewer cells; the seed with a membranous integument, the embryo straight, oblong, lying in fleshy albumen; the radicle superior. The plants belonging to the order are trees or shrubs abounding in a resinous juice, with alternate simple coriaceous exstipulate leaves, and axillary corymbs of flowers.

The affinities of this order are not well made out. In their albuminous seeds and slender embryo they agree with *Styraceæ*, as also in their balsamic wood. They resemble *Meliaceæ* very much in habit and in their fructification, but the anthers and seeds of *Humiriaceæ* differ very much from those of *Meliaceæ*. Von Martius compares this order with *Chlenaceæ*, whilst Lindley thinks that their real affinity is with *Aurantiaceæ*; "an affinity," he observes, "indicated by their inflorescence, the texture of their stamens, their disc, their winged petioles, and their balsamic juices." There are three genera belonging to this order, *Humirium*, *Helleria*, and *Saccoglottis*. All are natives of the tropical parts of America.

Humirium (from Oumiri, the Guyanese name of one of the species) has 20 stamens joined into a tube, the alternate ones shortest, ciliated above, an annular disc 20-lobed, the stigma 5-lobed, the fruit containing a 5-celled nut, the cells 2-seeded. *H. balsamiferum* is a tree 40 feet in height, with ovate oblong leaves half-clasping the stem, with a decurrent nerve on the back, the inflorescence longer than the leaves, the peduncles smooth as well as the petals. This tree is a native of Guyana. Its bark is thick, and abounds with a red balsamic fluid, which resembles styrax in smell; after it has exuded from the tree it becomes hard and transparent, and when burnt affords an agreeable odour. The negroes and natives of Guyana use the bark in slips for the purpose of flambeaux; they also use the wood in building their houses. We have no account of the composition of this resinous juice, but Aublet suggests that it might be used as a substitute for the Peruvian Balsam. The Creoles call this tree Red-Wood, on account of the colour of the wood. *H. floribundum* is a tree 20 or 30 feet high; the trunk when wounded yields a fragrant yellow liquid balsam, known by the name of Balsam of Umiri, resembling the properties of Copaiva and Balsam of Peru. The other species of *Humirium*, and also those of *Helleria* and *Saccoglottis*, yield resinous juices.

(Lindley, *Natural System*; Burnett, *Outlines of Botany*; Don, *Dichlamydeous Plants*.)

HUMITE. This mineral occurs in attached crystals, the primary form of which is a right rhombic prism. Cleaves readily parallel to the base of the primary form. Fracture uneven. Hardness 6·5 to 7. Scratches glass readily. Colour, various shades of yellow and brown, sometimes nearly colourless. Translucent, transparent. Streak white. Lustre vitreous. Heated by the blow-pipe it becomes opaque, but is not fusible; with borax it gives a transparent glass.

HUMMING BIRDS, the name of a brilliant family which includes the smallest of Birds. [TROCHILIDÆ.]

HU'MULUS, a genus of Plants belonging to the natural order *Urticaceæ*. It has the following characters:—Flowers diœcious. Males with the perianth parted; stamens 5; females with the perigone scale-like, open, hidden by the scales of an oval catkin; stigmas 2, elongated.

H. Lupulus, the Hop, twines round hedges in many parts of Europe. It is truly wild in England, and is also found apparently wild in the United States of America. It has rough opposite cordate lobed leaves, and numerous greenish-white flowers, of which the sexes are distinct. In the male the flowers form loose drooping panicles, and each consists of 5 sepals, 5 stamens, and a convex centre representing the ovary. In the female the flowers are arranged in little axillary stalked scaly tufts; each consists of a naked ovary, with two spreading downy stigmas, and is inclosed by a concave bract. These bracts increase in size after the flowering is past, are collected into a loose head of imbricated scales, within which are placed the small seed-vessels, or seeds, as they are usually called.

The female flowers, termed cones, strobuli, or catkins, of this plant, when ripe, constitute the Hops, which, independent of their employment in brewing, are of considerable utility in medicine. The mature hops consist of a number of imbricated membranous scales, having the fruit at their base: the surface both of the scales and of the fruit is studded with aromatic glands, which prepare a material bearing considerable resemblance to the pollen of the anthers, and termed Lupuline. This is the most valuable part, as in it reside the essential properties of the Hop: it possesses a cellular structure, and in the cells are contained volatile oil, resin, a bitter principle, with tannin, and a trace of malic acid, with acetate, hydrochlorate, and sulphate of ammonia.

The Hop (*Humulus Lupulus*).

1, a branch of the female plant; 2, a branch of the male plant; 3, a male flower; 4, a head of young female flowers; 5, a head of ripe flowers and fruit in the state of Hops.

The superiority of the Hop, as an ingredient in our malt-liquors, depends upon the fact of its containing within itself several distinct and independent elements of activity, which the bitter herbs that have at different times been employed as a substitute do not possess. The bitter principle imparts to the beverage a tonic quality and an agreeable flavour; while at the same time an aromatic ingredient adds a warmth and stimulating property, and modifies the bitterness: it likewise contains an astringent principle (tannin), the effects of which are to precipitate the vegetable mucilage, and thus to remove from the beer the active principle of its fermentation: every attempt therefore to substitute an ordinary bitter for that of the Hop must necessarily fail, unless a compound can be so artfully constructed as to contain in due proportions the principles of bitterness, astringency, and aroma.

The aromatic bitter gives to the Hop a very marked power over the digestive organs when debilitated. A narcotic property has also been ascribed to this article, which is denied to it by some writers, who attribute the intoxicating power of beer entirely to the alcohol and carbonic acid which it contains. Yet there can be no doubt that tincture of hops, and even extract of hops, possess sedative powers, and often procure quiet and sleep, where opium cannot be borne. Decoction does not seem to be a judicious mode of preparation, and should not be practised. Lupuline has been administered alone, but this does not possess any advantages over the common plan. [HOPS, in ARTS AND SC. DIV.]

HURA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has monœcious amentaceous flowers; the male flowers have a truncate calyx; numerous stamens united into a solid column; female flowers with 1 style; stigma with 12 or 18 rays; capsule with 12 or 18 cocci.

H. crepitans, Sandbox-Tree, is a native of the West India Islands, Mexico, and Guyana. It is a tree abounding in milky juice. Leaves cordate, acuminate, entire, or very slightly toothed, stalked, smooth, coriaceous, with simple veins passing from the midrib to the margin in a curved direction, within a quarter of an inch or so of each other, and connected by numerous oblique veinlets; stipules large, ovate, leafy, deciduous; petioles as long or rather longer than the leaves, with 2 glands at the apex. Male flowers arranged in an erect long-stalked axillary conical catkin, composed of imbricated 1-flowered scales; calyx short, urceolate, truncate; column of stamens surrounded in the middle by 2 or 3 rows of tubercles, each of which bears an anther on its under side. Female flower solitary at the base of the male peduncle, or near it; calyx urceolate, entire, or dividing eventually into 3 parts; stigma very large, discoidal, peltate. Fruit a depressed umbilicated woody capsule, about the size of a middling apple, with from 12 to 18 furrows, which separate into as many cocci, which fly asunder, each opening into two valves with great elasticity when dry and fully ripe. The milk is so venomous as to produce blindness in a few days after touching the eye. Seeds a violent drastic dangerous purgative. Aublet states that negro slaves to whom one or two seeds had been administered in the form of an emulsion, were nearly killed by them.

HURAULITE. [MANGANESE.]

HURO'NIA, the generic name assigned by Mr. C. Stokes to certain remarkable articulated bodies, of a partially radiated structure, found in the transition limestone of Lake Huron by Dr. Bigsby. Until lately these fossils were referred to the group of *Polypiaria*, but from a careful study of specimens more complete than those which he first observed, Mr. Stokes has found that the parts represented as lamelliferous corals are really only the siphuncular portions of shells of *Cephalopoda*, which may be included in the family of Orthoceratites. The structure of the siphuncular parts in these and other chambered shells from the limestone of various parts of North America, has led Mr. Stokes to propose two other new genera, namely *Actinoceras* and *Ormoceras*, whose characters, as well as those of *Huronia*, can only be well traced in comparison with the ordinary structure of *Orthoceras*. [ORTHOCERAS.]

HU'RRIA, Daudin's name for certain Indian Colubers, the scales or plates on the base of whose tails are constantly simple, and those of the point double.

HUTCHINSIA, a genus of Plants belonging to the natural order *Cruciferæ*, named in honour of Miss Hutchins. It has an entire elliptical pouch; boat-shaped valves, keeled, not winged at the back; seeds 2 in each cell; petals equal; filaments simple.

H. petræa is a rare plant, found on limestone rocks in Great Britain. It has pinnate leaves; a branched leafy stem; petals scarcely longer than the calyx; pouch obtuse at both ends. The stem is from 2 to 4 inches high. Flowers small.

(Babington, *Manual of British Botany*.)

HYA-HYA. [TABERNÆMONTANA.]

HYACINTH, a Mineral, consisting of silica and zirconia, transparent, and of a red colour. [ZIRCON.]

HYACINTHUS, a genus of Plants belonging to the natural order *Liliaceæ* and the tribe *Scilleæ*. One of the most common of our garden plants is the *H. orientalis*. The genus formerly included two species of British plants, which are now referred to the genera *Endymion* and *Muscari*. [ENDYMION; MUSCARI.] For the culture of these plants see HYACINTH, in ARTS AND SC. DIV.

HYÆNA. [HYÆNINA.]

HYÆNA-DOG, an animal found in the south of Africa, more especially the Cape. In size and form it is smaller and more slender than either the hyæna or the wolf. It is the Wild Dog of the settlers at the Cape. M. Temminck first described it as a hyæna (*Hyæna picta*), but subsequently regarded it as a species of dog. Desmarest considered it a species of *Canis*, and recorded it as *Canis pictus*. Brookes gave it the generic appellation of *Lycaon*; and Fischer, in his 'Addenda et Emendanda,' quotes it as *Canis Lycaon*, and, in his 'Index Nominum,' refers to it as *Lycaon tricolor* of Brookes. Cuvier places it among the dogs. Dr. J. E. Gray places it among the *Canina* in his order *Felidæ*. He calls it *Lycaon venaticus*, and gives the following synonyms in addition to the above:—*Canis aureus*, Thunberg; *Canis Hyænoides*, Cuvier; *Hyæna venatica*, Burchell; *Kynos pictus*, Rüppell; *Lycaon typicus*, A Smith. It is also known by the common names Simir and Melbia.

In the number and form of its teeth the Hyæna-Dog agrees with the dogs, as well as in its general osteological structure, which presents a remarkable difference from that of the hyæna. Externally it is distinguishable from both the hyænas and the dogs in the proportional length of its legs and the form and proportions of the body. There is no mane as in the hyænas, and the tail resembles that of some dogs. The head is hyæna-like, and, like the hyænas, it has only four toes to each foot.

Its colour is reddish or yellowish-brown, variously mottled in large patches along the sides of the body and on the legs, with black and white intermixed. Nose and muzzle black, with a strong black line passing from them up the centre of the forehead to between the ears, which are very large, black within and without, and furnished with a broad and expanded tuft of long whitish hairs arising from their anterior margin, and filling up a considerable part of their concavity. Beneath each of the eyes a lighter patch. Tail moderate, covered with long bushy hair, and divided in the middle by a ring of black, below which it is nearly white, as are also the fore parts of the legs below the joint. Mr. Bennett, who thus describes the animal, had an opportunity of seeing a living specimen in the Tower of London; but he observes that their colours and markings are subject to variation in different individuals, though their general disposition and appearance are similar.

Mr. Burchell, who brought to this country the first specimen, and pointed out the distinguishing characters, describing it under the name of *Hyæna venatica*, states that it hunts in packs, at night by preference, but frequently in the day. He describes it as swift, fierce, and active, so that only those animals which are gifted with great fleetness can escape from it. It attacks sheep openly and fearlessly; it approaches oxen and horses more cautiously, advancing upon them by stealth, biting off the tails of the oxen, and injuring the horses, especially young colts, so severely that they rarely survive.

Mr. Burchell's specimen continued ferocious though he kept it chained up in his stable-yard for more than a year, and the man who fed it "dared never to venture his hand upon it." It however became familiar with a dog, its companion. The Tower specimen arrived with a young Cape lion, with which it agreed perfectly till the lion became too strong and rough in his play, when the Hyæna-Dog was associated with a Striped Hyæna and two Spotted Hyænas, and all lived tolerably well together in the same den.

Mr. Swainson gives the name of Hyæna-Dog as the English synonym of *Proteles*. [AARD-WOLF.] The animal which is the subject of this article he describes under the name of *Lycaon*, the Hunting Dog. He arranges both under the family *Felidæ*, where they had been previously placed by Dr. Gray.

Two very fine specimens of this animal are now living (1854) in the Zoological Gardens, Regent's Park. They are young, and excessively playful, seldom allowing each other to rest a single moment.

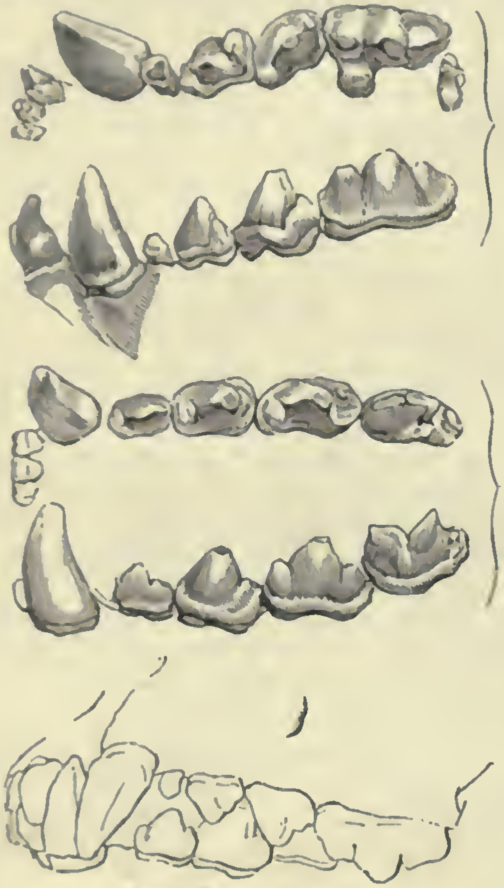
HYÆNANCHE, a genus of Plants belonging to the natural order *Euphorbiaceæ*. *H. globosa* yields a fruit which is collected by the Cape Colonists, and when powdered is used as a poison for hyænas by being rubbed over meat.

HYÆNINA, the name of a family of Digitigrade Carnivorous *Mammalia*, distinguished by having their fore legs longer than their hind legs, by their rough tongue, great and conical molar, or rather cutting-and-crushing teeth, projecting eyes, large ears, and a deep and glandular pouch beneath the anus.

Dental Formula:—Incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{5-5}{4-4} = 34$.

The false molars, three above and four below, are conical, blunt, and very large. The upper flesh-tooth (carnassière) has a small tubercle within and in front, but the lower one has none, and presents only two trenchant points. The whole of the dental and molar organisation, and indeed the whole cranial structure, appears to have been formed with a view to the bringing into the most available action the formidable natural instruments which enable the Hyænas to break the hardest bones.

Dr. Buckland gives the following account of the feats of a Cape Hyæna which he saw at Oxford in the travelling collection of Mr. Wombwell, the keeper of which confirmed in every particular the evidence given to Dr. Wollaston by the keeper of Exeter 'Change, and noticed in 'Reliquiæ Diluvianæ,' p. 20:—"I was enabled," says Dr. Buckland, "to observe the animal's mode of proceeding in the destruction of bones. The shin-bone of an ox being presented to this Hyæna, he began to bite off with his molar teeth large fragments from its upper extremity, and swallowed them whole as fast as they were broken off. On his reaching the medullary cavity the bone split into angular fragments, many of which he caught up greedily, and swallowed entire. He went on cracking it till he had extracted all the marrow, licking out the lowest portion of it with his tongue: this done, he left untouched the lower condyle, which contains no marrow, and is very hard. . . . . I gave the animal successively three shin-bones of a sheep; he snapped them asunder in a moment, dividing each in two parts only, which he swallowed entire, without the smallest mastication. On the keeper putting a spar of wood two inches in diameter into his den, he cracked it in pieces as if it had been touchwood, and in a minute the whole was reduced to a mass of splinters. The power of his jaws far exceeded any animal force of the kind I ever saw exerted, and reminded me of nothing so much as a miner's crushing-mill, or the scissors with which they cut off bars of iron and copper in the metal founderies." ('Reliquiæ Diluvianæ.')

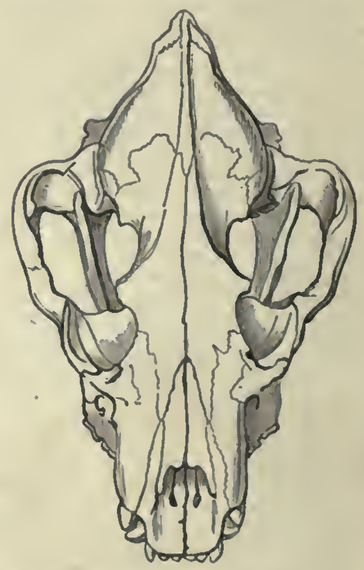


Teeth of Hyæna. (F. Cuvier.)

The accompanying figures will give the reader some idea of the area and space devoted to the attachment and development of the muscles destined to move the powerful jaws. These muscles, aided by the muscles of the neck, are so strong that it is almost impossible to drag from their vice-like grip that which the animal has once seized. Cuvier remarks that their efforts in this way sometimes produce anchylosis of the cervical vertebræ, and that this has given rise to the assertion that Hyænas have but a single bone in the neck. He also states that their name among the Arabs is the symbol of stubbornness. The tongue is rough. The feet have four toes each, like those of the suricates. The same author sums up their character by saying that they are voracious nocturnal animals, inhabiting caverns, living for the most part on carcasses, for which they ransack the tombs, and that they are the subjects of an infinity of superstitious traditions.

Skull of Spotted Hyæna: profile. (Cuvier.)

Skull of Striped Hyæna: profile. (Cuvier.)



Skull of Spotted Hyæna, seen from above.

The strength of these animals and their power of dragging away large bodies is strikingly exemplified in Colonel Denham's narrative. At Kouka he relates that the Hyænas (Dhubba), which were everywhere in legions, grew so extremely ravenous that a good large village, where he sometimes procured a draught of sour milk on his duck-shooting excursions, had been attacked the night before his last visit, the town absolutely carried by storm, notwithstanding defences nearly six feet high of branches of the prickly tulloh, and two donkeys, whose flesh these animals are, according to our author, particularly fond of, carried off, in spite of the efforts of the people. "We constantly," continues Colonel Denham, "heard them close to the walls of our own town at nights, and on a gate being left partly open, they would enter and carry off any unfortunate animal that they could find in the streets." From the same narrative it appears that it was necessary to protect the graves from the attacks of these rapacious brutes. Mr. Toole's grave had a pile of thorns and branches of the prickly tulloh, several feet high, raised over it as a protection against the flocks of hyænas which nightly infested the burying-places in that country.

Linnæus, in his last edition (12th) of the 'Systema Naturæ,' places the Hyæna under the genus *Canis*, between the Wolf and the Fox, and describes the Striped Hyæna only as *Canis Hyæna*, with sufficient accuracy. Brisson had already given the form a generic distinction under the name of *Hyæna*.

Gmelin, in his edition, adds the spotted species under the name of *Canis crocuta*, and places these hyænas between the *Canis Thous* and *C. aureus*, the latter being the Jackal; but Pennant had previously described both species in his synopsis under the title of 'Hyæna,' and as the Striped and Spotted Hyænas, arranging the form between the 'Dog' and the 'Cat,' names which he uses as generic distinctions for those carnivorous types, in the largest sense.

Cuvier makes the Hyænas the last subdivision of the Digitigrades following his Civets (*Viverra*), and immediately preceding the Cats (*Felis*). He describes the subdivision as containing the most cruel and most carnivorous animals of the class, and as comprising two genera (which he does not distinguish), adding that three species are known, namely, L'Hyène Rayée (*Canis Hyæna*, Linn.); L'Hyène Brune (*Hyæna brunnea*, Thunberg; *H. villosa*, Smith); and L'Hyène

Tachetée (*Canis crocuta*, not of Linnæus, as Cuvier quotes it, but of Gmelin).

Dr. J. E. Gray, in his method ('Annals of Philosophy,' 1825), brings the Hyænas under the family *Felidæ*, which he divides into two sections; the first consisting of those genera which have no tubercular grinders in the lower jaws; the second consisting of those which have tubercular grinders in both jaws. The first sub-family of the first section (which also includes *Felina*) is *Hyenina*, consisting of the genera *Hyæna* (Brisson) and *Proteles* (Geoffroy). [AARD-WOLF.]

M. Lesson arranges the genus *Hyæna* under his third section of the tribe of Digitigrades, which section consists of those genera which are without a small tooth behind the great molar of the lower jaw. Its situation is between *Proteles* and the Cats (*Felis*), and three species are recorded, the same as those mentioned by Cuvier, but two of them with different names; thus, the Spotted Hyæna is termed *Hyæna Capensis* (Desm.), and the Brown Hyæna, or Hyène Brune, is named *Hyæna rufa* (G. Cuv.).

The species are entirely confined to the Old World, Africa, and Asia.

Hyæna striata, the Striped Hyæna. This is the Ὕαινα and Hyæna of the ancients; the *Canis Hyæna* of Linnæus; *H. striata* of Zimmerman; *H. vulgaris* of Desmarst; and *H. antiquorum* of Temminck. *H. orientalis*, of Tiedemann, the Hooandor of Buffon, Bennett, and other writers. Ground colour uniform brownish-gray, rather darker above than beneath. Sides marked by several irregular, distant, transverse, blackish stripes or bands, which are more distinct on the lower part. Towards the shoulders and haunches these stripes become oblique, and they are continued in regular transverse lines on the outside of the legs Front of the neck, muzzle, and outsides of the ears black; the latter broad, moderately long, and nearly destitute of hairs, especially on the inside. Hairs of the body long, particularly on the back of the neck, and on the spine, where it forms a full and thick mane, which may be said to be continued even upon the tail, the latter being furnished with strong tufted hairs of considerable length. Mane and tail both marked with blackish spots or stripes, variously and irregularly placed. Individuals vary much in colour and markings. (Bennett.)

Striped Hyæna (*Hyæna striata*).

It seems uncertain whether this is the animal alluded to in the Bible. Some translate the words rendered in our copies of the Holy Scriptures 'the valley of Zeboim' (1 Sam. xiii. 18; Nehem. xi. 34) as 'the valley of Hyænas;' and the 'Seventy' render the words given by the English translators as 'a speckled bird,' and 'a bird of divers colours' (Jer. xii. 9), as 'the cave of the Hyæna,' Σπήλαιον Ὑαίνης, while others would substitute one of the Hebrew letters composing the word in Samuel for another, and make the reading 'vipers,' as if certain streaked serpents were meant. Bochart (and Scheuchzer seems to agree with him) shows that by the Tsabhua, or Tseboa, the word occurring in the ninth verse of the twelfth chapter of Jeremiah, the Hyæna was intended, and, if this opinion be correct, there can be little doubt that 'the valley of Zeboim' means 'the valley of Hyænas.' Dzuba and Dubba are, it appears, Arabic names for this species.

Whatever may be the opinions as to the Striped Hyæna being alluded to in those passages of Scripture which we have quoted, there can be no doubt that it is the Ὕαινα of Aristotle ('Hist. Anim.,' vi. 32; viii. 5) and the Greeks. The most monstrous fables were rife respecting this animal, and the extent to which they had reached may be supposed when we find Aristotle (vi. 32) taking pains to demonstrate the absurdity of the assertion that the animal was bisexual, or a true hermaphrodite. He declares that the genital parts of the male resemble those of the wolf and dog, and that the part which had been taken for the female organ is an opening with an imperforate bottom placed under the tail. This, as we have seen, is characteristic of the genus. Aristotle describes the parts with great minuteness; but notwithstanding his accuracy, we find Pliny (viii. 30, and xxviii. 8), and Ælian (i. 25, and vi. 14), stating not only that the Hyæna is bisexual, but that it changes the sex, being a male one year, and a female another. It is true that Pliny, in the passage first quoted, after stating—"Hyænis utramque esse naturam, et alternis annis mares, alternis fæminas fieri, parere sine mare, vulgus credit"—adds, "Aristoteles negat." But he leaves the subject there; and continues in such a strain, in both the books quoted, that his authority has been cited in support of these and other absurdities. Thus we are told that magicians looked on it with the greatest admiration, as possessing the magical power of alluring men.

It would be a waste of time and space to enumerate all the wonderful powers that were attributed to it; but among other accomplishments it was said to imitate the language of men, in order to draw to it shepherds whom it devoured at leisure, and to have the power of charming dogs so that they became dumb.

The animal does not seem to have made a part of the Roman shows till a comparatively late period. The third Gordian appears to have been the first who so introduced it; ten are said to have made their appearance at the games given by the emperor Philip, about A.D. 247.

The early modern naturalists repeated the fables of the ancients. Even Bélon, who was a good observer, gives "Le Portrait de la Civette, qu'on nommoit anciennement Hyæna." This figure is by no means bad for the time, and beneath in the small quarto volume 'Portraits D'Oyseaux, Animaux,' &c., &c., is the following quatrain:—

> "Voyant cecy, tu voy de la Civette
> Le vray portrait; qui rend abondamment
> Par son conduit le musc, pour excrement,
> Odeur, que plus à sentir on souhaite."

And this is the more curious when we find the same author ('Aquat.') giving a very fair cut of the Striped Hyæna (which Gesner, Aldrovandus, and Jonston copied) as the sea-wolf, an amphibious animal, satiating itself with fish, and seen on the shore of the British Ocean.

Pennant notices the propensity of this species to violate the repositories of the dead, and greedily devour the putrid contents of the grave. He also states, that it preys on the herds and flocks; but adds, on the authority of Shaw ('Travels'), that for want of other food it will eat the roots of plants, and that it will feed on the tender shoots of palms. He speaks of it as an unsociable animal, solitary, and inhabiting the chasms of the rocks, and says (also on the authority of Shaw), that the superstitious Arabs, when they kill one, carefully bury the head, least it should be applied to magical purposes; as the neck was of old by the Thessalian sorceress—

> "Viscera non Lyncis, non diræ nodus Hyænæ
> Defuit."
>
> "Nor entrails of the spotted Lynx she lacks,
> Nor bony joints from fell Hyænas' backs."—Lucan—Rowe.

After referring to the wild opinions of the ancients on this subject, he remarks, that it is no wonder that an ignorant Arab should attribute to its remains preternatural powers.

"They are," continues Pennant, "cruel, fierce, and untameable animals, with a most malevolent aspect; have a sort of obstinate courage, which will make them face stronger quadrupeds than themselves. Kæmpfer relates that he saw one which had put two lions to flight, regarding them with the utmost coolness." ('Synopsis Quadr.') This is a somewhat extraordinary translation of a passage in the second fasciculus of Kæmpfer's 'Amœnitates Exoticæ,' where he relates that he went to see a male Hyæna (Kaftaar), which a certain rich Gabr, or fire-worshipper, kept as a curiosity, the animal having been taken when a suckling. It was muzzled by means of a rope fastened round its jaws, led out, and the rope lengthened so as to enable the animal to run more freely; and Kæmpfer goes on to say, "Narrabant Gabri, sic frænatum nuper se opposuisse duobus leonibus, quos, adspectante serenissimo,* in fugam verterit." Kæmpfer gives a figure which, though rude, cannot be mistaken for any animal but a Striped Hyæna. Pennant seems to have been aware of his misconstruction, for afterwards, in his 'History of Quadrupeds,' he stops at, "put two lions to flight," omitting, "regarding them with the utmost coolness."

In the last-mentioned work Pennant remarks, that it will venture near towns; and quotes Niebuhr as authority that it will, about Gambron, in the season when the inhabitants sleep in the open air, snatch away children from the sides of their parents.

It has been the custom, among other fabulous assertions, to state that the Hyæna is not to be tamed: now, as Mr. Bennett observes, in the 'Tower Menagerie,' there is scarcely any animal that submits with greater facility to the control of man. He speaks of the docility and attachment to his keepers manifested by the Striped Hyæna, especially when allowed a certain degree of liberty, which the animal shows no disposition to abuse, though those which are carried about from fair to fair in close caravans are surly and dangerous from irritation and ill-treatment. The individual which Mr. Bennett figures was remarkably tame, and confined in the same den with one

* The king of Persia, apparently.

of the American bears. [BEAR.] Colonel Sykes ('Proc. Zool. Soc.,' 1830-31) remarks, that this species, Turrus of the Mahrattas, is numerous in Dukhun (Deccan), and susceptible of the same domestication as a dog. Other travellers speak of the Hyæna being susceptible of domestication and performing the duty of watch-dogs.

The Striped Hyæna is found in Asia, and Northern and Central Africa, the mountains of Caucasus, and the Altaic Chain, Asiatic Turkey, Syria, Persia, Barbary, and Senegal, and even as low as the Cape. There are living specimens in the Gardens of the Zoological Society at the Regent's Park.

H. maculata (Humboldt), the Spotted Hyæna. This species is the Tiger-Wolf of the colonists at the Cape; *Canis crocuta* of Erxleben and Gmelin; *Hyæna crocuta* of Zimmerman; *Hyæna Capensis* of Desmarest; *Crocuta maculata* of Gray. Gesner has a figure of this species devouring a dog; and the Spotted Zilio Hyæna of Jonston appears to owe its origin to the same animal.

Spotted Hyæna (*Hyæna maculata*).

Cuvier remarks that this and the preceding Hyæna are entirely distinct specifically, notwithstanding their generic resemblance, both externally and in the skeleton. The Spotted Hyæna has, he observes, no mane on the back, and instead of stripes has only round or black spots more or less scattered. He states that the last lower molar in the Spotted Hyæna is simply compressed and bilobated with a heel or process behind, whilst the Striped Hyæna has in addition a particular tubercle on the internal surface of its posterior lobe; there are also other osteological differences, which the reader will find pointed out in the 'Ossemens Fossiles.'

Size rather less than that of the Striped Hyæna. Muzzle short, but not so abruptly truncated. Ears short and broad, nearly quadrilateral. Colour yellowish-brown, the whole body covered with numerous spots of a deeper brown, tolerably uniform in size, but sometimes not very distinctly marked, and occasionally arranged in longitudinal rows. Hair shorter than in the Striped Hyæna; and though longer on the neck and in the central line of the back than elsewhere, it does not form so distinct and well-furnished a mane as that of the Striped Hyæna. Tail blackish-brown, covered with long bushy hair. (Bennett.)

It is found in the south of Africa, and especially the neighbourhood of the Cape of Good Hope. Lesson and others say that it is found even as high as Barbary, but this is doubtful. Ludolph, in his 'Ethiopia,' or rather the translator (i. 10), says, "The hyæna, or the *Crocuta*, near akin to the wolfe, is the most voracious of their wild beasts; for she not only by night and by stealth, but openly and in the daytime, preys upon all she meets with, men or cattle; and rather than fail, digs down the walls of houses and stables. Gregory described her to be speckled with black and white spots." To this is appended the following note:—"Begot between a Hyæna and a Lioness: familiar to Ethiopia. See 'Solinus,' l. 65, and Salmatius upon him." There is a living specimen in the Gardens of the Zoological Society, at the Regent's Park. It came from South Africa.

Numerous are the writers who have treated of the habits of this destructive animal. Le Vaillant, Sparrman, and other travellers give very interesting accounts of its manners; but we select the statement made in the first catalogue of the African Museum (where it is named *H. maculata*), which was dispersed in 1838, because we think that the statement carries internal evidence of its having proceeded from the pen of the eminent and accurate zoologist under whose zealous superintendence that collection was made. The catalogue, then, states that there are two species of Hyæna in South Africa, and that the Spotted Hyæna, or Tiger-Wolf of the colonists, is more numerous and more widely diffused than the other species, which has the name of the Strand, or Coast-Wolf, and is also more voracious and destructive, not only devouring such animals as it chances to find dead, but also carrying off the smaller ones from the pens of the farmers during the night, and often succeeding in killing or mutilating such of the larger kinds as have not been secured before dusk. Sickly animals, it appears, are less liable to suffer from the voracity of this creature than those that are in full health; the latter, by their rapid flight, inspiring their enemy with a courage of which by nature he is destitute; whereas the sickly face him, and thus intimidate him from attacks which might be successful if made. So anxious is he for the flight of the animals, as a preliminary to his

attack, that he uses all the grimace and threatening he can command to induce them to run, and never dares to attack them unless they do so. "The character of this hyæna," continues the author, "makes his destruction an object of no small importance to the farmers, whose ingenious snares for him call forth amazing cunning and dexterity on the part of the animal to render them of no avail. The more common methods employed against beasts of prey, such as spring-guns, traps, &c. do not succeed in his case. During his nocturnal wanderings he minutely examines every object that presents itself to his notice with which he is not perfectly familiar; and if he see reason to suspect that it can injure him, he will turn back and make his way in an opposite direction. Thus cords or leather thongs, which are often laid across the footpaths the hyæna is accustomed to travel upon, and which are attached to the triggers of loaded guns, with the design that his contact with the thong may cause the discharge of the gun in his direction, are very carefully examined by him, and the usual result of his examination is his deciding against trusting himself in contact with them. The farmers have so often observed this result, that they now very rarely attempt his destruction by this means, but occasionally succeed by substituting for cords the delicate stems of creeping plants, which are regarded by him without suspicion until he has actually suffered through them. Many other ingenious methods, suggested by the necessity of the case, have been adopted by the farmers for the destruction of hyænas; but a description of them, though elsewhere desirable, would here be out of place. This species seldom, if ever, moves abroad during the day, but passes that period in a state of repose, either in holes in the ground, or in retired situations densely covered with bush. Night is his favourite season for seeking his food; and towards nightfall his howlings are regularly heard, announcing to the various animals the approach of their voracious enemy, and thus enabling many of them to escape his wiles. The propensity this beast has for howling seems therefore to be disadvantageous to him; and if his almost continuous noise be not intended to put the animals upon which he preys upon their guard, its actual purpose is scarcely conceivable. Some have surmised it to be his call to creatures of his own species; but that this is not the case is certain from the fact that hyænas are heard to utter their supposed call even while separating from each other farther and farther as each cry is uttered; in addition to which it may be remarked that it is contrary to the habit of this animal to hunt in company, or even to congregate in large numbers, save when assembled by the temptation of an abundance of carrion. A still further proof that the hyæna's cry is not a friendly call to his own species, may be found in the fact that when individual hyænas have found a dead animal they cease to utter their melancholy howl, as if in fear of calling participators of their feast."

It appears from the above interesting account that the Spotted Hyæna puts in practice "all the grimace and threatening he can command" to induce the objects of his attack to run: in other words, his plan of attack is founded upon intimidation. May not his howls be intended to inspire terror and shake the nerves of the animals within hearing of the doleful nocturnal sounds?

"Till lately," adds the author in conclusion, "hyænas were in the habit of paying nightly visits to the streets of Cape Town, and were regarded as very useful in carrying away the animal refuse, which might otherwise have been disagreeable. This however no longer occurs, partly perhaps from better regulations now existing in the town, and partly from the number of these animals having very greatly decreased. Even now however individual hyænas occasionally approach the town, and their howlings are sometimes heard under Table Mountain, and in other directions, during the nights. In the countries inhabited by the Kaffirs they are very numerous and daring, generally approaching the villages during the night, and attempting, either by strength or stratagem, to pass the wattles by which the houses are defended. If they be thus far successful, they next endeavour to enter the houses, which they sometimes accomplish, in which case they not unfrequently carry off some young child of the family. Scars and marks on various parts of the body often testify to the traveller how dangerous a foe the natives have in this animal."

Mr. Steedman, in his 'Wanderings and Adventures in the Interior of Southern Africa,' gives most appalling accounts of the rapacity of the Spotted Hyæna. He states that Mr. Shepstone, in a letter from Mamboland, relates that the nightly attacks of wolves, as the Hyænas are generally called, have been very destructive amongst the children and youth; for within a few months not fewer than 40 instances came to his knowledge wherein that beast had made a most dreadful havoc. "To show clearly," says that gentleman, "the preference of the wolf (spotted hyæna) for human flesh, it will be necessary to notice that when the Mambookies build their houses, which are in form like beehives, and tolerably large, often 18 or 20 feet in diameter, the floor is raised at the higher or back part of the house, until within 3 or 4 feet of the front, where it suddenly terminates, leaving an area from thence to the wall, in which every night the calves are tied to protect them from the storms or from wild beasts. Now it would be natural to suppose, that should the wolf enter, he would seize the first object for his prey, especially as the natives always lie with the fire at their feet; but notwithstanding this, the constant practice of this animal has been in every instance to pass by the calves in the area, and even by the fire, and to take the children from under the mother's kaross, and this in such a gentle and cautious manner, that the poor parent has been unconscious of her loss until the cries of her little innocent have reached her from without when a close prisoner in the jaws of the monster." Mr. Shepstone then particularises two instances within his own knowledge, one of a boy abont ten years of age, and the other of a little girl about eight, who had been carried off by this species, and wretchedly mangled, but recovered by the attention of Mr. Shepstone and his friends. Notwithstanding this ferocity, the Spotted Hyæna has, it is stated, been domiciliated in the houses of the peasantry, "among whom," says Mr. Bennett, "he is preferred to the dog himself for attachment to his master, for general sagacity, and even, it is said, for his qualifications for the chase."

H. villosa the Strand-Wolf. In a communication to the Zoological Society of London (1833), Dr. Andrew Smith stated his belief that the Striped Hyæna does not inhabit South Africa; its place being occupied by the *H. villosa*, which bears, when young, considerable resemblance to that species. *H. villosa* was first described by Dr. Smith in the 'Transactions of the Linnæan Society.' This animal was considered by Cuvier as identical with L'Hyène Brune (*H. brunnea* of Thunberg), which is quoted by M. Lesson as Hyène Rousse, (*H. rufa*, of Cuvier). In the list of the specimens of *Mammalia* in the British Museum, this animal is regarded as a variety of *H. striata*. The following are the dimensions of a specimen in Mr. Steedman's collection:—

	Feet.	Inches.
From the nose to the root of the tail	4	4
Height at the shoulder	2	4
Height at the croup	2	0
Breadth of head between the ears	0	5½
Length of head from nose to occiput	0	10
Length of the ear	0	5
Length of the tail to the extremity of the vertebræ	0	9½
Length of the tail with hair	1	2

Strand-Wolf (*Hyæna villosa*).

The hair is described as remarkably long, coarse, and shaggy over the whole body of the animal; whilst on the head, ears, and extremities alone it is short and crisp. Its length on the back and sides is 8 or 10 inches, and it does not form a long mane on the spine, as is the case with the common Striped Hyæna. The general colour of the head, body, and extremities, is grizzled brown, from the long hairs being grayish at the roots and brown at the points, marked on the sides and hips with large but rather indistinct transverse bands of a deep vinous brown-colour. The legs, particularly those before, which as in other Hyænas, are much longer than those behind, are marked with transverse black bands much more distinct and apparent than those on the body. The upper lip is furnished with remarkably long bristly black moustaches, and the tail, which is thickly covered with long hair, and of greater length than in the common Hyæna, is uniform dark-brown. The fore-arms and thighs are darker than other parts of the animal, and a large collar of dirty yellowish-white surrounds the throat and extends up the sides of the neck, occupying the entire space between the setting on of the head and shoulders. Under each eye is a large irregular black patch; the chin is black also, and a narrow band of the same colour marks the junction of the head and neck, bordered by the dirty white collar above mentioned. The ears are large, erect, and rather pointed. The individual was aged, all the teeth being mnch worn: the two exterior incisors were much larger than the others, and had the form and size of small canines. A young one, 19 inches in length, also in Mr. Steedman's collection, exhibited all t o general characters of the aged specimen, excepting that the hair was shorter and more woolly. (Steedman.)

This animal inhabits the sea-coast throughout the whole extent of Southern Africa, but is by no means so common as the Spotted Hyæna. The young specimen mentioned above was obtained alive with two others in the neighbourhood of the Nieuveld Mountains, a considerable distance in the interior of the country, which shows, as Mr. Steedman observes, that the species is not so strictly confined to the vicinity of the sea-coast, as its name 'Straand-Wolf' would imply, or as the accounts of travellers would lead us to imagine.

The Straand-Wolf devours carrion and such dead animal substances, whales for instance, as the sea casts up: but when pressed by hunger its habits seem to resemble those of the other species, for it then commits serious depredations on the flocks and herds of the colonists, who hold its incursions in great dread. Mr. Steedman, who states this, says he saw a very fine specimen, which had been shot by a farmer residing in the vicinity of Blauwberg, and was informed that it had destroyed three large calves belonging to the farmer. He adds, that it is said to be a remarkably cunning animal, retiring to a considerable distance from the scene of its depredations to elude pursuit, and concealing itself during the day-time in the mountains, or in the thick bush, which extends in large patches throughout the sandy district in which it is usually found.

H. rufa, the Brown Hyæna. It is the *Crocuta brunnea* of Gray; *H. fusca* of Geoffroy; the *H. crocuta rufa* of Fischer, and the *H. brunnea* of Thunberg. This species is a native of South Africa, and has been taken at Natal. There is a living specimen at present in the collection of the Zoological Society in Regent's Park.

Fossil Hyænas.—Fossil Hyænas occur abundantly in the third period of the Tertiary deposits (Pliocene of Lyell), especially in the ossiferous caverns. Dr. Buckland gives the following localities for the remains of Hyænas in caves or fissures:—Kirkdale, Plymouth, Crawley Rocks, near Swansea, Paviland Caves near Swansea, district of Muggendorf, district of the Harz, Fouvent in France, Sundwick in Westphalia, and Köstritz near Leipzig. Those found in the superficial loam or gravel are stated to have occurred at Lawford near Rugby, at Herzberg, and Osterode, Canstadt near Stutgardt, Eichstadt in Bavaria, and the Val-d'Arno near Florence. The fossil species named are *H. spelæa*, Goldf.; *H. spelæa major*, Goldf.; *H. prisca* (Hyène Rayée Fossile), M. De Serres; *H. intermedia*, M. De Serres; *H. Perrierii*, Brav., Croiz., and Job.; *H. Arvernensis*, Brav., Croiz., and Job.; and *H. dubia*, Brav., Croiz., and Job. Of these the only species which has been found in the caves of great Britain is the *H. spelæa*. As the discovery of the bones principally of this animal in the caves at Kirkdale were amongst the first to attract attention among the numerous extinct *Mammalia* which formerly lived in Great Britain, we give an extract from Dr. Buckland's description of that remarkable locality.

"Both the roof and the floor for many yards from the entrance are composed of regular horizontal strata of limestone, uninterrupted by the slightest appearance of fissure, fracture, or stony rubbish of any kind; but farther in the roof and sides become irregularly arched, presenting a very rugged and grotesque appearance, being studded with pendent and roundish masses of chert and stalactite; the bottom of the cavern is visible only near the entrance, and its irregularities, though apparently not great, have been filled up throughout to a nearly level surface by the introduction of a bed of mud or loamy sediment. There is no alternation of mud with any repeated beds of stalactite, but simply a partial deposit of the latter on the floor beneath it; and it was chiefly in the lower part of the earthy sediment, and in the stalagmitic matter beneath it, that the animal remains were found: there was nowhere any black earth, or admixture of animal matter, except an infinity of extremely minute particles of undecomposed bone. In the whole extent of the cave only a very few large bones have been discovered perfect; most of them are broken into small angular fragments and chips, the greater part of which lay separately in the mud, whilst others were wholly or partially invested with stalagmite; and others again mixed with masses of still smaller fragmeuts, and cemented by stalagmite, so as to form an osseous breccia. In some few places where the mud was shallow and the heaps of teeth and bones considerable, parts of the latter were elevated some inches above the surface of the mud and its stalagmitic crust, and the upper ends of the bones thus projecting, like the legs of pigeons through a pie-crust, into the void space above, have become thinly covered with stalagmitic drippings, whilst their lower extremities have no such incrustation, and have simply the mud adhering to them in which they have been imbedded; a horizontal crust of stalagmite about an inch thick crosses the middle of these bones, and retains them firmly in the position they occupied at the bottom of the cave. A large flat plate of stalagmite, corresponding in all respects with the above description, and containing three long bones fixed so as to form almost a right angle with the plane of the stalagmite, is in the collection of the Rev. Mr. Smith of Kirby Moorside. The same gentleman has also, among many other valuable specimens, a fragment of the thigh-bone of an elephant, which is the largest I have seen from this cave. The effect of the loam and the stalagmite in preserving the bones from decomposition, by protecting them from atmospheric air, has been very remarkable; some that had lain uncovered in the cave for a long time before the introductiou of the loam were in various stages of decomposition, but even in these the further progress of decay appears to have been arrested as soon as they became covered with it, and in the greater number little or no destruction of their form, and scarcely any of their substance, has taken place. I have found on immersing fragments of these bones in acid till the phosphate and carbonate of lime were removed, that nearly the whole of their original gelatine has been preserved.

"Analogous cases of animal remains preserved from decay by the protection of similar diluvial mud occur on the coast of Essex near Walton, and at Lawford, near Rugby, in Warwickshire. Here the bones of the same species of elephant, rhinoceros, and other diluvial animals occur in a state of freshness and perfection even exceeding that of those in the cave at Kirkdale, and from a similar cause, namely, their having been guarded from the access of atmospheric air, or the percolation of water, by the argillaceous matrix in which they have been imbedded; whilst other bones that have lain the same length of time in diluvial sand or gravel, and have been subject to the constant percolation of water, have lost their compactness and strength and great part of their gelatine, and are often ready to fall to pieces on the slightest touch, and this where the beds of clay and gravel alternate in the same quarry, as at Lawford. The bottom of the cave on first removing the mud was found to be strewed all over like a dog-kennel, from one end to the other, with hundreds of teeth and bones, or rather splintered fragments of bones of all the animals above enumerated; they were found in greatest quantity near its mouth, simply because its area in this part was most capacious; those of the larger animals—elephant, rhinoceros, &c.—were found co-extensively with all the rest, even in the inmost and smallest recesses.

"Scarcely a single bone has escaped fracture, with the exception of the astragalus and other hard and solid bones of the tarsus and carpus joints, and those of the feet. On some of the bones marks may be traced which, on applying one to the other, appear exactly to fit the form of the canine teeth of the hyæna that occur in the cave. The hyænas' bones have been broken and apparently gnawed equally with those of the other animals.

"Heaps of small splinters, and highly comminuted yet angular fragments of bones, mixed with teeth of all the varieties of animals above enumerated, lay in the bottom of the den, occasionally adhering together by stalagmite, and forming, as has been before mentioned, an osseous breccia. Many insulated fragments also are wholly or partially enveloped in stalagmite, both externally and internally. Not one skull is to be found entire; and it is so rare to find a large bone of any kind that has not been more or less broken, that there is no hope of obtaining the materials for the construction of a single limb, and still less of an entire skeleton. The jaw-bones also even of the hyænas are broken to pieces like the rest; and in the case of all the animals, the number of teeth and solid bones of the tarsus and carpus is more than twenty times as great as could have been supplied by the individuals whose other bones we find mixed with them."

Dr. Buckland continues:—

"Mr. Gibson alone collected more than three hundred canine teeth of the hyæna, which at least must have belonged to seventy-five individuals, and, adding to these the canine teeth I have seen in other collections, I cannot calculate the total number of hyænas of which there is evidence at less than two or three hundred. The only remains that have been found of the tiger species are two large canine teeth and two molar teeth, exceeding in size the largest lion's or Bengal tiger's. There is one tusk only of a bear, which exactly resembles those of the extinct *Ursus spelæus* of the caves of Germany.

"In many of the most highly-preserved specimens of teeth and bones there is a curious circumstance, which before I visited Kirkdale had convinced me of the existence of the den, namely, a partial polish and wearing away to a considerable depth of one side only: many straight fragments of the larger bones have one entire side, or the fractured edges of one side, rubbed down and worn completely smooth, whilst the opposite side and ends of the same bones are sharp and untouched, in the same manner as the upper portions of pitching stones in the streets become rounded and polished, whilst their lower parts retain the exact form and angles which they possessed when first laid down. This can only be explained by referring the partial destruction of the solid bone to friction from the continual treading of the hyænas and rubbing of their skins on the side that lay uppermost at the bottom of the den."

The species of Hyæna whose remains have been found in such large numbers in the caves at Kirkdale and other parts of this country was first determined by Cuvier. It differs chiefly in its larger and more robust proportions; the scapula is narrower in proportion to its articular extremity, and the deltoid crest of the humerus is longer and stronger.

"In the numerous specimens," says Professor Owen, "of the Fossil Hyæna from British localities which I have examined and compared in public and private collections, I have not hitherto detected any characters indicative of a species distinct from the *Hyæna spelæa*; the differences observed have been those only of size and dental development, depending on diversity of sex and age. Of that fossil species which is more nearly allied to the Striped Hyæna (*Hyæna Monspessulana*, Christol) no trace has presented itself to my notice. It appears to have been confined to the middle of France, Languedoc, and Italy. Fossil remains of the Hyæna have been discovered by MM. Baker and Durand in the tertiary strata of the Sewalik Hills; and, what is more remarkable, were represented in the ancient Fauna of South America by a species which its discoverer Dr. Lund has termed *Hyæna neogæa*." (Owen, *British Fossil Mammals.*)

HYALÆIDÆ, a family of *Pteropoda*, according to the systems of Lamarck and Cuvier, but belonging to the family *Thecosomata* (order *Aporobranchiata*) of De Blainville. M. Rang, in his 'Tableau Méthodique,' follows De Férussac in making the *Hyalæidæ* a family, and enumerates the following genera as composing it:—*Cymbulia*, *Limacina*, *Hyalæa*, *Cleodora*, *Cuvieria*, *Euribia*, and *Psyche*.

The following are the characters of the family:—Animal furnished with a head, but it is not distinct, with a third natatory membrane smaller and intermediate at the ventral part; mouth situated at the bottom of a cavity formed by the union of the locomotive organs.

Shell nearly always present, and very variable in form. The shell is absent in the genus *Psyche*.

Cymbulia.—Cuvier describes the *Cymbulia* as having a cartilaginous or gelatinous envelope in the form of a boat or slipper, beset with points in longitudinal rows; and the animal itself as possessing two great wings of a vascular tissue, which are at once branchiæ and fins, and between them on the open side a third smaller lobe, which is three-pointed. The mouth with two small tentacula is placed between the wings, towards the shut side of the shell, and above two small eyes and the orifice of generation, whence issues an intromissive male organ in the form of a small proboscis (trompe). The transparency of the texture permits the observer to distinguish the heart, the brain, and the viscera through the envelopes.

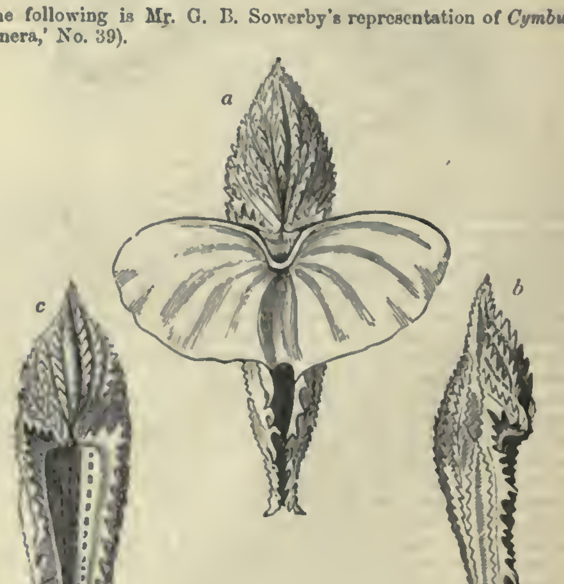
M. Rang gives the following characters of this genus:—Animal oblong, gelatinous, transparent, furnished with two eyes (?), two tentacles (?), and a mouth in the form of a proboscis (trompe)? Two lateral fins, which are large and rounded, carry the vascular net of the branchiæ; they are united at their base, on the posterior side, by an intermediate appendage in form of an elongated lobe.

Shell gelatinoso-cartilaginous, oblong, in the form of a slipper, entirely covered with a delicate and hardly visible membrane, with a superior opening, long and truncated at one of its extremities.

Cymbulia.

a, *a*, fins; *b*, the intermediate lobe; *i*, the viscera, seen through the shell; *h*, the shell.

The following is Mr. G. B. Sowerby's representation of *Cymbulia* ('Genera,' No. 39).



a, the animal in the shell, seen from above; *b*, the shell, seen edgewise; *c*, the shell, seen from above.

M. Rang further observes that this curious and very incompletely known genus only contains a single species, which is found in the Mediterranean Sea; and he adds that he only knows it by a drawing communicated to him by Cuvier, who remarks ('Règne Animal') that in the figure given by M. De Blainville ('Malacologie,' xlvi. 3) the animal is placed in the shell the wrong way ("en sens contraire du veritable"), and that his (Cuvier's) description rests on recent and repeated observations made by M. Laurillard. M. Deshayes confirms this remark as to the inverse position of the animal, and says that he has had occasion to verify it often.

M. Rang in 1829 knew but one species. M. Deshayes, in his edition of Lamarck (1836), enumerates five. The species known to M. Rang must have been *Cymbulia Peronii.*

Limacina (*Spiratella*, De Bl.).—Animal elongated anteriorly, turned into a spiral form behind; branchiæ in the form of plaits on the back; mouth furnished with two small appendages, which are united by one of their extremities to the anterior border.

Shell very delicate, fragile, vitreous, spiral, not carinated, turning rather obliquely on itself, with a circular aperture and simple borders. (Rang.)

Cuvier is of opinion that the *Limacinæ* ought, according to the description of Fabricius, to bear a strong relationship to *Pneumodermon;* but their body is terminated by a tail, which is twisted spirally ("contournée en spirale"), and is lodged in a very delicate shell, of one whorl and a half, umbilicated on one side and flattened on the other. Cuvier adds that the animal uses its shell as a boat and its wings as oars when it would swim on the surface of the sea. The same author remarks, that the only species, *Clio helicina* of Phipps and Gmelin, is scarcely less abundant in the icy sea than *Clio borealis* [CLIO], and is considered as one of the principal aliments of the whale. He observes that he does not know whether the animal figured by Mr. Scoresby, of which M. De Blainville ('Malacologie,' pl. xlviii. bis, f. 5) makes his genus *Spiratella*, is in reality, as M. De Blainville believes, the same animal with that of Phipps and Fabricius. M. Rang considers *Spiratella* of M. De Blainville as synonymous with *Limacina*, of which M. Rang states that but one species is known, and says that it would be interesting to have new accounts of it. He speaks of its inhabiting the North Sea, its prodigious abundance, and the possibility of its serving as food for the whales. Phipps mentions it as being found in innumerable quantities in the arctic seas, and describes its body as of the size of a pea, rolled up into a spire like a helix, and its ovate, obtuse, expanded wings as being greater than the body. The following cut is taken from the figure of M. De Blainville, who founds his genus (which he places under his family of *Pteropoda*, between *Atlanta* and *Argonauta*) on the materials furnished by the Rev. Dr. Scoresby, and considers his *Spiratella* as synonymous with Cuvier's *Limacina.*

Spiratella Limacina of De Blainville.

Mr. G. B. Sowerby gives a figure of a *Limacina* ('Genera of Recent and Fossil Shells,' in the same number as that which contains *Cymbulia*) from Messina. He describes it as a thin, fragile, spiral, discoid shell, umbilicated on both sides, and carinated on the back and below, with a membranaceous lamellar keel, and he says that it has externally much the appearance of a very diminutive umbilicated *Nautilus.*

M. Deshayes, in his edition of Lamarck, remarks that the *Limacinæ*, of which M. De Blainville formed his genus *Spiratella*, have in fact much analogy with the *Cleodoræ;* and that they are *Cleodoræ* whose shell is spiral, and not swimming Gastropods, like the *Carinariæ* and *Atlantæ.* M. Deshayes goes on to state that he has many individuals preserved in spirit, which he owes to the generosity of Dr. Fleming, that he has examined them with attention, and that they have not the projecting foot of *Atlanta*, nor a fin-like foot, but two lateral fins of the form of those of the *Cleodoræ.* He adds that they have no tentacles, and no eyes, but a mouth in the shape of a triangular slit at the summit of the angle which forms the fins. The shell is not closed by an operculum as that of *Atlanta* is. The anus and the organs of generation have their issue from the right side, below the fin and at its base. M. Deshayes is of opinion that the genus ought to remain among the Pteropods, where it was placed by Cuvier and Lamarck.

Spiralis.—Shell thin, transparent, of several spiral whorls, coiled to the left, spire elevated or depressed, surface smooth or reticulated, mouth angulated below or canaliculated, sometimes prolonged into a spine-like curved beak. Animal elongated, spiral; head not distinct; two fin-like expansions united at their base by an intermediate lobe bearing an operculum; branchiæ in a cavity formed by the mantle. Operculum vitreous, very thin and transparent, of few whorls.

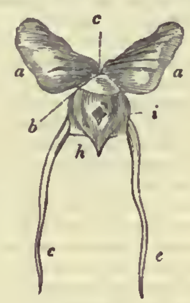
This genus was constituted by the naturalists attached to the exploring ship Bonite, for some very small Pteropods they met with during their voyage. They are distributed through all seas, and are equally present in the Atlantic, the Indian, and Pacific Oceans. Three species of this genus have been recorded as British, *S. Flemingii*, *S. MacAndrei*, and *S. Jeffreysii.* They are all very rare.

Hyalæa.—Animal globular or oblong, furnished with two lateral expansions more or less elongated backwards; the intermediate lobe of a demi-circular form; two very short tentacles, hardly distinct, contained in a cylindrical sheath; the aperture of the mouth provided with two labial appendages; orifice of the anus at the right side of the mantle; that of the male organ in front and within the right tentacle; that of the female organ on the same side, at the point of separation of the two parts of the body; branchiæ pectinated on each side in a particular cavity.

Shell horny or vitreous, transparent and fragile, in form of a slipper, straight or recurved, with an anterior opening, and split laterally, tricuspidated backwards. (Rang.)

M. Rang remarks that this beautiful and interesting genus, the anatomy of which has been made known by M. Cuvier and M. De Blainville, is perfectly distinct from those which approach it. He speaks of the *Hyalææ* as very small animals, spread over all the seas of the torrid zone and a great part of those of the temperate zones, and of the occurrence of the same species on the most opposite points of the globe. He adds that the discovery which he had made of many species, one in a fossil state, had caused him to divide the *Hyalææ* into the two following groups: 1. *Globulosæ.*—Shell subglobular, having the lateral slits nearly as long as itself, and the appendages placed very much backward. *H. uncinata*, &c. This group, he says, is the most numerous. 2. *Elongatæ.*—Shell elongated, having the lateral slits short and the appendages advanced. *H. trispinosa*, &c.

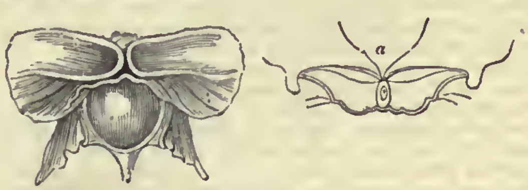
He states that at the time he wrote five species completed the group, and gives the following figure of a *Hyalæa.*



Hyalæa.

a, fins; *b*, intermediate lobe; *c*, mouth; *e*, lateral expansions of the mantle; *i*, viscera, seen through the shell; *h*, the shell.

Cuvier describes *Hyalæa* as having two great wings, no tentacles, a mantle slit at the sides, lodging the branchiæ in the bottom of the fissures, and covered by a shell equally slit at the sides, the ventral surface of which is very convex, the dorsal flat and longer than the other, and the transversal line which unites them behind furnished with three pointed dentilations. In the living state, the animal projects by the lateral slits of the shell filaments more or less long, which are productions of the mantle. Cuvier concludes by observing that the species most known (*Anomia tridentata*, Forskahl; *Cavolina natans*, Abildgaardt; *Hyalæa cornea* (*tridentata*), Lamarck) has a small yellowish demi-transparent shell, which is found in the Mediterranean Sea and in the ocean.



Hyalæa tridentata.

a, the anterior border, showing the mouth.

M. De Blainville, who has published a monograph of this genus in the 'Journal de Physique' and in the 'Dictionnaire des Sciences Naturelles,' states that it contained at that time (1825) from five to six species, all of which appear to be the inhabitants of warm climates. He considers the genus *Glandiolus* of De Montfort as belonging to the *Hyalææ*, and quotes the observation of M. Defrance to that effect with approbation.

M. Deshayes in his edition of Lamarck (1836) observes, that in the comparison which the latter makes of the *Hyalææ* with the Conchifers, he had remarked that they approached so closely that he had found it proper to place the *Hyalææ* at the head of the Mollusks. Lamarck had suffered himself to be seduced by an analogy rather apparent than real. It is not with the Lamellibranchiate Conchifers, continues M. Deshayes, that the *Hyalææ* should be compared, but with the Brachiopods, an inferior class of animals [BRACHIOPODA]; for the *Hyalææ* and the Brachiopods are placed in the shell in the same way. We find, he observes, in the *Hyalææ* the two valves of the *Terebratula* soldered together; and, in becoming free, the animal has closed the umbo of the great valve, and the shell has left a passage always open for the ciliated appendages, changed into locomotive organs. This comparison, says M. Deshayes, would appear sufficiently just, and yet it is not. Upon the examination of the two groups we are soon convinced of their dissemblance in all the essential parts of their organisation. To this we beg to add, that it will be probably difficult to establish any essential difference in the organisation of the two groups except upon the higher development of the nervous system, and the presence of a head in *Hyalæa*. M. Deshayes enumerates sixteen recent species exclusive of *Hyalæa cuspidata*, which, he says, is not a true *Hyalæa*, as Bosc, De Roissy, and Lamarck believed, but a *Cleodora*. Messrs. Rang, D'Orbigny, Lesueur, and Quoy and Gaimard, have principally contributed to the number of species.

H. tridentata is the *Anomia tridentata* of Forskahl, Gmelin, and Dillwyn; *Hyalæa papilionacea* of Bory de St. Vincent; *H. cornea* of De Roissy. M. Deshayes keeps Lamarck's synonym with a query—*Monoculus telemus* (?), Linnæus. It is a native of the Mediterranean and the seas of warm climates. The size scarcely reaches that of a small hazel-nut.

In the 'History of British Mollusca,' *H. trispinosa* is admitted, a specimen having been taken by Mr. Robert Ball at Youghal in Ireland.

Cleodora.—Cuvier remarks that the *Cleodoræ*, for which Brown originally founded the genus *Clio*, appear analogous to the *Hyalææ*, in the simplicity of their wings and the absence of tentacles between them: their conic or pyramidal shell, he adds, is not slit on the sides; and he quotes M. Rang's genera and sub-genera.

M. Deshayes, in his edition of Lamarck, states that the *Cleodoræ* are much more allied to the *Hyalææ* than the *Clios*, approaching the former not only in having a shell, but also in the form of the animal, which bears a great resemblance to that of *Hyalæa*. It is not astonishing, proceeds M. Deshayes, to see Lamarck, who had approximated the *Cleodoræ* to the *Cliones*, indicate not very natural relations to the former; for when he wrote but a very small number of species were known, and he could hardly foresee that the assiduous researches of Messrs. Quoy and Gaimard, Rang and D'Orbigny, should have contributed to throw so much light on the Pteropods in general, and the *Hyalææ* and *Cleodoræ* in particular. If we have before us a sufficient number of species belonging to the two last-named genera, we shall see them blend into each other so as to make it impossible to draw the line between them. It is thus, continues M. Deshayes, that we proceed by insensible degrees from the globular to the lanceolate species. A globular *Hyalæa* seems formed of two unequal valves soldered together, leaving between them a principal anterior slit, and also lateral slits, sometimes without communication with the aperture, and sometimes forming the prolongation of this part. The posterior extremity is prolonged into a spine, which is ordinarily short, sometimes straight, and sometimes curved. Taking these species of *Hyalæa* as the commencement of the genus, M. Deshayes points out the following alterations of their characters in the rest of the series. At first the posterior extremity is seen to be elongated, and in this case the two parts of the shell are flattened, become nearly equal, and, if in some of the species there remains the trace of posterior lateral slits, for the most part these slits rise sufficiently to be in continuation of the aperture. This aperture is always transverse and narrow, as in the *Hyalææ* properly so called. When the shells are thus elongated, some have their posterior extremity curved; others have it straight, as in the *Cleodoræ*. These last are elongated more and more, and in proportion as this elongation exists the aperture is enlarged, and the lateral slits progressively diminish, are reduced to simple inflexions, and at last entirely disappear. These changes in the form of these shells are not, M. Deshayes observes, more extraordinary than those to which he has drawn attention in other groups, and principally in the Acephalous Mollusks. If, continues the same author, the animals coincide with these modifications in their external form, their internal organisation offers but little alteration; and he cites the authority of Messrs. Quoy and Gaimard, who assert positively that the lanceolate *Cleodoræ* differ in nothing essentially from the *Hyalææ* properly so called. This M. Deshayes considers as the more important to him, inasmuch as he is thereby confirmed in the opinion which he had long entertained as to the analogy of the *Hyalææ* and *Cleodoræ*.

The following is M. Rang's definition of *Cleodora*:—Animal of an oblong or elongated form, furnished with an intermediate demicircular lobe, but having no lateral expansions; mantle open in front; branchiæ and organs of generation incompletely known.

Shell fragile, vitreous, in form of a sheath or case (gaine ou cornet), more or less pointed posteriorly; aperture very large, nearly always without a slit, and without lateral appendages.

The same zoologist having, as he states, obtained many new species, and studied their organisation, divides the genus into the following sub-genera:—

1. *Cleodoræ* properly so called.—Animal of an oblong form, having the mantle very much dilated and advanced on each side.

Shell pyramidal, angular, very much dilated anteriorly, with a very large aperture, canaliculated on each side, and rarely slit.

M. Rang makes this sub-genus comprise (1829) five species only, two of which he considers as very doubtful.

C. lanceolata. Shell compressed, elongated, lanceolate; aperture dilated.

It inhabits the seas of warm climates.

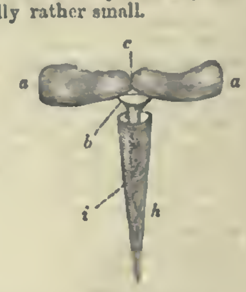
The following figure will convey a general idea of the form of the animal and shell.

Cleodora pyramidata.

a, animal and shell; *b*, shell, seen edgewise; *c*, shell, seen from above.

M. Deshayes, in his edition of Lamarck, records 13 species, besides *Hyalæa cuspidata*.

2. *Cresis* (Rang).—Animal very slender; the mantle not dilated on its sides, fins generally rather small.



Cresis.

a, fins; *b*, intermediate lobe; *c*, mouth; *i*, viscera, seen through the shell; *h*, the shell.

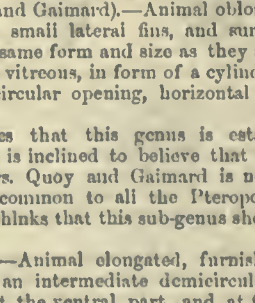
Shell very slender, fragile, and diaphanous, in the form of a straight or curved case (cornet), with an aperture almost always as large as the shell itself, and generally without a canal; no lateral appendages. M. Rang, who gives this description, says, that he formed this subgenus for some very small new mollusks, which he frequently met with in the middle of the ocean, and to which he unites, by analogy, the genera *Vaginella* of Daudin, and the *Gadus* of Moutagu, known in the fossil state; and M. Rang reckons 9 species.

3. *Tripter* (Quoy and Gaimard).—Animal oblong, fleshy, contractile, furnished with two small lateral fins, and surmounted by a membranous veil of the same form and size as they are.

Shell diaphanous, vitreous, in form of a cylindrical sheath, rounded posteriorly, with a circular opening, horizontal and dentilated on its borders.

M. Rang observes that this genus is established on a single species, and that he is inclined to believe that the membranous veil described by Messrs. Quoy and Gaimard is nothing more than the intermediate lobe common to all the Pteropods of the family of *Hyalæidæ*, and he thinks that this sub-genus should be united to the preceding.

Cuvieria (Rang).—Animal elongated, furnished with two rather large fins and with an intermediate demicircular lobe; the exterior branchiæ situated at the ventral part, and at the base of the intermediate lobe; organ of generation incompletely known; the mouth furnished with dentiform pieces proper for mastication.



Cuvieria.

a, fins; *b*, intermediate lobe; *c*, mouth; *e*, gills; *i*, viscera, seen through the shell; *f*, ovaries; *g*, heart; *h*, shell; *d*, posterior cavity of the shell.

Shell in form of a cylindrical case, rather flattened near its aperture, which is heart-shaped with sharp edges; the side opposite to the aperture shut by a diaphragm which is convex externally but not terminal, being surpassed by the walls of the cylinder.

M. Rang remarks that he established this curious genus on a species equally common in the Indian Sea, the ocean, and the South Sea.

Euribia (Rang).—Animal furnished with two horizontal fins, at the base of which is the mouth; the intermediate lobe is very small and of a triangular form; body globular, short; gills and organs of generation unknown.

Shell cartilagino-membranous, delicate, transparent, regular, and in form of a reversed cap (calotte).

M. Rang states that there is only a single species which he has not been able to observe sufficiently, but which presented well-defined generic characters.

Psyche (Rang).—Shell absent. Animal enveloped in a membranous mantle, furnished with two rather long fins, but which do not appear united on the ventral side by an intermediate lobe; branchiæ overspreading the fins.

M. Rang established this genus on a species from the seas of Newfoundland (Terre-Neuve); he adds that Mr. Reynaud brought back from his Indian voyage some drawings of Pteropods which appear to be referrible to it.

M. Deshayes says that he is led to reject many genera proposed some years since by M. Rang, in the 'Annales des Sciences Naturelles,' as well as in his 'Mannel,' under the name of *Cresis* and *Cuvieria*. M. Deshayes observes that M. Rang has comprehended under his subgenus *Cresis* a living shell named *Gadus* by Montagu, and some other fossils placed by Lamarck in the genus *Dentalium*. [DENTALIUM.] Although M. Deshayes is as yet uncertain as to these species, he adopts the opinion of Lamarck as preferable, because, he says, M. Rang has contested it only on the supposition that they had been defined after the mutilation of their posterior extremity, which, being naturally short, only presented itself as open by accident. This view taken by M. Rang, he continues, is not founded on any good observation, and he says that he has seen a sufficiently large number of individuals perfectly preserved, to be able to affirm that their posterior extremity was open when the animal was alive. These shells then, he states in conclusion, do not belong to the Pteropods, and are more probably *Dentalia*. This opinion is a very strong one, and, coming from the quarter it does, is deserving of all respect: but as M. Rang has justly the reputation of a good observer in this department of natural history, we have thought it right to lay before the reader the descriptions and figures given by him.

Fossil Hyalæidæ.

M. Rang, as we have seen, mentions one fossil species of *Hyalæa*, and Mr. G. B. Sowerby states that the genus occurs in a fossil state in Sicily. M. Rang notices the fossil analogue of *Cleodora* from Piedmont; if *Vaginella* and *Gadus* are to be considered as belonging to this family, they must be added. The last-mentioned author says that he has detected a fossil species of *Cuvieria* in the shell sand of Piedmont, where it had been collected by the elder De Luc. M. Deshayes, in his tables, enumerates two fossil (tertiary) of *Hyalæa* and three of *Cleodora*,* tertiary also; of the latter he records *Cleodora lanceolata* as a species found both living and fossil (tertiary).

HYALITE, a Mineral, a variety of Opal. [SILICA.]

HYALOSIDERITE, a synonym of the Mineral Chrysolite. [CHRYSOLITE.]

HYAS, a genus of Brachyurous Crustaceans belonging to the *Maia* family. [MAIADÆ.]

HY'BODUS, a genus of Fossil Fishes placed in the order of Placoidians by M. Agassiz ('Recherches sur les Poissons Fossiles,' vol. iii., tab. 8, 9, 10). The information which M. Agassiz has collected concerning this extinct group of fishes appears to be considerable, yet only in a few instances (from the Lias of Lyme Regis and Bristol) has he been able to reconstruct the whole skeleton. In consequence, the spinous rays and the teeth of one species may be, and probably are, described under different specific names. The species of *Hybodus* are supposed to amount to 22, and extend from the New Red-Sandstone (Grès Bigarré) to the Chalk inclusive. They present analogies to the genus *Squalus* of Linnæus, in the teeth and spinous rays; it appears that there were two dorsal fins, each having spinous rays, not differing more than in recent species of fishes with two spinous dorsal fins.

HYBRID. This term is generally applied in natural history to the produce of two organic beings supposed to belong to different species. It is not in all cases that animals or plants of different species will breed together, and where offspring occurs it is generally regarded as indicative of a closer relationship or affinity between the species. One peculiarity of all hybrids is their inability to continue the characters of both parents. Although they are known amongst birds and higher animals to produce fertile offspring, yet in the course of time the tendency to the character of the original species of one or other of the first parents is so strong, that the hybrid character is lost. Amongst plants the same law holds good. The knowledge of the fact that the pollen-cells of one species of plant will produce embryoes with the ovules of another is often used in horticulture for the purpose of producing new forms of plants. [HYBRIDISATION, in ARTS AND SC. DIV.; REPRODUCTION IN PLANTS; REPRODUCTION IN ANIMALS.]

* Including, probably, *Cresis* and *Vaginula*.

HYBRID PLANTS. [SEXES OF PLANTS.]

HYDA'TICA, a genus of Fossil Plants (probably aquatic) from the Coal Formation. (Artis.)

HYDATIDS. [ENTOZOA.]

HYDNOCARPUS. [FLACOURTIACEÆ.]

HYDNO'PORA (Fischer), a genus of *Polypiaria*, nearly synonymous with *Monticularia* of Lamarck. Goldfuss ranks some of the species under his somewhat indefinite group of *Astræa*.

HYDNORA. [CYTINACEÆ.]

HYDRA (Linnæus), a genus of Polypiferous Animals, including the Fresh-Water *Hydra*, or Polype. It has the following technical definition:—Polypes locomotive, single, naked, gelatinous, subcylindrical, but very contractile and mutable in form; the mouth encircled with a single series of granulous filiform tentacula.

As of all the forms of polypiferous animals the *Hydra* is the most interesting, we give an abstract of their history, from Dr. Johnston's 'British Zoophytes:'—

Leeuwenhoek discovered the *Hydra* in 1703, and the uncommon way its young are produced; and an anonymous correspondent of the Royal Society made the same discovery in England about the same time; but it excited no particular notice until Trembley made known its wonderful properties about the year 1744. These were so contrary to established experience, and so foreign to every preconceived notion of animal life, that by many they were regarded as impossible fancies. Leading men of our learned societies were daily experimenting on the creature, and transporting it by careful posts from one to another, while even ambassadors were forwarding to their respective courts early intelligence of the engrossing theme. The *Hydræ* are found in fresh waters only. They prefer slowly-running or almost still water, and adhere to the leaves and stalks of submerged plants. The body is exceedingly contractile, and hence liable to many changes of form; when contracted it is like a tubercle, a minute top, or button, and when extended it becomes a narrow cylinder, being ten or twelve times longer at one period than another, the tentacula changing in size and form with the body. On the point opposite the base, and in the centre of the tentacula, we observe an aperture, or mouth, which leads into a wider cavity, excavated as it were in the middle of its body, and from which a narrow canal is continued down to the sucker. When contracted, and also when fully extended, the surface appears smooth and even; but in 'its middle degree of extension' the sides seem to be minutely crenulated, an effect probably of a wrinkling of the skin. The tentacula encircle the mouth and radiate in a star-like fashion; but they seem to originate a little under the lip, for the mouth is often protruded like a kind of small snout; they are cylindrical, linear, or very slightly tapered, hollow, and roughened, at short and regular intervals, with whorls of tubercles, which under the microscope form a very beautiful and interesting object.

Each tentaculum forms a slender membranaceous tube, filled with an albuminous nearly fluid substance, intermixed with some oleaginous particles; and at certain definite places this substance swells out into tubercles or denser wartlike nodules, which are arranged in a spiral line. Every nodule is furnished with several spinigerous vesicles, used as organs of touch, and with a very singularly constructed organ for catching the prey. The organ of touch consists of a fine sac, inclosing another with thicker parietes, and within this there is a small cavity. From the point where the two sacs coalesce above there projects a long cilium, or capillary spine, which is non-retractile and apparently immovable. Surrounded by these cilia, and in the centre of the nodule, is placed the captor organ, called the 'hasta;' this consists of an obovate transparent sac, immersed in the nodule, with a small aperture even with the surface. At the bottom of the sac, and within it, there is a saucer-like vesicle, on whose upper depressed surface is seated a solid ovate corpuscle, that gives origin to, and terminates in, a calcareous sharp sagitta, or arrow, that can be pushed out at pleasure, or withdrawn, till its point is brought within the sac. When the *Hydra* wishes to seize an animal, the sagittæ are protruded, by which means the surface of the tentacula is roughened, and the prey more easily retained; and Corda believes that a poison is at the same time injected—a conjecture offered to explain the remarkable fact of the almost instant death of the prey. The nodules of the tentacula are connected together by means of four muscular fibres, or bands, which run up, forming lozenge-shaped spaces by their intersections. These are the extensor muscles of the tentaculum. They are again joined together by transverse fibres, which Corda believes to be adductor muscles, and to have also the power of shortening the tentacula. But it may be doubted whether this muscular apparatus is of itself sufficient to effect the wonderful extensibility of these organs —from a line, or, as in *H. fusca*, to upwards of eight inches; and to produce this degree of elongation, it seems necessary to have superadded the propulsive agency of a fluid. Water flows, let us say by suction, into the stomach through the oral aperture, whence it is forced by the vis-a-tergo, or drawn by capillary attraction, into the canals of the tentacula, and its current outwards is sufficient to push before it the soft yielding material of which they are composed, until at last the resistance of the living parts suffices to arrest the tiny flood, or the tube has become too fine in its bore for the admission of water attenuated to its smallest possible stream—how inconceivably slender may indeed be imagined, but there is no thread fine enough to equal it, seeing that the tentacula of *H. fusca*, in tension, can be compared to nothing grosser than the scarce visible filaments of the gossamer's web.

The *Hydra*, though usually found attached, can nevertheless move from place to place, which it does either by gliding with imperceptible slowness on the base, or by stretching out the body and tentacula to the utmost, fixing the latter, and then contracting the body towards the point of fixture, loosening at the same time its hold with the base; and by reversing these actions it can retrograde. Its ordinary position seems to be pendant, or nearly horizontal, hanging from some floating leaf or weed, or stretching from its sides. In a glass of water the creature will crawl up the sides of the vessel to the surface and hang from it, sometimes with the base and sometimes with the tentacula downwards; and again it will lay itself horizontally. Its locomotion is very slow, and the disposition of the zoophite is evidently sedentary; but the contractions and mutations of the body are very vivacious, while in seizing and mastering its prey it is surprisingly nimble, seizing a worm with as much eagerness as a cat catches a mouse. It enjoys light, and expands more freely under its influence; hence we generally find the *Hydra* near the surface and in shallow water. The *Hydræ* are very voracious, feeding only on living animals. In confinement however Trembley found they might be fed on minced veal, fish, or beef and mutton. They will sustain long fasts with no other change than a paler colour indicates. Small worms, crustaceans, and insects seem to form a favourite food. Sometimes two polyps will seize upon the same worm, and most amusing is it then to witness the struggle that ensues, sometimes resulting in the swallowing of the weaker polyp by the stronger, which however is soon disgorged with no other loss than his dinner. This is the more curious when contrasted with the fate of the worms on which they feed. No sooner are they seized than they evince every symptom of painful suffering, but their contortions are merely momentary, and a certain death suddenly follows their capture. How this effect is produced is still a matter of conjecture. Worms are in ordinary circumstances most tenacious of life, and hence one is inclined to suppose that there must be something poisonous in the *Hydra's* grasp. To the *Entomostraca* the touch is not equally fatal, their shell evidently protecting them from the poisonous secretion. The *Hydra* is chiefly celebrated on account of its manner of propagation. It is like zoophytes in general, monœcious, and every individual possesses the power of continuing and multiplying its race, principally however by the process of subdivision. During the summer season a large tubercle arises on the surface, which lengthening and enlarging every hour, in a day or two develops in regular succession and in successive pairs a series of tentacula, and becomes in all respects except in size similar to its parent. It remains attached for some time, and grows and feeds, and contracts and expands after the fashion of its parent, until it is at length thrown off by a process of exfoliation or sloughing. They develop with great rapidity in warm weather, and sometimes the young ones themselves breed others, and they again a third or fourth generation before they become separated from the original parent. Trembley found that an individual of *H. grisea* produced 45 young ones in two months. In autumn the *Hydra* generates by internal oviform gemmules, which extrude from the body, and lie during the winter in a quiescent state, and are stimulated to evolution only by the returning warmth of the spring. Few observations have been made on these ova, so that their structure, source, manner of escape, and condition are scarcely known.

These are the modes in which the *Hydra* naturally multiplies its kind, but it can be increased by artificial sections of the body in the same manner that a perennial plant can by shoots or slips. If the body be halved in any direction each half in a short time grows to a perfect *Hydra;* if it is cut into four or eight or even minced into forty pieces, each continues alive, and develops a new animal which is itself capable of being multiplied in the same extraordinary manner. If the section is made lengthwise so as to divide the body into two or more slips connected merely by the tail, they are speedily reunited into a perfect whole, or if the pieces are kept asunder each will become a perfect polyp. If the tentacula are cut away, new ones are quickly produced, and the lopt-off parts are not long without a new body. When a piece is cut out of the body the wound speedily heals, and as if excited by the stimulus of the knife, young polyps sprout from the wound more abundantly; when a polyp is introduced by the tail into another body, the two unite and form one individual, and when a head is lopt off, it may safely be ingrafted on the body of any other which may chance to want one. And the creature suffers nothing itself by all these apparently cruel operations; for before the lapse of many minutes the upper half of a cross section will expand its tentacula and catch prey as usual, and the two portions of a longitudinal division will after an hour or two take food and retain it. A polyp cut transversely in three parts requires four or five days in summer and longer in cold weather for the middle piece to produce a head and a tail, and the tail part to get a body and head, which they do in pretty much the same time. And what is still more extraordinary, polyps produced in this manner grow much larger and are far more prolific in the way of their natural increase than those which were never cut. When such things were first announced, when to a little worm the attributes of angelic beings were assigned, and the wild fictions of antiquity realised, it is not wonderful that the vulgar disbelieved, when naturalists, familiar with all the miracles of the insect world, were amazed and wist not what to do.

The following are British species of this genus:—

H. viridis (Polypes Verds of Trembley), is of a grass-green colour. The body cylindrical or insensibly narrowed downwards; tentacula 6 to 10, shorter than the body. It is commonly found in ponds and still waters. The polyps of this species differ from the following, not only in colour, but likewise in their arms, which are much shorter in proportion to their bodies, capable of but little extension, and narrower at the root than the extremity, which is contrary to the other species. Their arms were so short they could not clasp round a very small and slender worm, but seemed to pinch it fast till they could master and devour it, which they did with as much greediness as any. It was first observed in England in the spring of 1743 by a Mr. Ducane of Essex. It appears to be a hardy animal, and is easily kept for a length of time in a phial of water.

H. vulgaris is of an orange-brown or yellowish colour, body cylindrical, tentacula 7 to 12, as long or longer than the body. It is found in weedy ponds and slowly-running waters. This does not exceed *H. viridis* in size, which it resembles also in its habits and form. It is always of an orange-brown or red colour, the intensity of the tint depending on the nature of the food, or the state of the creature's repletion. Every part of the body is generative of young, which may frequently be seen hanging from the parent at the same time in different stages of their growth.

H. attenuata is of a light oil-green colour, the body attenuated below, with pale tentacula longer than itself. It is found in ponds, and in Yetholm Lough, Roxburghshire. This is a larger animal than *H. vulgaris*, and comparatively rare, less sensible to external impressions, and of a more graceful form. Its colour is a pale olive-green, with paler tentacula, which are considerably longer than the body, and hang like silken threads in the water, waving to and fro without assuming that regular circular disposition which they commonly do in *H. viridis*. Dr. Johnston says he has not observed more than one young at a time, which pullulated from near the middle of the body, and after this has attained a certain growth the polyp has the appearance of being dichotomously divided.

H. oligactis (Polypes à Long Bras of Trembley) is brown or griseous; inferior half of the body suddenly attenuated; tentacula several times longer than the body. It is found in still waters in England, rare. In a pond at Hackney; and in a pond at Cranmore, near Belfast, September 1812. The tails of these are long, slender, and transparent, and when placed under the microscope a long straight canal may be seen passing from the body or stomach to an opening at the end thereof; these are rather lighter coloured than *H. vulgaris*, and have seldom more than 6 or 8 arms, but those capable of great extension. It may be worth while to call attention to the remarkable resemblance of the *Hydra fusca* to the *Cucullanus cirratus* of Müller, which is an intestinal worm.

(Johnston, *History of British Zoophytes;* Landsborough, *Popular History of British Zoophytes;* Trembley, *Mémoires pour servir à l'Histoire d'un Genre de Polypes d'Eau douce*, the Hague, 1743; Baker *Natural History of the Polype.*)

HYDRACHNA. [TRACHEARIA.]

HYDRACTINIA. [HYDROIDA.]

HYDRALES. [ENDOGENS.]

HYDRANGEA. [HYDRANGEACEÆ.]

HYDRANGEACEÆ, *Hydrangeads*, a natural order of Exogenous Plants consisting of shrubs, with perfectly opposite simple leaves, smooth or downy, with simple hairs, destitute of stipules, sometimes creeping and rooting like ivy. Flowers usually in cymes; those in the centre male, the marginal often sterile, and furnished with larger petals than the others. Calyx adhering more or less to the ovary, 4- or 6-toothed. Petals 4 or 6, inserted within the edge of the calyx, deciduous. Stamens 8 or 12, in two rows, inserted in the orifice of the calyx, distinct, deciduous. Anthers oblong or roundish, pollen with three longitudinal furrows. Ovary more or less adherent to the calyx, consisting of from 2 to 5 carpels, adhering by their sides, and forming an incompletely 2- or 5-celled cavity; placentæ distinct from each other, but touching with many anatropal ascending or horizontal ovules; styles as many as the carpels, perfectly distinct, diverging, with simple reniform stigmas. Fruit a capsule crowned by the permanent diverging styles, 2- or 5-celled, with a number of minute seeds, sometimes indefinite, sometimes few, in consequence of the abortion of a part of the ovules. Testa thin, membranous, netted, occasionally expanded into a wing. Embryo orthotropal in the axis of a small quantity of fleshy albumen. The relationship between Hydrangeads and Saxifrages is admitted by all systematists, who have in general united them in the same order. Lindley places this order between *Saxifragaceæ* and *Cunoniaceæ*, and near *Philadelphaceæ* and *Caprifoliaceæ.* It differs from *Hensloviaceæ* mainly in its indefinite seeds, small quantity of albumen, and constant tendency to produce a superior ovary. Out of the species hitherto discovered, all of which inhabit the temperate parts of Asia and America, two only belong to the southern hemisphere, and twenty-three or about one-half to China and Japan. The species are found naturally in moist shady places. None of them appear to be of much use to man.

Hydrangea is a well-known genus of hardy shrubs, of which one species is commonly cultivated for the sake of its beautiful flowers. This plant is a native of China and Japan: it was originally observed in the gardens of Canton by Loureiro, who took it for a primrose, and called it *Primula mutabilis.* It was next met with by Commerson, a French traveller, who named it *Hortensia,* in compliment to Madame Hortense Lépeaute. Thunberg referred it to the genus *Viburnum,* and Smith called it by its present name, coupling with it the name *Hortensia* of Commerson, converted however into *Hortensis.* When this plant is hardy enough to survive the winter, it grows to a considerable size, and when covered by a multitude of its very large round heads of rosy flowers, becomes a magnificent object. But as it is rather tender, we more commonly see it grown in pots, by which its beauty is much diminished. To have it in perfection it should be planted in the open ground in rich soil; during winter it should be covered with a mat well stuffed with straw. As soon as it begins to move its buds in spring, it should be unpacked, and during summer it should be most abundantly supplied with water. We have known a large plant receive as much as 100 gallons of water daily. If thus treated, the *Hydrangea* is without a rival in the shrubberies of this country. The blue colour which the flowers of this plant now assume does not indicate a distinct variety, but is only owing to the soil in which the plant is made to grow containing a greater quantity of iron than usual. Other species are *H. arborescens* and *H. quercifolia.*

The leaves of *H. Thunbergii* are dried in Japan and used as a kind of tea, which for its excellence they call Ama-tsja, or Tea of Heaven. There are 9 genera and 45 species of this order.

HYDRARGYRUM. [MERCURY.]

HYDRASTIS. [WARNERA; RANUNCULACEÆ.]

HYDRIDÆ, a family of Snakes belonging to the Colubrine suborder of Dr. J. E. Gray's arrangement, and the first section of this sub-order, which includes the *Hydridæ* and *Boidæ.* [BOIDÆ.] It is thus characterised:—Belly covered with narrow elongate shields or scales, nearly resembling those of the back.

The following is a synopsis of the genera, and a list of the species, compiled from the Catalogue of the specimens of Snakes in the British Museum:—

Hydridæ.—The ventral shields narrow, hexagonal or band-like; the hinder limbs not developed; the eyes and nostrils superior, vertical, the latter valvular, generally placed in the middle of a shield, with a slit or groove to its outer edge; fangs moderate, intermixed with the maxillary teeth; pupil small, round; tail compressed or conical. They live in the sea or salt-water lakes, or in fresh water.

Synopsis of the Genera.

I. Tail compressed (except in *Acrochordus*). Belly keeled, with two rows of small scale-like shields, often united together into a single, rather broad, 6-sided shield.

A. Head shielded to the nape. Nasal shields very large, with a large, operculated, superior nostril in their hinder edge; the frontal shields two pairs, small; loreal shield none; labial shields high, large. *Hydrina.*

These are the true Sea-Snakes. They coil themselves up on the shore, and appear to live on sea-weed, and lay their eggs on the shore. They are often found asleep on the surface of the sea, where they are easily caught, for they cannot descend into the sea without throwing themselves on to their backs. This arises apparently from the necessity of expelling the air from their large lungs. They are often thrown ashore in the surf, and are occasionally carried up rivers by the tide, but they cannot live in fresh water. Their bite is venomous, and they are held in great dread by fishermen wherever they occur, on this account. In spite of their venomous properties, one species at least, the *Hydrus* (*Pelamis*) *bicolor* is said by Cuvier to be eaten at Taheite.

a. Scales square or 6-sided, placed side by side.

* Head elongate, depressed.

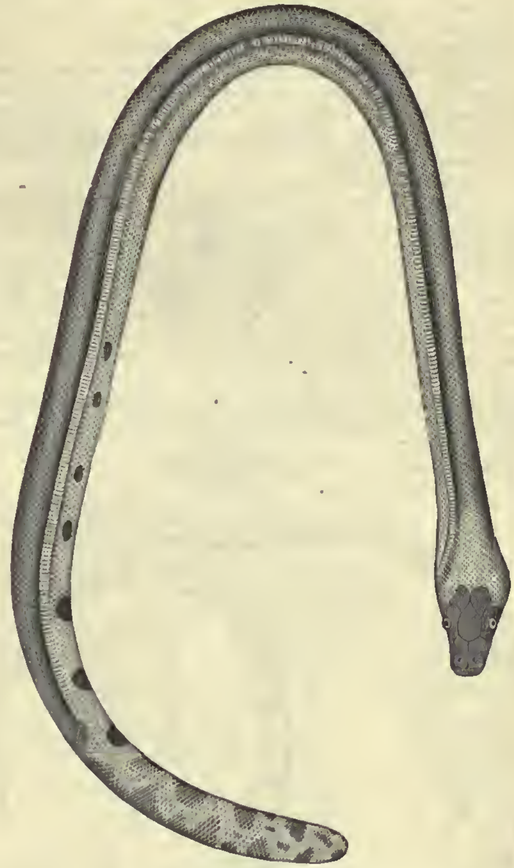
1. *Pelamis.*
P. bicolor. Pacific Ocean.
P. ornata. Borneo.

** Head moderate, rather compressed; gape moderate.

2. *Lapemis.*—Head moderate, short, rounded in front; dorsal scales square; ventral shield broad, 6-sided.
L. curtus. Madras.
L. Hardwickii. Borneo.

3. *Aturia.*—Head moderate, short, rounded in front; dorsal scales 6-sided; ventral shield 6-sided.
A. ornata. Indian Seas.
A. Belcheri. New Guinea.

4. *Microcephalophis.*—Head small; scales 6-sided; ventral scales keeled.
M. gracilis, the Kadel Nagam. Madras.



Pelamis bicolor (*Hydrus bicolor,* Schn.).

b Scales ovate, 6-sided, imbricate, keeled, or with the keel reduced to a tubercle on the centre of the scales; head and gape moderate.

* Labial shields occupying the greater part of the lips; the eyes over the fourth, or rarely over the third, or the fourth or fifth shield; ventral shield united.

5. *Enhydrina.*—Rostral plates narrow, erect; lower linear, sunken; nasal narrowed in front; ventral shield flat; head moderate, short; eyes moderate.
E. Bengalensis. Madras.
E. Valakadyen. Madras.

6. *Hydrophis.*—Rostral broad, transverse; lower triangular; nasal truncated or notched in front; ventral shield flat; head short; eyes small.
H. obscura, the Shootur Sun. Madras.
H. Lindsayii. China.
H. fasciata. Indian Ocean.
H. nigrocincta, the Kerril. Bengal.
H. doliata, the Black-Headed Kerril. Australia.
H. subcincta, Shaw's Chittul. Indian Ocean.
H. sublævis, the Chittul. China and Indian Ocean.
H. mentalis, the Pale Chittul. Indian Ocean.
H. ocellata, the Eyed Chittul. Australian Seas.
H. spiralis, the Shiddil. Indian Ocean.
H. subannulata, the Ringed Sea-Snake. India.
H. aspera, the Rough Sea-Snake. Singapore.
H. cærulescens, the Bluish Sea-Snake. Bengal.

7. *Chitulia.*—Rostral broad, transverse; lower triangular; nasal truncated or notched in front; ventral shields flat; head elongate, depressed; eyes large.
C. inornata. Indian Ocean.
C. fasciata. Indian Ocean.

8. *Kerilia.*—Rostral broad, transverse; lower triangular; nasal truncated in front; ventral shield broad, convex, forming a slight keeled ridge; the hinder ones with a keel on each side; head short, shelving; scales very large, broad, 6-sided; eyes rather large, over third and fourth labial shields.
K. Jerdonii, the Kerilia. Madras.

** Labial shield occupying the front half of the lip; eyes over the fifth or sixth shield; hinder part of the face covered with small scales; ventral scales generally 2-rowed, forming a keeled ridge, some united in pairs into 6-sided shields.

9. *Hydrus.*
H. major, the Sea-Snake. India; Australia.
H. annulatus, the Ringed Sea-Snake. Singapore.

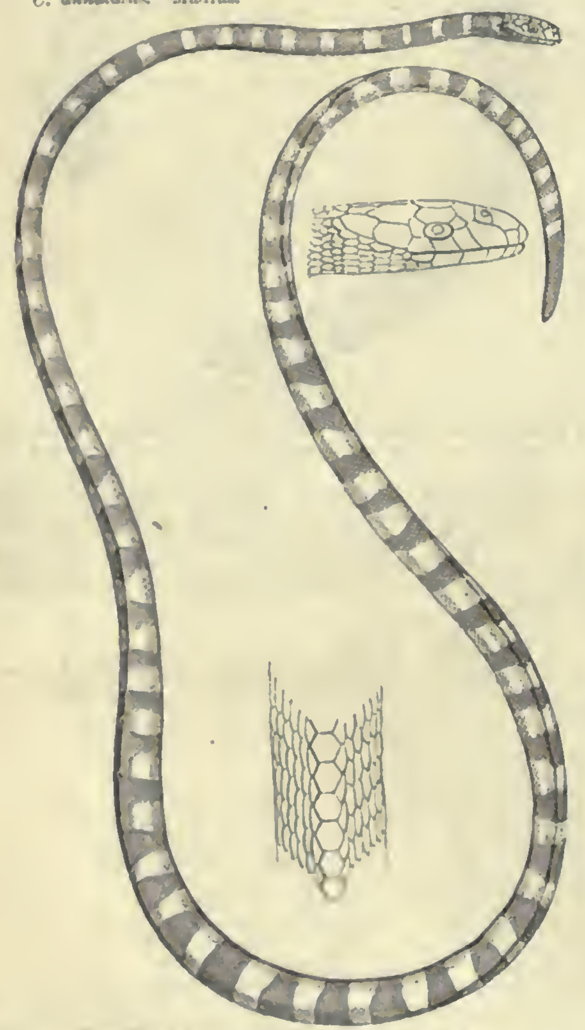
c. Body covered with smooth polished imbricate scales; head as large as the body; ventral shields rather large, transverse, smooth, folded together and keeled.

10. *Tomogaster.*—Head with regular shields; superciliary shields simple; ventral shields entire.
T. Eydourii. Indian Ocean.

11. *Stephanohydra.*—Head shields numerous; superciliary shields 3 or 4; ventral shields nicked behind.
S. fusca, Jukes's Hypotrophis. Darnley Islands.

B. Head covered with scales, like the body; nostrils surrounded by a small, continuous ring; eyes surrounded by a series of small scales; labial shields small, with a larger series above them; pupil round; ventral shields very small, scale-like, separated on each side of a keeled ridge. The species are all inhabitants of rivers. *Acrochordina.*

12. *Chersydrus.*—Tail compressed, sword-shaped, prehensile; body fusiform, covered with small rhombic scales, with a central tubercular keel.
C. granulatus, the Chersydrus. Madras.
C. annulatus. Madras.



Chersydrus granulatus (*Acrochordus fasciatus*, Shaw).

13. *Acrochordus.*—Tail conical, tapering, moderate; body fusiform, covered with tricuspid scales.
A. Javanicus. Java.

II. Tail conical, tapering. Belly rounded beneath, with more or less broad band-like shields. Rivers or ponds.

A. Head shielded; tail scaly beneath; abdominal shields flat, small, 6-sided, with a keel on each side, as if formed of two united scales; nostrils in a ring of small scales; scales keeled. *Erpetonina.*

14. *Erpeton.*
E. tentaculus, the Erpeton. [ERPETON.]

B. Head shielded; tail with two series of shields beneath; nostrils between two shields; abdominal shields broad, keeled on each side; scales smooth. *Bitiana.*

15. *Bitia.*—Head small.
B. hydroides.

C. Head shielded; scales striated, and keeled or smooth; tail conical, tapering, with two series of shields beneath; nostrils in centre of a large nasal shield, with a groove to the outer side; ventral shields rounded (or rarely slightly keeled on the sides); frontal shields 3, rarely 2 or 4, all small. *Cerberina.*

a. Crown scaly; occipital rudimentary; frontals 4; anterior pair very small.

16. *Cerberus.*—Scales keeled, striated; hinder labial shield low.
C. cinereus, the Karoo Bokadam. India.
C. acutus. Borneo.
C. unicolor. Philippines.
C. australis. Australia.

b. Crown shielded; occipital moderate.

* Head distinct, depressed; frontals 4; anterior pair small; rostral rounded.

17. *Ferania.*—Scales smooth; seventh upper labial low, with a large shield over it.
F. Sieboldii. Bengal.

** Head distinct, depressed; frontals 3; anterior transverse; rostral rounded.

† Fourth and fifth hinder labial shields small or divided.

18. *Homalopsis.*—Scales keeled.
H. buccata. Java.
H. Hardwickii. India.

19. *Phytolopsis.*—Scales smooth.
P. punctata. India.

†† Hinder labial large, like others; scales keeled; rostral rounded.

20. *Uranops.*—Scales truncated, strongly keeled, striated; eye over fourth shield.
U. angulatus. Tropical America.

21. *Tachynectes.*—Scales truncated, strongly keeled.
T. Leopardina.

22. *Tropidophis.*—Scales ovate, keeled, striated; eye over fourth and fifth shield.
T. Schistosus, the Chittee. Ceylon.

23. *Myron.*—Scales ovate, slightly keeled, smooth.
M. Richardsonii. Australia.
M. trivittatus. India.

24. *Helicops.*—Scales ovate, polished; of back and tail keeled.
H. carinacaudus. North America.

††† Hinder labials large, like others; scales smooth; rostral rounded.

25. *Hypsirhina.*—Seventh labial large; eye over fourth and fifth labial; loreal distinct.
H. plumbea. Borneo.
H. Hardwickii. Penang.
H. Aer, the Ular Aer. Borneo.
H. bilineata. China.
H. Chinensis. China.
H. Bennettii. China.

26. *Farancia.*—The seventh labial large; eye over the third and fourth labial.
F. fasciata, the Wampum-Snake. New Orleans.

27. *Hydrops.*—The seventh labial large: eyes over the fourth labial; ventral shield broad; body thick; loreal none.
H. Martii. Brazil.

28. *Hygina.*—The seventh labial large; eyes over the fourth labial; ventral shield narrow; body slender; loreal none.
H. fasciata. Demerara.

29. *Dimades.*—The seventh labial short, small; eye over third and fourth labial; loreal none.
D. plicatilis. New Orleans; North America.

*** Head moderate, depressed; frontal 3; anterior elongate, erect, between the nasals; seventh smooth; rostral rounded.

30. *Fordonia.*—Scales broad, rhombic; ventral shield rounded; loreal none; eye over third labial.
F. leucobalia. Timor.
F. unicolor. Borneo.

31. *Gerarda.*—Scales broad, rhombic; ventral shields rounded; eye over fourth shield; loreal square.
G. bicolor, the Gerard. West Indies.

32. *Hipistes.*—Scales narrow, flattened; ventral shields keeled at each end; loreal square.
H. fasicatus. West Indies.

**** Head indistinct; frontal 4; anterior 4-sided, rather smaller; scales smooth; body cylindrical.

33. *Abastor.*—Body cylindrical; loreal shield none; anterior frontal 4-sided; posterior ocular 2.
A. erythrogrammus, the Striped-Wampum. North America.

34. *Raclitia.*—Head small, conical; body subcylindrical; anterior frontal very small, triangular; loreal distinct; posterior ocular.
R. Indica. India.

35. *Miralia.*—Head small, conical; body compressed; frontal plates 2 pairs; loreal none; posterior ocular 2.
M. alternans. Java.

***** Head moderate, depressed; frontal shields, 2, small, lateral; rostral shield angular, high, erect, between frontals and nasal.

36. *Ficinia.*—Head small; rostral plate large, produced between the frontal, angular and recurved in front.
F. olivacea. Mexico.

****** Head small; frontal shields 2, transverse, band-like; rostral triangular, subangular.

37. *Prosymna.*
P. meleagris. Guinea.

D. Head covered with small scales; tail with one row of shields beneath; abdominal shield broad, rounded, smooth; nostril in a shield, anterior, sublateral; scales granular, with rows of keeled scales. *Xenodermina.*

38. *Xenodermus.*
X. Javanicus, the Gonionote. Java.

Dr. Gray says, "The separation of the specimens of this family into species and genera is attended with great difficulty; the form and number of the shields of the head, lips, temple, and chin are liable to great variation, not only in the different specimens, but often in the two sides of the same individual. The two ventral series of scales are, in the same specimen, sometimes separate, and at other times united into a shield; and many specimens have a series of small triangular shields on the edge of the lips, between the sutures of the lip-shield, not found in other individuals of the same species.

"The distribution of the colours on the body appears to be one of the most permanent characters of the species; but this becomes less distinct in the older specimens, and is often lost in the specimens that have been carelessly or long preserved in a museum."

The existence of this family of Water-Snakes has undoubtedly given rise to the notion that a large Ophidian, which meets the popular view of a Great Sea-Serpent, exists. In all cases however the reports of the existence of such a creature have been traced to the capture or sight of some other animal, or to the exaggerated representations of some other natural object. The *Hydridæ* amongst the *Ophidia* are of comparatively small size, seldom equalling the *Boidæ* in this respect, and falling far short of the enormous dimensions popularly attributed to the Great Sea-Serpent. [BOIDÆ; OPHIDIA.]

HYDRILLA. [HYDROCHARIDACEÆ.]

HYDRO'BATA, Vieillot's name for the Water-Blackbirds, *Cinclus.* [MERULIDÆ.]

HYDRO'BATES, Temminck's name for the Sea-Ducks. [DUCKS.]

HYDROBORACITE, a Mineral, occurring in small needle crystals, which appear to be flat six-sided prisms. Its colour is white, with spots of red from silicated peroxide of iron. Hardness similar to that of gypsum. It is translucent. The specific gravity is 1·9. Found in a collection of Caucasian minerals. The following is an analysis by Hess:—

Boracic Acid	49·22
Lime	13·74
Magnesia	10·71
Water	26·33
	100

HYDROCANTHERA, a tribe of Insects belonging to the Pentamerous family of the *Coleoptera.* They are all aquatic in their habits. The principal sections are the *Dytiscidæ* and *Gyrinidæ.* [DYTISCIDÆ; GYRINIDÆ.]

HYDROCHARIDA'CEÆ, *Hydrocharads*, a small natural order of Endogenous Plants inhabiting ditches, lakes, and rivers in various parts of the world. They have tripetaloideous flowers, often separate sexes, and an inferior ovary. The latter character cuts them off from *Alismaceæ* and *Butomaceæ*, to which they bear some resemblance in habit. *Vallisneria spiralis*, a plant of this order, is remarkable for its spiral flower-stalk, which enables it to accommodate itself to the depth of the stream in which it floats, so as always to keep its flowers above water when it is necessary. [VALLISNERIA.] It is in the leaves of this plant that a peculiar movement in the interior of the cell called *Cyclosis* [CYCLOSIS] was originally observed. The same movement is also seen in the cells of *Hydrocharis Morsus Ranæ* and *Anacharis alsinastrum*, and is probably present in the whole of the order. The species are natives of fresh-water in Europe, North America, and the East Indies. One species is found in Egypt (*Damosonium Indicum*), and two Vallisnerias in Australia. Nothing is known of their uses unless that the fruit of *Enhalus* is eatable, and its fibres capable of being woven. According to Agardh, *Ottilia* and *Boottia* are eaten in India as pot-herbs.

Hydrocharis Morsus Ranæ.

1, a portion of the plant, with flowers, leaves, and stem; 2, a male flower; 3, a female flower; 4, a section of the ripe fruit; 5, a seed, with a part of the testa stripped off to show the embryo.

The Janji of Hindustan, the *Vallisneria alternifolia* of Roxburgh *Hydrilla* of Hamilton, is one of the plants used in India for supplying water mechanically to sugar in the process of refining it, "as clay is used in the West Indies to permit the slow percolation of water." Lindley places this order near *Naiadaceæ*, *Pistiaceæ*, and *Bromeliaceæ.* It has 12 genera and 20 species.

HYDROCHARIS. [HYDROCHARACEÆ.]

HYDROCHŒRUS. [HYSTRICIDÆ.]

HYDROCOTYLE (from ὕδωρ, water, and κοτύλη, a cavity), a genus of Plants belonging to the natural order *Umbelliferæ* and to the sub-order *Orthospermeæ.* The calyx obsolete; the petals ovate, entire, acute, with a straight apex; the fruit flatly compressed from the sides; the carpels without vittæ; the five ribs or nerves nearly filiform, the carinal and lateral ones usually obsolete, and the two intermediate ones joined. The species of this genus are generally bog-herbs; but few of them are under-shrubs. The umbel is single, surrounded by a few-leaved involucrum; the flowers sessile or pedicillate, white.

Upwards of ninety species of plants have been referred to this genus. It is not however improbable that a more attentive study of them will lead to the distinction of other genera amongst them.

H. vulgaris, Pennywort, has peltate orbiculate double crenate leaves; umbels capitate, of 5 flowers, often proliferous; fruit emarginate below. This plant is a native of Great Britain, and throughout nearly the whole of Europe, in marshy boggy places, and on the margins of rivulets on a peat soil. This plant is commonly called Pennywort, on account of its leaves lying flat on the ground and having the size and form of a piece of money. It is also known by the names of Water-Pennywort, Sheep-Killing Pennygrass, White-Rot, Fluke-Wort, and Sheep's-Bane. These latter names it has obtained on account of its being supposed to produce the rot and other diseases in animals that feed on it. This is however an error, as this plant will not produce disease in animals; but it occurs in damp moist situations, where animals that feed are likely to be attacked with rot and other diseases. It is in this way that other marsh-plants, as the species of *Drosera* and *Pinguicula*, have been supposed to cause disease in sheep and oxen.

Of the large number of species of this genus few if any are used in the arts or medicine, and none of them are sufficiently ornamental to lead to their cultivation. *H. Asiatica* is said to be used in India as a diuretic, and occasionally as a culinary vegetable. *H. umbellata* is recommended by Martius as a remedy in hypochondriasis, but on what grounds is not stated. The fresh juice acts as an emetic. It is said to possess an aromatic odour and an agreeable taste. The species of *Hydrocotyle* are easily cultivated; they must all be kept moist. The stove-greenhouse and frame kinds should be grown in pots placed in pans of water.

(Don, *Dichlamydeous Plants*; Burnett, *Outlines*; Babington, *Manual of British Botany*.)

HYDROCYON, a genus of Fishes belonging to the *Malacopterygii Abdominales*. The species are very numerous. They have the point of the muzzle formed by the intermaxillaries, the maxillaries nearer, before the eyes, and completing the aperture; the tongue and vomer smooth, the jaws with conical teeth, and the large suborbital covers the cheek like an operculum.

A large number of species inhabit Brazil. They are also found in the Nile.

HYDRODICTYON. [ALGÆ.]

HYDROIDA, a name given to a section of the order *Polypifera*, embracing forms resembling the fresh-water *Hydra* in the simplicity of their organisation. The following is Dr. Johnston's arrangement of the families of British Zoophytes referred to the *Hydroida*:—

* Ovisacs or bulbules naked, bud-like, pullulating from the bases of the tentacula.

Tubularina, Ehrenberg (*Tubularia*, Linnæus; *Tubulariadæ*, Johnston; Les Tubulaires, Van Beneden).

Family I.—Polyps naked, or with only a rudimentary polypidom. *Corynidæ*.

† Polyps naked.

The tentacula scattered. *Clava*.
The tentacula in one row. *Hydractinia*.

†† Polyps with a horny cuticle.

The tentacula with globose tips. *Coryne*.
The tentacula filiform. *Cordylophora*.

Family II.—Polypidom fistular; the tentacula whorled. *Tubulariadæ*.

† The tentacula in a single whorl. *Eudendrium*.

†† The tentacula in a double whorl.

Polypidom rooted. *Tubularia*.
Polypidom unrooted and deciduous. *Corymorpha*.

** Ovisacs in the form of horny capsules or vesicles scattered on the polypidoms, and deciduous.

Sertularina, Ehrenberg (*Sertularia*, Linnæus).

Family III.—Cells of the polyp sessile. *Sertulariadæ*.

† Cells biserial.

Cells alternate, tubular. *Halecium*.
Cells vasiform, everted. *Sertularia*.
Cells conico-tubular, appressed. *Thuiaria*.

†† Cells uniserial.

The branchlets plumose or pectinate. *Plumularia*.
The branchlets whorled. *Antennularia*.

Family IV.—Polype-cells on ringed stalks. *Campanulariadæ*.

Cells alternate, campanulate. *Laomedea*.
Cells irregular, or whorled. *Campanularia*.

*** Polyps propagating by buds and ova, which develop themselves on and in the body of the parent.

Hydrina, Ehrenberg (*Hydra*, Linnæus; *Hydraidæ*, Johnston). One genus only. *Hydra*. [HYDRA; POLYPIFERA.]

HYDROLEA'CEÆ, a very small and unimportant natural order of Monopetalous Exogenous Plants, which are by most authors united with *Hydrophyllaceæ*. [HYDROPHYLLACEÆ.] They are weeds inhabiting the East Indies, with alternate glandular or stinging leaves, monopetalous regular flowers, with a gyrate inflorescence, definite stamens, a superior polyspermous 2- or 3-celled fruit, and seeds with the embryo lying in the midst of fleshy albumen. In their gyrate inflorescence they correspond with *Boraginaceæ*.

HYDROLITE. [GMELINITE.]

HYDROMAGNESITE. [MAGNESITE.]

HYDROMETRIDÆ, a family of Insects belonging to the order *Hemiptera*. This family was established by Dr. Leach, and is thus characterised:—Rostrum with 2 or 3 distinct joints; labrum very short; eyes moderate; feet very long, formed for walking on the water, with the claws minute, inserted laterally into a fissure on the extremity of the terminal joint of the tarsus.

The genera *Hydrometra*, *Gerris*, and *Velia* of Latreille belong to this family. Those species which have setaceous antennæ, the head prolonged into a snout and receiving the rostrum beneath, belong to the first of these three genera, of which the *Hydrometra stagnorum* will serve as an illustration. This insect is about 3-8ths of an inch in length, and not broader than an ordinary sized pin, of a black or brown colour, with pale brown legs, and is very common on ponds and ditches, generally near the margin. Like the other species of the

Hydrolea spinosa.

1, a flower, seen from beneath; 2, a stamen; 3, a ripe seed-vessel; 4, a section of a seed, showing the embryo.

family *Hydrometridæ*, it possesses the power of walking upon the surface of the water: it differs however from those of the two remaining genera, inasmuch as its movements are comparatively slow.

In the genus *Velia* the antennæ are filiform, 4-jointed, the first joint the longest, the remaining joints long, about equal to each other, and bent at an angle with the first; rostrum 2-jointed; legs moderate, and nearly equidistant.

V. rivulorum (Latreille) is a very common insect in this country, frequenting running streams, and running on the surface of the water with great rapidity. It is about 1-4th of an inch in length, and 1-12th of an inch in breadth; of a black colour, the body red, spotted with black, the thorax brown, with two white spots, and the elytra each with four white spots.

The principal characters of the genus *Gerris* are—Antennæ filiform, 4-jointed, the basal joint nearly as long as the remaining three; rostrum 3-jointed, legs long, the second pair the longest, and inserted far from the first.

G. Paludum is about 5-8ths of an inch in length, and 1-12th of an inch in breadth, of a brownish-black colour above, and silvery-white beneath. This insect is very abundant, and its peculiar habits of darting about on the surface of the water must have attracted the attention of all persons. Its food appears to consist chiefly of such insects as are blown or accidentally fall into the water, which it seizes with its fore legs.

HYDROPELTIDEÆ, *Watershields*, a natural order of Exogenous Plants (*Cabombaceæ* of Torrey, Gray, and Lindley). The species are aquatic plants, with floating peltate leaves. Flowers axillary, solitary, yellow, or purple. Sepals 3 or 4, coloured inside. Petals 3 or 4, alternate with the sepals. Stamens definite or indefinite, hypogynous, arising from an obscure torus. Anthers linear, turned inwards, continuous with the filaments. Carpels 2 or more, terminated by a short style. Ovules orthotropal, pendulous. Fruit indehiscent, tipped by the hardened style. Seeds definite, pendulous. Embryo minute, 2-lobed, inclosed in the fleshy sac of the amnios, at the apex of the nucleus, and external to an abundant fleshy albumen. There can be no doubt of the near relationship of these plants to the Water-Lilies. They are American water-plants, found from Guyana to New Jersey, and also on the coast of Australia beyond the tropics.

Hydropeltis purpurea is said to be nutritious, but slightly astringent. The leaves are employed as a remedy for phthisis and dysentery.

(Lindley, *Vegetable Kingdom*.)

HYDROPELTIS. [HYDROPELTIDEÆ.]

HYDROPHANE. [SILICA.]

HYDROPHI'LIDÆ, a family of Coleopterous Insects established by Leach. The insects of this family are included by Latreille in his section *Palpicornes*. They have generally nine joints to the antennæ, but sometimes only 6; the terminal joints always form a perfoliated knob; the maxillary palpi are very long and slender; the body is usually oval or rounded, convex above and flat beneath, or nearly so: the tarsi are 5-jointed, and the mandibles bidentate.

The principal genera of the family *Hydrophilidæ* may be thus characterised:—

Genus *Hydroüs*.—Antennæ with the terminal joint acuminated; sternum produced into an acute spine, which reaches considerably beyond the insertion of the posterior pair of legs; scutellum large; labrum entire; tarsi of the four posterior legs compressed, and furnished with bifid claws. The male sex has the anterior tarsus dilated.

Hydroüs piceus (*Hydrophilus piceus* of the older authors) is one of the largest beetles of this country, measuring about one inch and a half in length. It is of a glossy black colour and oval form, convex above and flat beneath, and has the elytra somewhat pointed at the apex. This insect is not very uncommon in stagnant waters in certain parts of England. It lives near the bottom of the water, and may be said to walk rather than swim in that element. The female insect deposits her eggs in a little nest composed of a gummy substance, which is ejected from the abdomen, and in this nest the eggs float until they are hatebed. The larvæ, which are of a lengthened form and brownish colonr, live in the water.

Genns *Hydrophilus* (Leach).—Labrum emarginated; mandibles internally ciliated; antennæ with the terminal joint somewhat obtnse and obliqnely truncated; sternum terminating in a slightly acute spine, which scarcely reaches beyond the insertion of the posterior legs; claws dentated at the base; the anterior tarsi simple in both sexes.

Hydrophilus caraboides (Linnæus), a common insect in some parts of England, and like the species which is given as an illustration of the preceding genus, lives in stagnant waters. Its form is oval, convex above, and flattened beneatb; and the elytra are rounded posteriorly. It is of a glossy black colour, sometimes with a bluish or violet hne, and about tbree-quarters of an inch in length.

The genus *Spercheus* (Fabricius) is chicfly distinguished by the antennæ, which apparently are only 6-jointed; the clypeus emarginate; the maxilla with the external lobe palpiform: tibia smooth. The body is very convex.

Spercheus emarginatus (Fabricius) is about a quarter of an inch in length, and of a brownish colour above and blackish beneath. It lives in stagnant waters, and has been found adhering to the roots of plants. As yet this has always been considered a very uncommon insect in England.

Genus *Berosus* (Germar).—Eyes prominent; clypeus entire; apparently 8-jointed, the terminal joint large and somewhat globular; thorax very convex; the elytra broader than the thorax, and also very convex; posterior tarsi ciliated.

Berosus luridus (Stephens) is less than a quarter of an inch in length, of an oval form, and grayish-yellow colour. The head is of a brassy green colour, and there is a spot of the same hue on the thorax. The elytra are striated. This species is common in ponds, &c. in various parts of England.

Genus *Hydrobius* (Leach).—Antennæ 9-jointed, the terminal joint somewhat compressed and acuminated; clypeus entire; scutellum small; sternum simple; eyes small and not prominent; claws simple.

The species of this genus are usually of small size, of an oval or rounded form, and always very convex. Like those of the preceding genera, they live in ponds and ditehes, and appear to prefer stagnant waters. Mr. Stephens, in his 'Illustrations of British Entomology,' enumerates 25 species.

HYDROPHIS. [HYDRIDÆ.]

HYDROPHITE, a Mineral, a variety of Green Serpentine containing vanadium. It occurs amorpbous. Its fracture is irregular. The colour is mountain green. Soft. Specific gravity 2·65. It is found at Taberg in Smaland. Tho following is its analysis:—

Silica	36·195
Oxide of Iron	22·729
Oxide of Manganese	1·66
Magnesia	21·082
Vanadic Acid	0·115
Water	16·080
	——97·861

HYDROPHYLLACEÆ, *Hydrophyls*, a natural order of Exogenous Plants, consisting of small trecs, bushes, or herbaceous plants, often hispid. The leaves are often lobed, alternate, or the lower ones opposite. The flowers arranged in gyrate racemes or unilateral spikes, or occasionally solitary and stalked in the axils of the leaves. Calyx inferior, persistent, deeply 5-cleft, the recesses usually augmented with reflexed appendages. Corolla monopetalous, hypogynous, regular, shortly 5-cleft, between campanulate and rotate, rarely fnnnel-shaped. Stamens 5, epipetalous, alternate with the segments of the corolla, inflected in æstivation; anthers versatile, 2-celled, tho cells parallel, dehiscing longitudinally. Ovary superior, simple, 1- or 2-celled, styles 2, long; stigmas 2, terminal; placentæ 2, free at their back, or nnited to the shell of the ovary, with two or many amphitropal ovules on their inner face. Fruit capsular, 2-valved, sometimes 1-celled, with a large placenta filling the capsule, sometimes somewhat 2-celled, with the dissepiments incomplete. Seeds reticulated; albumen abundant, cartilaginous; embryo conical, with its radicle next the hilum. For many years it has been considered that *Hydroleaceæ* was a distinct order from *Hydrophyllaceæ*, but recent botanists recognise so little distinction between them, that they are now both included in the above definition. Dr. Lindley places

Hydrophyllum virginicum.

1, an entire flower; 2, the ovary; 3, a ripe seed-vessel; 4, a section of a mature seed.

Hydrophyllaceæ near *Primulaceæ*, *Plumbaginaceæ*, and *Boraginaceæ*. Some of the species are cultivated in gardens for the sake of their gay flowers, but none appear to possess useful qualities of any importance. They are mostly found either in tbe north or south provinces of America, and are not known much beyond that continent. *Nama* and *Hydrolea* are found in the East Indies. In the United States a decoction of *Hydrophyllum Canadense* is one of the many remedies for snake bites. *Hydrolea* is bitter, and the leaves are applied as a poultice in India.

Many of tbe species, especially those of the genera *Nemophila* and *Eutoca*, are beautiful objects, and are extensively cultivated in our gardens. There are 16 genera and 75 species.

HYDROPHYLLUM. [HYDROPHYLLACEÆ.]

HYDROPIPER. [ELATINACEÆ.]

HYDROSAURUS. [IGUANIDÆ.]

HYDROSTATICA. [ACALEPHÆ.]

HYDROTALCITE, a Mineral, occurring massive, investing Steatite in foliated masses. The colour is white. Streak the same, with a pearly lustre. Transparent. It is flexible, with a soapy fcel. Hardness 2. It is found at Snarum. The following is its analysis:—

Magnesia	36·30
Alumina	12·00
Peroxide of Iron	6·90
Carbonic Acid	10·54
Water	32.66
Insoluble residue	1·20
	—— 99·60

HYDRUS. [HYDRIDÆ.]

HYLA. [AMPHIBIA.]

HYLACTES, a genus of Birds established by Captain Philip Parker King, R.N., for a form allied to *Megapodius*, with the following characters:—Bill sub-elongated, rather thin, with a sub-emarginate apex; nostrils basal, longitudinal, the membrane subtumescent, and covered with hairs down the middle. Wings very short, rounded; fiftb quill longest. Tail sub-elongated, graduated. Feet strong; tarsi rather elongated, scutellated in front; toes aud claws elongated, the latter rather strong and sub-compressed; hallux very strong, incumbent.

Ex. *Hylactyes Tarnii.* It inhabits the Island of Chiloe and Port Otway, in the Bay of Peñas. ('Zool. Proc.,' 1830-31.)

HYLÆOSAURUS, Dr. Mantell's name for an extinct Saurian discovered by him in the forest of Tilgate, and thence termed the Forest-Lizard. The remains upon which this genus was characterised were embedded in a block of stone 4½ feet by 2½ feet, and consisted principally of bones of the trunk. A chain of five cervical and five dorsal vertebræ with corresponding ribs, and four detached vertebræ, were visible; as were the coracoids and omoplates of both sides. There was a peculiarity in the structure of the last-mentioned parts which, in the opinion of Dr. Mantell, warranted the separation of this Saurian from all recent and fossil genera; for the *Hylæosaurus* had the omoplates of a crocodile with the coracoids of a lizard. There was also a still more extraordinary osteological structure, consisting of a series of spinous bony apophyses, which varied from 3 to 17 inches in length, and from 1¼ to 7 inches in width. These maintained a certain parallelism with the vertebral column, as if they had occupied a line along the back. Dr. Mantell suggested that these processes might be the remains of a dermal fringe or serration, with which, as in some recent species of Saurians, the back of the Forest-Lizard might have been armed; but he at the same time noticed many anatomical peculiarities which led him to hesitate in determining positively that these parts had formed such appendages. He next entered upon a careful examination of the reasons why they could not be processes of the vertebræ. Dr. Mantell also discovered many dermal bones, which served to support the large scales, in the stone: he finally proposed the genus as depending for its characters on the peculiarity of the sternal apparatus and the spinous processes. The paper in which the remains of this large extinct Saurian were described was read before the Geological Society of London in December, 1832.

Dr. Buckland ('Bridgewater Treatise') is of opinion that this extinct Saurian was probably about 25 feet long, and speaks of its most peculiar character as consisting of the remains of the series of long flat and pointed bones, which, Dr. Buckland thinks, seem to have formed an enormous dermal fringe like the horny spines on the back of the modern Iguana. (Dr. Mantell, 'Geology of the South-East of England,' 8vo, London, 1833.)

The remains of several specimens of this extinct reptile are now, with the rest of Dr. Mantell's collection, in the British Museum. The original species described by Dr. Mantell has been named *H. Oweni.* (Mantell, 'Petrifactions and their Teachings.')

HYLO'BATES (from ὑλοβάτης, wood-walker, or one that goes through woods), Illiger's name for the Long-Armed Apes, or Gibbons. The general characters of these Apes as to dentition and form agree with those of the Orangs; but there is some modification of the dental system in the Gibbons, which have also longer anterior extremities and have posterior callosities, though they have no tail. The vermiform appendix of the cœcum is also shorter.

Dental formula:—Incisors, $\frac{4}{4}$; canines, $\frac{2}{2}$; molars, $\frac{10}{10} = 32$.

In the upper jaw the first incisor is large, terminated by a straight line, worn obliquely within, and cut transversely by the impression of the lower incisor; the second is smaller than the first, and worn obliquely on the side of the canine, which is wider than it is thick, trenchant on its posterior border, and presents two longitudinal furrows on its internal surface, separated from each other by a projecting rib,* the posterior furrow being larger and deeper than the anterior one. The two next teeth are false molars, and the second is rather larger than the first; but both are composed of blunt tubercles, one on the external and the other, smaller, on the internal border. The three next molars, which increase gradually in size from the first to the last, have the same form; they are composed of four tubercles, two of equal size on the external and two on the internal border, the posterior tubercle being smaller than that which precedes it: these tubercles are formed by furrows, which divide the tooth unequally.

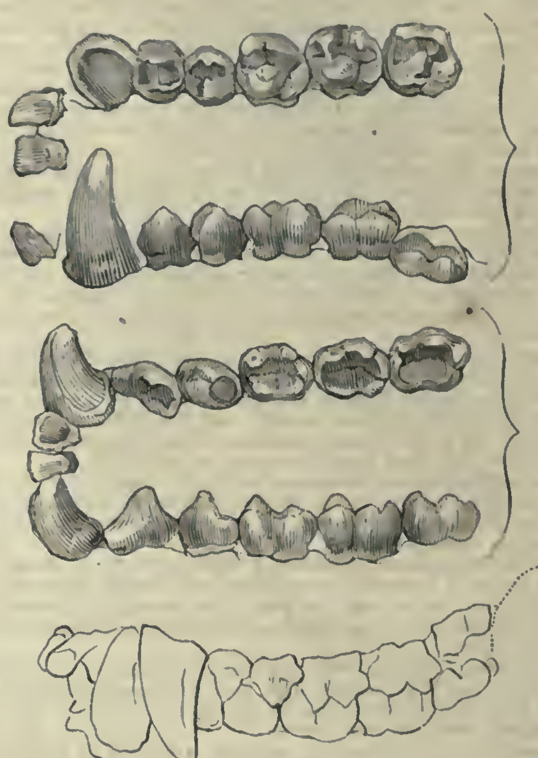
In the lower jaw the first incisor is small, and terminated by a straight line; the second is rounded on its external surface, terminated in a point, and strengthened on its internal surface by a longitudinal rib, which thickens it in the middle. The canine is more equal in its dimensions than that of the other jaw, and is terminated posteriorly by a process or heel; but its internal surface presents also the two furrows and the rib which are found in the other. The first false molar, which is placed obliquely, has only a single point; the second has two, one internal and the other external, situated nearer to the anterior than to the posterior border. Three molars succeed, which progressively increase in size, and resemble each other. They present five tubercles, two of which are anterior, and three, disposed in a triangle, posterior.

F. Cuvier takes this type of dentition from the Siamang, and says that it is also found in the Wow-Wow and Onko.

The height of the Gibbons rarely exceeds four feet, and when they are placed in an erect posture their upper extremities reach the ground.

The species are found all over India and its islands. The forests are the haunts of these creatures, and they are rarely seen at a distance from them. Gregarious, but shy and timid, they keep up a howling concert, resembling in this respect in some degree the Howling Monkeys of America, and having some of them guttural sacs like that tribe. In the forest the activity of certain species is great, and they make way on the trees with their long arms and lengthened feet most rapidly; but when surprised on open plain ground they are altogether as helpless. Other species (the Siamang, for instance) appear to be more sluggish; but these make good use of their acute eyes and ears, and are generally off before the enemy approaches near enough for a capture.

* In *Hylobates Hoolock* the canines are remarkably long.



Teeth of *Hylobates*, increased 1-6th. F. Cuvier.

In confinement they are gentle, and seem capable of great attachment to those who are attentive to them. Dr. Burrough gives a most interesting account of three individuals of the species called Hoolock (*Hylobates Hoolock*), which he had an opportunity of observing in that state. One of them, a male, showed a most amiable and docile disposition; and a young female, which died early, was equally gentle and pacific. The Siamang kept by Sir Stamford Raffles was, according to Dr. Horsfield, very tame and tractable, and was never happy unless it was in the company of some person. Mr. George Bennet gives

Wow-Wow (*Hylobates agilis*), male.

a lively description of the affectionate manners of another of these apes towards those who made its captivity light by their kindness.

H. agilis, the Wow-Wow, or Active Gibbon, may be taken as an example of the genus. It has the forehead very low; orbitary arches very projecting; face blackish-blue in the male, and brown in the female; in the former a white band over the eyes, which unites with the whitish whiskers. Hair of the body fine, except about the neck, where it is longer and inclined to be woolly and curled; upper part chocolate-brown; back and fore part of the thighs yellowish-brown, but the colour varies a good deal according to the sex and age, the young being paler than the adults and aged, and the very young uniform yellowish-white. Height about 2 feet 7 or 8 inches. No guttural sac.

Wow-Wow (*Hylobates agilis*), female and young.

It is very agile in its habits. As soon as they reach the forest they set pursuit at defiance, swinging, leaping, and throwing themselves from tree to tree with great rapidity. Notwithstanding the want of the guttural sac they howl in a manner very nearly resembling the Siamang, which has one.

In captivity they are not very lively, as might be expected, from the impossibility of their exerting that freedom of motion on which their vivacity in a state of nature so much depends; but though timid they are soon re-assured, take pleasure in being caressed, and become familiar and even playful.

This species is found in the forests of Sumatra, where the species is named Ungapnti.

The Siamang of the Malays, *Simia syndactyla* of Sir Stamford Raffles's 'Catalogue of a Zoological Collection made in Sumatra' ('Linn. Trans.,' xiii. 241), *Pithecus syndactylus* of Desmarest, *Hylobates syndactylus* of F. Cuvier, has a peculiar formation of the hands or feet of the lower extremities, the index and middle fingers being united as far as the middle of the second phalanx. This peculiarity would seem to indicate a generic distinction, notwithstanding the similarity of the teeth and skull to those of the rest of this tribe. These Sumatran Apes, sluggish and timid as they are, exhibit strong maternal affection; for though, if any of the troop are wounded, the rest abscond and leave them to their fate, the mother will remain with her little one if it is hurt, and will suffer herself to be captured rather than abandon it. The females are also generally very attentive to their offspring, according to the accounts given by Messrs. Diard and Duvaucel.

The following species are given in the 'British Museum Catalogue':—

Hylobates Hoolock, the Hoolock. It is the Simia Hoolock, Harlan; *H. Seyrites* and *H. Coromandus*, Ogilby; *H. Houloch*, Lesson. Asam (?).

H. agilis, the Oungha; *Pithecus agilis*, Desmarest; *H. variegatus*, Müller; *H. Rafflesii*, Geoffroy; *H. Lar*, F. Cuvier. Black specimens are marked from the Himalaya, and brown from Malacca.

H. Lar, the Gibbon; *Homo Lar*, Linnæus; *Simia longimana*, Schreber; *S. albimana*, Vigors and Horsfield; Le Grand Gibbon of Buffon. It is a native of Malacca.

H. leuciscus, the Silvery Gibbon, or Wow-Wow. *Simia leucisca*, Schreber, Moloch, Audeb. Malacca.

HYLOBIUS. [CURCULIO.]

HYMENÆA (from 'Hymen,' in reference to its twin leaflets), a genus of Plants belonging to the natural order *Leguminosæ*. It has a calyx furnished with two bracts at the base; the tube turbinate, coriaceous; the limb 4-5 parted, deciduous, with two lobes sometimes united into one; 5 petals nearly equal, glandular; 10 stamens, distinct, inflated in the middle; the style filiform; the legume woody, oblong, many-seeded, containing fecula; the embryo straight. The species are trees, with bifoliate leaves, and corymbs of white or yellow flowers.

H. Courbaril, Locust-Tree, or Gum-Anime Tree, has oblong ovate leaflets, unequal-sided, and unequal at the base, ending in a long point; with the legume oblong, compressed, yellowish, shining. It is a fine lofty spreading tree, and grows in the tropical parts of America and in Jamaica. The seeds are enveloped in a cellular mealy substance, which is sweet like honey, and is eaten by the Indians with great avidity. When fresh it is slightly purgative, but by keeping it loses this property. A decoction of this substance, when allowed to ferment, forms an intoxicating drink resembling beer. From between the principal roots of this tree there exudes a fine transparent resin, of a red or yellowish-red colour, and which is collected in large lumps and sold under the name of Gum Anime, or Gum Animi. This resin resembles amber, is very hard, and sometimes contains leaves, insects, or other objects imbedded in it, which remain in a perfect state of preservation. It burns readily, emitting a very fragrant smell. Dissolved in rectified spirits of wine it makes one of the finest kinds of varnish. According to Lindley this resin is called Jataby, Jatchy, or Copal, and, in Minas Geraës, Jatoba. Courbaril is the name of the tree in some parts of South America. In countries where this tree grows the resin is used medicinally, and has also been employed in that way in Europe. It acts as a stimulant when taken internally, and as an irritant when applied externally. In fumigation it has been employed for persons labouring under asthma and dyspnœa. Dissolved in spirits of wine or oil it is used as an embrocation in rheumatism. Internally it has been recommended as a substitute for guaiacum, in venereal disease, and chronic rheumatism. The inner bark, either in the form of tincture or decoction, is administered as a vermifuge. The curadores have a method of mixing it with sugar and rum, so as to make a very agreeable emulsion or syrup. The wild bees are fond of building their nests in the trunk of this tree. The timber of the old trees is very hard and tough, and is in great request for wheelwork, particularly for cogs. The wood is so heavy that a cubic foot is said to weigh a hundred pounds: it takes a fine polish.

Several other species of *Hymenæa* are described, but of these comparatively little is known. The Copal of Madagascar, and probably of the East Indies generally, is furnished by *H. verrucosa*. The Locust-Trees of the West have long been celebrated for their gigantic stature, and other species are the Colossi of South American forests. Some of them are, according to Martius, 84 feet in circumference at the bottom, and 60 feet where the boles become cylindrical.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica.*)

HYMENO'CERA, Latreille's name for a genus of Macrurous Crustaceans belonging to the tribe of Alpheans, in the family of the Salicoques, or Shrimps, according to the system of M. Milne-Edwards, who places it between *Atya* and *Alpheus*.

HYMENODICTYON. [CINCHONACEÆ.]

HYMENOMYCE'TES, the first sub-order of the *Fungi*, a natural order of Plants. [FUNGI.] They are characterised by their reproductive organs, called the hymenium, being naked. This sub-order is divided by Fries into four tribes [FUNGI]; by Berkeley into six tribes. Those of the latter are—*Pileati, Clavati, Mitrati, Cupulati, Tremellini*, and *Sclerotiacei*.

The tribe *Pileati* contains the following British genera:—

Agaricus, in which the hymenium consists of plates radiating from a common centre, with shorter ones in the interstices, composed of a double closely-connected membrane, more or less distinct from the pileus: the veil is various or absent. [AGARICUS.]

Cantharellus has the pileus furnished below with dichotomous, radiating, branched, subparallel folds, not separable from the flesh, sometimes anastomosing or obsolete.

Merulius has the hymenium veiny, or sinuoso-plicate; the folds not distinct from the flesh of the pileus, forming unequal angular or flexuous pores. [MERULIUS.]

Schizophyllum has the gills radiating from the base, composed of a folded membrane, which is ruptured along their edge; the two portions of the fold being revolute, bearing asci only on the outer surface.

Dædalea has the hymenium composed of anastomosing gills, or flexuous elongated pores formed out of the corky substance of the pileus.

Polyporus has the hymenium concrete, with the substance of the pileus consisting of subrotund pores with their simple dissepiments.

Boletus has the hymenium distinct from the substance of the pileus, consisting of cylindrical separable tubes, with oblong sporidia. [BOLETUS.]

Fistulina has the hymenium formed of a distinct substance but concrete with the fibres of the pileus; the tubes at first wart-like, somewhat remote, closed, radiate-fimbriate, at length approximated, elongated, open.

Hydnum has the hymenium of the same substance as the pileus, composed of free spine-like processes.

Sistotrema has the hymenium somewhat distinct from the pileus, composed of irregularly-disposed curved and gyrose lamellate teeth.

Irpex has the hymenium concrete with the substance of the pileus, torn into distinct spines, disposed in rows or in a reticulate manner, their bases connected together by lamellate, sinuous, or porous folds; the asci slender, situated only on the toothed processes.

Radulum has the hymenium tuberculated; the tubercles shapeless, resembling papillæ or rude somewhat angular spines, more or less obtuse, distant, distinct or irregularly fasciculate, the inner substance homogeneous with the receptacle; the asci occupying indifferently all parts of the hymenium.

Phlebia has the hymenium homogeneous and concrete, with the pileus smooth, venoso-rugose, wrinkles interrupted, disposed irregularly, straight or flexuous, bearing asci all over.

Thelephora has the hymenium homogeneous and concrete with the pileus, even or papillate, the whole surface bearing asci.

Of these genera *Agaricus* contains by far the greatest number of species. On this account it has been found necessary to class the species under various sub-genera. The following table contains the sub-genera of Fries arranged in seven series:—

Agaricus.—Lamellæ simple, unequal, juiceless, persistent, discrete from the pileus.	*Leucosporus.* Lamellæ unchangeable; veil variable or none; sporidia white.	*Amanita.* *Lepiota.* *Limacium.* *Tricholoma.* *Clitocybe.* *Omphalia.* *Collybia.* *Mycena.* *Omphalia.* *Pleurotus.*
	Hyporhodius. Lamellæ changeable in hue; veil none; sporidia rose-coloured.	*Clitopilus.* *Eccilia.* *Leptonia.* *Nolanea.*
	Inocybe. Lamellæ changeable; veil springing longitudinally from the innate fibres of the pileus; sporidia tawny brown.	*Inocybe.*
	Derminus. Lamellæ discoloured; veil floccose; sporidia subferruginous.	*Pholiota.* *Hebeloma.* *Flammula.* *Naucoria.* *Galera.* *Tapinia.* *Crepidotus.*
	Phæotus. Lamellæ changeable, nebulous; veil various; sporidia dark brown.	*Pratellarius.*
	Pratellus. Lamellæ changeable, lax, nebulous; veil floccose; sporidia brownish purple.	*Volvaria.* *Psalliota.* *Gomphus.* *Hypholoma.* *Psilocybe.* *Psathyra.*
	Coprinarius. Veil partial; lamellæ lax; nebulous; sporidia black.	*Coprinarius.*

Most of the species included under the series *Leucosporus* are eatable, and contain those species which are mentioned as edible in the article AGARICUS. It also contains the various species of *Amanita*, which are among the largest and most remarkable forms of the fungi. *A. Cæsarea* is remarkable for its beauty, but not so much so as for the traditional belief that it was in a dish of these mushrooms, which were regarded by the Romans as one of the greatest luxuries of the table, that Agrippina administered poison to her husband Claudius Cæsar, in order to hasten her son's accession to the imperial power. *A. muscaria* possesses an intoxicating or narcotic property. It is used by the inhabitants of the north-eastern parts of Asia in the same manner as wine, brandy, arrack, spruce, &c. are by other nations. One large or two small fungi is a common dose to produce a pleasing intoxication for the whole of the day. [FUNGI.]

Upwards of 700 species of the genus *Agaricus* have been described; of these 333 are natives of the British Islands.

Eight species of the genus *Cantharellus* inhabit Great Britain. The *C. aurantiacus* is said to be a poisonous plant. It is common in fir-woods and pastures. It has a beautiful orange colour and a strong smell. *C. cibarius*, the Common Chanterelle, is common in woods in the summer and autumn. The pileus is of a pale yellow colour, and the whole plant has an agreeable smell like that of apricots. On the continent of Europe this fungus is eaten, but is not often used in Great Britain. It is however dangerous when eaten raw, and should always be cooked. They form a delicious ingredient in rich gravies.

One of the species of *Merulius* has been supposed to be the cause of dry-rot. [DRY-ROT; MERULIUS.] Berkeley describes five species of this genus as natives of Great Britain.

Of *Schizophyllum* but one species has been found in Great Britain, the *S. commune*. It is a very beautiful fungus, and has been found in almost every part of the world.

The genus *Dædalea* has been so named from the remarkable sinuosities and sculpture-like pores of its hymenium. *D. quercina* is found commonly on oak-trees or stumps and roots of that wood. It is an astringent, and has been applied to wounds to arrest hæmorrhage. It is commonly called "the lungs of the oak," and was formerly on this account used as a remedy in phthisis. It is at the present day sold in Covent Garden market for that purpose. There are several other species of this genus which are indigenous in Great Britain. *D. suaveolens* is a northern plant. It yields an agreeable perfume.

Upwards of forty species of the genus *Polyporus* are found in Great Britain, and many more European species have been described. Many of the species are used in arts and medicine. *P. igniarius* has long been famed as a styptic. Amadou, or German Tinder, is made from this plant by separating the porous hymenium from the harder parts, and steeping it in a solution of nitre after it has been beaten into a soft spongy state. Many other species of *Polyporus* may be used for the same purpose. The Laplanders also use them for applying the actual cautery in the same way as the Japanese and Chinese use the moxa. When they suffer from pain in the limbs, they pull the fungus in pieces, and placing it on the skin, set fire to it and allow it to burn away till it blisters the skin, when it acts as a counter-irritant. *P. officinalis* is a cathartic. *P. sauveolens* has a pleasant smell. Some of the species secrete acids, and boletic, fungic, and oxalic acids have been obtained from them. *P. squamosus* is one of the largest of British fungi, weighing sometimes as much as 30 lbs. *P. destructor* is one of the fungi found on decaying timber when it is attacked with what is called dry-rot.

Many of the plants formerly included under the genus *Boletus* are now referred to *Polyporus*. Berkeley enumerates sixteen species of the genus *Boletus* as natives of Great Britain. [BOLETUS.]

The genus *Hydnum*, although named after ὕδνον, the truffle, includes a different series of plants. The hymenium is formed of spinous bodies which give to the species of this genus a very formidable appearance. Hence they are called in the country spine-stools, prickle-stools, &c. Several species are natives of Great Britain. Some are eatable, but caution should be used in their selection. De Candolle says that those which have a dark colour are dangerous.

The genus *Fistulina* has one representative in Great Britain, *F. hepatica*, the Pipe-Stool. It grows upon the trunks of old oaks and other trees. It is eaten in France. When cut into it is beautifully marbled with red and white streaks resembling a fine piece of beef. It is called in France Foie de Bœuf, Langue de Bœuf, Glue de Chêne, &c. It has an acid taste, but is rather tough. It has been known sometimes to attain the weight of 30 lbs.

The genera *Sistotrema*, *Irpex*, *Radulum*, and *Phlebia* are small genera, and not used as food, or in any other way. *Thelephora* is an extensive genus, and forty-two species are indigenous in Great Britain. They are common on decaying branches of trees, &c., and exhibit a variety of colours.

The tribe *Clavati*, which are distinguished by a single or branched vertical receptacle, embrace the following British genera:—*Clavaria*, *Calocera*, *Geoglossum*, *Spathularia*, *Mitrula*, *Typhula*, and *Pistillaria*. These plants, in their branched and club-shaped forms, resemble the corals, and were actually placed by the older naturalists in the same class. Some of the species of the *Clavati* are edible. All the *Clavaria* are esteemed as food. *C. rugosa* has an agreeable flavour like that of the common mushroom. *C. flava* and *C. pyxidata* are prized on account of their taste. *C. cinerea* is the species most commonly eaten on the Continent.

The *Mitrati* have a bullate, filiform, margined receptacle. They embrace five British genera:—*Morchella*, *Helvella*, *Veapa*, *Leotia*, and *Vibrissea*.

The genus *Morchella* yields the esculent fungus morel. [MOREL.] Three species are found in Great Britain. There are also three British species of *Helvella* as that genus is at present defined. The species of *Helvella* are edible. *H. crispa* is considered the best species for eating, but none of the species, foreign or British, are poisonous.

The tribe *Cupulati*, which has a patelliform margined receptacle with a superior hymenium, contains the following British genera:—*Peziza*, *Patellaria*, *Ascobolus*, *Bulgaria*, *Ditiola*, *Tympanis*, *Cenangium*, *Stictis*, *Cryptomyces*, *Cyphelia*. Of these *Peziza* is the most extensive genus, containing upwards of 300 species, of which 106 are natives of Great Britain. Some of these plants are very remarkable from the regular cup-like form and the deep colours they present. *P. coccinea* is perhaps the most elegant plant belonging to the natural order of *Fungi*. The outer surface of the cup which it forms is white and downy, whilst the inside is of the richest carmine. It frequently grows on sticks covered with moss, the green colour of which forms a beautiful contrast with the white and crimson of the *Peziza*. *P. æruginosa* has a deep green colour, and possesses the property of staining wood on which it grows of the same colour as itself. The *Pezizæ* are not generally eaten, but none of them are poisonous.

The fifth and sixth tribes of the *Hymenomycetes* are the *Tremellini* and *Sclerotiacei*. The *Tremellini* embrace six British genera. [TREMELLINI.] The British genera included under *Sclerotiacei* are *Pyrenium*, *Acrospermum*, *Sclerotina*, *Periola*, and *Spermoedia*. These are among the lowest forms of the Hymenomycetous *Fungi*, and include species which are found attacking the various *Cerealia*, producing the disease called ergot. [ERGOT; SPERMOEDIA.] An account of the remaining forms of the *Fungi* is given under GASTEROMYCETES.

(Burnett, *Outlines of Botany;* Berkeley, *English Flora,* vol. v.; Fries, *Systema Mycologicum.*)

HYMENOPHYLLEÆ, a family of Ferns including the British genera *Hymenophyllum* and *Trichomanes.* The fronds consist of branched veins, each accompanied throughout by a membranous wing or margin; a cluster of capsules, nearly spherical, is seated on one of these veins which projects beyond the edge of the leaf, the cluster being inclosed in a kind of cup-like involucre.

I. *Trichomanes* has thecæ on an elongated filiform receptacle within a cup-shaped involucre of the same texture with the frond.

T. radicans, Babington, the Bristle-Fern (*T. speciosum,* Wildenow), has fronds three or four times pinnatifid, glabrous; segments uniform, linear; involucres solitary, in the axils of the upper segments; setæ at first included, ultimately very prominent. The frond in fact consists of hard wiry branched ribs, each furnished throughout with a rather membranous wing. Rhizome black, downy, very long. Fronds rather triangular, very much divided, from 4 to 8 inches long. Involucres scarcely winged.

This is a very interesting fern, on account of its beauty, its rarity, its susceptibility to injury from exposure when in cultivation, and its entire absence from all European countries or islands, with the single exception of Ireland. In texture as well as in scent it resembles some of the marine *Algæ,* and it has been observed to assume a life-like appearance on being immersed in water after being kept perfectly dry for years. At the present time this plant is to be found nowhere but in Ireland, though formerly it is said to have grown at Bell Bank, in Yorkshire. It has been lately supposed by some botanists that there are two Irish species of *Trichomanes,* the Killarney and the Glouin Caragh plants. Mr. Newman however believes the latter to be merely a variety of *T. speciosum,* and calls it *T. s. Andrewsii.* It differs from the former in having lanceolate fronds and winged involucres. It is found in very damp shady places. No other fern will thrive well in a case with the *Trichomanes,* the treatment required for one being destructive to the other. The *Trichomanes* will live or even grow lazily in a glass with other ferns, but will never attain a vigorous state of growth.

II. *Hymenophyllum* has the thecæ on a narrow subclavate receptacle within a 2-valved involucre of the same texture with the frond.

H. Tunbridgense, the Tunbridge Filmy Fern, has pinnate fronds, pinnæ distichous; segments linear, undivided, or bifid, spinosely serrate; involucre compressed, spinosely serrate; rachis broadly winged. It is slender and delicate, the rhizome very long and thread-shaped. Pinnæ, rachis, aud involucres in the same place. Valves of the involucre adpressed throughout the greater part of their length, slightly gibbous at the base. It is found amongst moss and in shady places, on the surface of rocks and stones, in many places in England, Wales, and Ireland. This plant is the *Trichomanes Tunbridgense* of Linnæus, Hudson, and many of our earlier authors.

H. Wilsoni, Wilson's Filmy Fern, has pinnate fronds, pinnæ recurved; segments linear, undivided, or bifid, spinosely serrate; involucre inflated, entire, rachis slightly bordered. It resembles the preceding species, but the pinnæ curve backward and the involucres forward. The valves of the involucre are convex or gibbous throughout, touching only by their edges, which are quite entire. The range of this species seems to be much more extensive than that of *H. Tunbridgense;* it also appears to be a more northern species, and generally to prefer a greater elevation; still the two plants are often intermixed, particularly about the waterfalls in the vicinity of Killarney, and it is frequently very difficult to distinguish the one from the other. (Newman, *British Ferns.*)

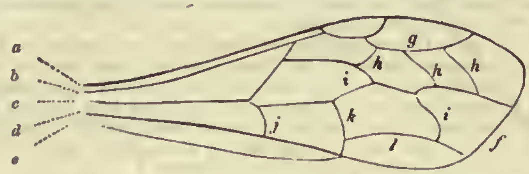
HYMENO'PTERA, one of the orders into which Insects are divided. Hymenopterous Insects possess four membranous wings, of which the anterior pair are the larger; they have all the usual parts of the mouth well-developed, that is to say, they possess labrum, labium, mandibles, maxillæ, and two pairs of palpi; besides the ordinary compound eyes, they are furnished with three ocelli, or simple eyes, which are usually situated on the vertex of the head. Their tarsi are 5-jointed. The females are provided with an ovipositor, consisting chiefly of three elongated slender processes, of which two serve as a sheath to the third. This ovipositor, in many species, is so organised that it can not only perform its ordinary function, but serve as a weapon of defence, and is the part which in bees and wasps is called the sting: in these insects it is barbed at the apex. The antennæ are generally filiform or setaceous. The mesothorax and metathorax are well-developed; the prothorax is narrow.

Insects of the order *Hymenoptera* undergo what is termed complete metamorphosis, that is, the larva is unlike the perfect insect, and the pupa does not possess the power of locomotion. The larvæ of some of these insects very much resemble those of the order *Lepidoptera* (Butterflies and Moths), but differ in the number of their legs, &c.: these feed upon plants. [SECURIFERA.] The larvæ however generally speaking are destitute of legs, and do not possess a distinct head; and these are for the most part fed by the parent insect, or, as in the case of bees and wasps, by the neuters. In the pupæ, all the parts of the perfect insect are visible, since they are inclosed only in a delicate semi-transparent membrane.

In the imago or perfect state most Hymenopterous Insects live upon flowers, or at least often frequent them, some for the purpose of gathering honey, and others find them a convenient resort wherein they may prey upon the less powerful species of their own class.

The comparatively simple neuration of the wings will serve to distinguish insects of the present order from those of the order *Neuroptera,* where the wing is divided by minute nervures into an infinite number of little cells resembling network; whereas, in the species of the order *Hymenoptera,* the basal portion of the wings is furnished with longitudinal nervures only, and the apical portion is divided into comparatively few cells, and these nervures and cells are so uniform in species nearly related to each other by affinity, that the absence of some, or even a slight difference in their form, has afforded good characters for the definition of groups. It is to Jurine that we are indebted for this discovery and a very successful application of it. We may remark that the modifications of the marginal and cubital cells and their nervures are those which have been chiefly employed by this author in characterising the various groups. The following figures from Mr. Schuckard's work on 'Fossorial Hymenoptera,' represent one of the anterior wings of a Hymenopterous Insect, in which all the nervures and cells are present.

1, stigma; 2, radial or marginal cell; 3, first cubital cell; 4, second cubital cell; 5, third cubital cell; 6, fourth cubital cell; 7, first discoidal cell; 8, second discoidal cell; 9, third discoidal cell; 10, first apical cell; 11, second apical cell; 12, costal cell; 13, externo-medial cell; 14, interno-medial cell; 15, anal cell.



a, costal nervure; *b,* post-costal nervure; *c,* externo-medial nervure; *d,* anal; *e,* posterior margin; *f,* apical; *g,* radial; *h, h, h,* transverso-cubital; *i, i,* recurrent; *j,* transverso-medial; *k,* discoidal; *l,* subdiscoidal.

The order *Hymenoptera* is divided by Latreille into two great sections, to which he applies the name of *Terebrantia* and *Aculeata.* In the species belonging to the first of these sections the female sex possesses a distinct ovipositor, whereas in the second the ovipositor is replaced by a sting. Many of the ants however form an exception, since they do not possess a sting, and defend themselves by ejecting an acid liquid. In the *Aculeata* the antennæ are always simple, and composed of 13 joints in the males and 12 joints in the females. The palpi are generally filiform; the maxillary, often the larger, have 6 joints, and the labial are 4-jointed. The abdomen is composed of 7 joints in the males, and 6 joints in the females. These two great sections, of which the principal characters have just been given, are again subdivided, the *Terebrantia* into two sub-sections, and the *Aculeata* into four.

The first sub-section of the *Terebrantia,* to which Latreille applies the name of *Securifera,* is thus characterised by that author:—Abdomen sessile, that is, it is closely joined to the thorax, of which it appears to form a continuation, and does not possess free motion. The females are provided with an ovipositor, which is most commonly serrated, and not only used to deposit their eggs, but to prepare a place for their reception. The larvæ have always six horny legs, and often others which are fleshy. This sub-section contains two families, the *Tenthredinidæ* and *Urocerata.*

The second sub-section, or the *Pupivora* [PUPIVORA], have the abdomen attached to the thorax by a slender stalk, which is often very long, and admits of free motion. The larvæ are always destitute of feet, and for the most part parasitical and carnivorous. This group is divided into six families: *Evaniales, Ichneumonides* [ICHNEUMON], *Gallicolæ* [GALLICOLÆ], *Chalcidites, Oxyuri,* and *Chrysides* [CHRYSIDIDÆ].

We now come to the sub-divisions of the second great section, the *Aculeata.* These are four in number, the *Heterogyna, Fossores, Diploptera,* and *Anthophiia.*

In the *Heterogyna* the species are many of them composed of three kinds of individuals (as in the Hive-Bee), males, females, and neuters. They have the antennæ geniculated, and the ligula is small. Some live in society, and these possess the three kinds of individuals, of which the males and females are provided with wings, aud the neuters are apterous. The Ants (*Formica,* Linn.) belong to this section.

[ANT; FORMICIDÆ.] The remaining *Heterogyna* are solitary, and there are but two kinds of individuals; the males are winged and the females apterous. The antennæ are either filiform or setaceous. This section is composed chiefly of the Linnæan genus *Mutilla*.

The *Fossores* comprise those species, possessing a sting, of which all the individuals are furnished with wings; they do not live in society, and consequently there are but males and females; the legs are formed for running, and in very many for burrowing, and hence the name which has been applied to them. The tongue is always more or less widened at the extremity, and not slender and elongated. They are divided into eight families:—1. *Scoliadæ* [SCOLIADÆ]. 2. *Sapygidæ* [SAPYGIDÆ]. 3. *Pompilidæ* [POMPILIDÆ]. 4. *Sphecidæ* [SPHECIDÆ]. 5. *Bembicidæ* [BEMBEX], containing those species in which the prothorax is transverse and narrow, elongated laterally, and extending to the base of the anterior wings; legs moderate or short; head, when viewed from above, broader than long, the eyes extending to the posterior margin; abdomen conical; labrum distinct. Of this family three genera are characterised by Latreille: — *Bembex*, *Monedula*, and *Stizus*. 6. *Larridæ* [LARRIDÆ]. 7. *Nyssonidæ* [NYSSONIDÆ]. 8. *Crabronidæ* [CRABRONIDÆ]. In the insects of this last family the head is generally very large, nearly square when viewed from above; the antennæ are often thick near or at the apex, and the abdomen is oval. It contains the following genera:—*Trypoxylon*, *Gorytes*, *Crabro*, *Stigmus*, *Celia*, *Diodontus*, *Ceratophorus*, *Passalœcus*, *Pemphredon*, *Cemonus*, *Mellinus*, *Alysson*, *Psen*, *Arpactus*, *Mimesa*, *Cerceris*, and *Philanthus*.

The *Diploptera* contains those species which have the superior wings folded longitudinally when at rest. The antennæ are usually geniculated in this group, and thickened at the extremity. The eyes are emarginated, and the prothorax is prolonged posteriorly on each side to the origin of the wings. The anterior wings possess two or three closed cubital cells, of which the second receives two recurrent nervures. The body is smooth, or nearly so, and almost always varied with black and yellow colours. Many of the species live in society, and have three kinds of individuals.

Latreille divides this tribe into two families, the *Masarides* and the *Vesparia*. The Wasp and Hornet are familiar examples of the section *Diploptera*. [VESPIDÆ.]

The last tribe, the *Anthophila*, or the Bees, are distinguished by the greatly elongated maxillæ and labium, which form the proboscis used in collecting honey. They have the two posterior legs generally formed for collecting and conveying pollen. The first joint of the tarsi of these legs is very large and much compressed. The larvæ live upon honey and pollen collected by the parent insect. The perfect insect feeds upon honey. [BEE; MELISSA.]

HYMENOSO'MA, Dr. Leach's name for a genus of Brachyurous Crustaceans. [PINNOTHERIANS.]

HYODON, a genus of Fishes belonging to the family *Clupeidæ*. The species resemble the Herring. They are found in the fresh waters of North America.

HYOSCY'AMUS, a genus of Plants belonging to the natural order *Solanaceæ*, among which it is distinguished by having an irregular corolla slit on one side, a 5-toothed permanent calyx, and a capsule opening by a transverse lid.

H. niger, Henbane, is a biennial, hairy, clammy, branched, fetid plant, from one to two feet high, growing in waste and uncultivated places. It has oblong stem-clasping coarsely-lacerated leaves, dull yellow flowers traversed with livid purple veins, and a large spiny calyx. When in fruit, the whole of the upper part of the plant is occupied by the large spreading spiny calyxes arranged in 1-sided leafy spikes. It is wild in England in calcareous soils. The leaves and seeds are officinal. The leaves should be collected when the plant is flowering. The lower leaves are large and have short petioles; the upper are smaller and sessile: they are more or less deeply sinuate, pinnatifid, or toothed, soft to the touch, hairy, slightly viscid, and of a grayish-green colour. Odour disagreeable, stupifying; taste herbaceous, nauseous, somewhat acrid. Both odour and taste are much diminished by drying, which should be quickly performed, and the leaves preserved in well-closed vessels, in a cool dry place; 100 parts of fresh leaves dry into 14, and 10 lbs. of fresh herb yield by careful management 9 ounces of inspissated juice, or extract, which is extremely apt to spoil and lose all its virtues; yet with proper attention it may be so prepared as to keep for several years with its qualities unimpaired. An insect, *Cimex Hyoscyamia* (Linn.) is apt to attack the leaves, and render them useless. The virtues are dependent on the presence of *Hyoscyamia*, which however is more easily obtained from the seeds. The seeds are small, flattened, kidney-shaped, with minute dots and indentations on the surface; of a yellowish-gray colour. When bruised they evolve an odour of henbane. Taste oily, bitter. By expression they yield a fat oil, and also furnish a very powerful extract, as well as *Hyoscyamia*. This alkaloid crystallises in stellated acicular crystals, with a silky lustre; but it more generally occurs in a colourless transparent soft viscid mass. When properly dried it is devoid of odour, but when moist, and particularly in an impure and coloured condition, the odour is highly disagreeable, stupifying, and tobacco-like. Its action, even in very small quantity, is extremely narcotic and fatal, like nicotine. It kills more slowly than conia, and scarcely causes convulsions. Applied externally to the eye, even in very minute quantity, it causes great and enduring dilatation of the pupil. Cats to which it has been given have been observed to gnash the teeth and foam at the mouth.

Hyoscyamus, when taken by a person in health, produces disorder of the nervous system, inducing symptoms greatly resembling hysteria, if the dose be moderate; but if large, it causes all the phenomena of narcotic poisoning, such as result from other solanaceous plants, particularly congestion of the vessels of the brain with coma. Administered in medicinal doses to persons with disturbance of the nervous system, it lessens the irritability, quiets the circulation, and when morbid wakefulness exists, disposes to sleep. It possesses a superiority over opium in many instances, as it does not constipate the bowels, but rather acts as a mild laxative. This circumstance often renders it a valuable agent in allaying pains and other distressing symptoms incident to females in particular states of their system. Tincture or a well prepared extract is a good form of exhibition; but probably some of the salts of *Hyoscyamia* will be found the most eligible mode of administration, or a tincture of the seeds may be used.

In case of accidental poisoning, the stomach-pump should be used, or an emetic of sulphate of zinc be given; if the brain should appear much oppressed, venesection may also be resorted to.

In some parts of the Greek continent the stalks of *H. albus* are used against the toothache. They are dried and employed instead of tobacco for smoking.

HYPANTHO'CRINUS, a genus of fossil *Crinoidea*, from the Silurian Strata.

HYPERICA'CEÆ, *Tutsans*, a natural order of Polypetalous Exogenous Plants, with an imbricated calyx, polyadelphous stamens, and a many-celled many-seeded ovary, with several styles, which are usually quite distinct. The leaves are often marked with pellucid dots, and there is in many species, in addition, a number of black dots which occupy some part, usually the margin, of both leaves and flowers. In all cases the latter belong exclusively to the xanthic series of colour.

The species inhabit various parts of the world, both within and without the tropics; they are especially common in the southern States of the North American Union. They are found on mountains and in valleys, marshes and dry places, meadows, and heaths. Many are objects of ornament, but they are little cultivated because they have frequently a disagreeable hircine odour. They are generally astringent, and in some cases, as in the genus *Vismia*, yield a substance so much resembling gamboge as to have acquired in commerce the name of American Gamboge.

In the United States a stomachic is prepared from *Elodea virginea*. *Cratoxylon Hornschuchia* is slightly astringent and diuretic. The position of the order is between *Clusiaceæ* and *Reaumuriaceæ*. It is also allied to *Saxifragaceæ*. There are 13 genera and 276 species.

HYPE'RICUM, a genus of Plants belonging to the natural order *Hypericaceæ*. The calyx is 5-parted, or it has 5 sepals; 5 petals; 3 styles, and a 3-celled capsule. The flowers of the species are mostly yellow. There are 13 British species of this genus, and 172 are enumerated by Don as growing in various parts of the world. St. John's Wort is the common name of all the species.

H. maculatum has an erect quadrangular stem, elliptical ovate obtuse leaves with a few pellucid dots, reflexed ovate lanceolate sepals having pellucid streaks, obtuse petals with purple streaks and dots beneath. It is the *H. quadrangulum* of Fries; and is found in moist places by ditches and rivers.

H. perforatum has an erect 2-edged stem, ovate or elliptical leaves with numerous pellucid dots, anthers with black dots, the styles as long as the capsule. It is found in large quantities in Britain and throughout Europe; also in the north of Asia and Africa. The flowers are of a bright-yellow colour, dotted and streaked with purple; when rubbed they emit a powerful lemon-like scent, and stain the fingers with dark purple. The whole of the plant contains a powerful volatile oil, which is aromatic and possibly astringent, though as yet it has been but little used in medicine. Its sensible qualities however, and the few instances in which it has proved beneficial, entitle its virtues to a further trial. When boiled with alum this plant yields a yellow dye, which is used for colouring wool. The common people of Germany and France gather this species of St. John's Wort with great ceremony on St. John's day, and hang it in the windows and about their houses as a charm against evil spirits, storms, thunder, and all other calamities, mistaking the meaning of some medical writers who fancifully called the plant *Fuga Dæmonum*, from a notion that it was a remedy in maniacal disorders. At one time the people of Scotland used to carry it about their persons as a protection against witchcraft and enchantment, and they fancy it prevents ropy milk by milking upon the fresh herb. Cows and goats will eat the plant, but horses and sheep refuse it. It is the Ἄσκυρον of Dioscorides (iii. 162). It is found at the present day on the high hills of Attica.

H. laxiusculum has a smooth herbaceous stem, rather distant obtuse leaves full of pellucid dots; the lower leaves narrow and lanceolate, segments of the calyx equal, nearly linear and acute. It is a native of Brazil, in the provinces of St. Paul and Minas Geraës, where a decoction of the leaves is used as a remedy against the bites of serpents.

H. crispum has a round branched stem, sessile lanceolate leaves, sinuately waved at the base, full of dots, small blunt sepals. It is native in the regions of the Mediterranean, and is the 'Υπέρικον of Hippocrates ('Morb. Mul.' i. 610); also of Dioscorides (iii. 161), and the Hypericon "quod alii chamaepityn, alii corion appellant" of Pliny (xxvi. 8; xxvii. 4, 5). At the present day it grows near the sea in Attica.

H. perfoliatum, the 'Ανδρόσαιμον of Dioscorides (iii. 163). It has a 2-edged stem; ovate clasping dotted leaves; fringed and dotted sepals and petals, and sessile flowers. It is a native of Italy.

H. Coris has a shrubby erect round stem, linear leaves in whorls, with revolute margins, and a bluntish linear calyx. It is the Κόρις of Dioscorides (iii. 174), and the Coris of Pliny (xxvi. 3). This species is a pretty little shrub, native of the Levant, and in dry places in the south of Europe.

H. organifolium is distinguished by its ascending downy stem, ovate blunt and pubescent leaves full of pellucid dots, numerous stamens, and many black dots in the corolla. It is a native of the East, about Constantinople, Thrace, and Armenia, and is frequently found on high mountains in company with *H. perfoliatum*. It is probably the 'Αγήρατον of Dioscorides (iv. 5), and undoubtedly the Ageratum of Pliny (xxvii. 4).

H. Olympicum has elliptical lanceolate leaves full of pellucid dots; a round stem, and withering corolla and stamens. It is a native of Mount Olympus and of China. Fraas thinks it probable that this is the Πολεμώνιον of Dioscorides (iv. 8).

Most of the species of *Hypericum* are showy, and deserve cultivation. The hardy herbaceous kinds will thrive in any common garden soil, and are easily propagated by dividing the roots or by seeds. Those that require the greenhouse or frame will thrive best in a mixture of loam and peat, and strike root readily in sand under a bell-glass.

(Don, *Dichlamydeous Plants*; Babington, *Manual Brit. Bot.*; Fraas, *Synopsis Plantarum Floræ Classicæ*.)

HYPEROODON. [CETACEA.]

HYPERSTHENE. [AUGITE.]

HYPERSTHENE ROCK. This is among the rarer varieties of those igneous aggregates which by many geologists are grouped together under the title of Trap. Dr. M'Culloch, who first noticed Hypersthene Rocks in Skye and Ardnamurchan, describes three varieties:—

Hypersthene with Compact Felspar.
Hypersthene with Common Felspar.
Hypersthene with Glassy Felspar.

In largeness of grain it varies from large-grained granite to ordinary greenstone, or is even as fine as basalt; the Felspar is of various colours. It passes to common greenstone.

In Skye it forms the Cuchullin Mountains; part of the mountain of Carrock Fell in Cumberland is also formed of it; a dyke of Hypersthenic Trap was noticed in Radnorshire; it occurs also in Cornwall. In the Valteline M. Necker has pointed out the passage from Hypersthenic Sienite to Granite.

HYPHÆNE. [PALMACEÆ.]

HYPNEA, a genus of Plants belonging to the natural order *Ceramiaceæ*, or Rose Tangles. In the Greek Archipelago medicinal qualities as a vermifuge are attributed to *H. musciformis*.

Several species furnish Iodine, which gives them their peculiar odour.

HYPNUM. [MUSCALES.]

HYPO'CHŒRIS, a genus of Plants belonging to the natural order *Compositæ*, to the sub-order *Cichoraceæ*, and to the section *Hypochœrideæ*, which has a scaly receptacle and a feathery pappus. The heads are many-flowered, the involucre is oblong and imbricated, the fruit glabrous, muricated, and beaked; the pappus in two rows, the outer short and setaceous, the inner long and feathery. There are two British species of this genus—*H. glabra*, with oblong dentate-sinuate leaves, and *H. radicata*, with runcinate obtuse leaves. They are found on dry and gravelly places and waste places. (Babington, *Manual of British Botany*.)

HY'POGENE, a term in Geology, implying 'nether-formed' (from ὑπὸ, below, and γεν, the root of γίγνομαι, which signifies 'birth,' or 'formation'), proposed by Sir Charles Lyell as a substitute for the word Primary. He affirms that "the popular nomenclature of geology, in reference to the rocks called Primary is not only imperfect, but in a great degree founded on a false theory; inasmuch as some granites and granitic schists are of origin posterior to many Secondary rocks. In other words, some primary formations can already be shown to be newer than many secondary groups—a manifest contradiction in terms."

As far as Granite is concerned, this remark is entirely true: its origin is proved to be independent of any particular epoch, and it has been long thrown out of the modern catalogue of primary rocks. As applied to granite, Mr. Lyell's emendation is exactly equivalent to the term Plutonic used in Brongniart's classification; but when the term Hypogene is used to include the primary stratified rocks, a particular hypothesis of their origin is tacitly assumed, which many geologists think not sufficiently established.

It is assumed in this hypothesis that the primary strata have acquired their present mineral aspect, not through any circumstances peculiar to their original formation, and supposed to be characteristic of the physical agencies exerted in the earlier eras of the world, but through the subsequent agency of heat and chemical forces in those regions, and under those circumstances where the Plutonic rocks are generated. The term Primary implies only that the rocks so named are the earliest we can trace in the crust of our planet; and as geological classification is mainly founded on succession of time, and the relative antiquity of strata can be determined as a fact, it seems unlikely that the well-known designations of Primary, Secondary, and Tertiary Strata will be abandoned, though, as expressing the subterranean origin of certain properties and conditions of mineral masses, the word Hypogene appears very suitable.

(Lyell, *Principles of Geology*.)

HYPOPITYS. [MONOTROPA.]

HYPOXIDACEÆ, *Hypoxids*, a natural order of Endogenous Herbaceous Plants, with a tuberous or fibrous perennial root. Leaves always growing from the root and crown, nowhere else, linear entire, plaited, of a dry texture. Scapes simple or branched, occasionally very short. Flowers complete, hermaphrodite. Perianth petaloid, adherent to the ovary, 6-parted, with the sepals coarser than the petals. Stamens 6, inserted into the base of the segments of the perianth; filaments distinct; anthers turned inwards, 2-celled, erect, opening lengthwise. The number of the plants of this order is very inconsiderable. Those that are known inhabit the Cape of Good Hope, Australia, the East Indies, the tropics of America, and the warmer parts of the United States.

The roots of *Curculigo orchioides* are somewhat bitter and aromatic, and are employed medicinally in India. The tubes of *C. stans* are eaten in the Marianne Islands; those of *Hypoxis erecta* are employed by the aborigines of North America in healing ulcers and against intermittents.

(Lindley, *Vegetable Kingdom*.)

HYPSIPETES. [LANIADÆ.]

HYPSIPRYMNUS. [KANGAROO.]

HYPUDÆUS, the more correct mode of writing *Hipudæus*; but the latter form is generally used by the French zoologists.

HYRAX, a genus of *Mammalia* of small size, but of great interest, in consequence of the peculiarity of their organisation, which has led modern zoologists to assign them a place among the *Pachydermata*, though their external appearance, when cursorily examined, would seem to point out their relationship to the *Rodentia*, among which they have been erroneously classed.

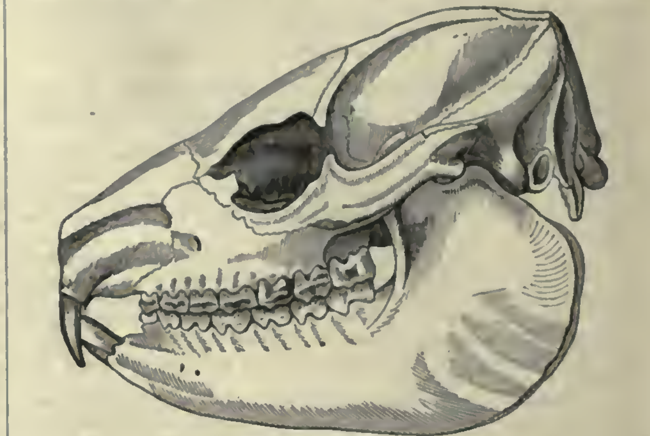
Dental Formula.—Incisors, $\frac{2}{4}$; canines, 0; molars, $\frac{7-7}{7-7} = 34$.

Teeth of *Hyrax*. F. Cuvier.

Cuvier observes that there is no species of *Mammalia* which proves more completely than *Hyrax* the necessity of having recourse to anatomy for the determination of the true relations of animals. To that great zoologist we are indebted for the fact that the quadruped under consideration is a true Pachyderm, and, notwithstanding the smallness of its proportions, must be regarded as intermediate between the Rhinoceros and the Tapir. The resemblances which the *Hyrax* bears to the former of these may be traced, according to Cuvier, as far as the osseous structure is concerned, in the general form of the trunk, in the first place. The *Hyrax* has 21 ribs on each side, a number superior to that possessed by any other quadruped, the Unau excepted, which has 23; and those which, after *Hyrax*, have the the most, belong precisely to the order of Pachyderms, in which Cuvier would arrange it. Thus the Elephant and the Tapir have each 20; the Rhinoceros has 19; the Solipeds have 18. The greater part of the Rodents, on the contrary, have only 12 or 13; and the Beaver, which has the most, has only 15. As regards the lumbar vertebræ, the resemblance begins to be more distant, for the Rhinoceros has only 3, followed by 4 sacral and 21 or 22 caudal; while *Hyrax* has 8 lumbar, 7 sacral, and 5 coccygeal. The difference becomes more marked in the form of the pelvis; for the ossa ilii are very wide in the Rhinoceros, and sufficiently narrow in the *Hyrax*; but the analogy reappears in the femora, which exhibit a very marked commencement of a third trochanter, and is continued in many respects in the formation of the feet. But it is in the bony structure of the head that the *Hyrax* departs from the conformation of the Rodents, and approaches the Pachyderms, particularly the Rhinoceros. It is true that as the nose of the *Hyrax* has no horn to support, the nasal bones have not received, as in the Rhinoceros, the thickness necessary for carrying that defensive organ; but the maxillary bones differ at once from those of the Rodents by the smallness of their extent, and the inferior size of the suborbital hole, which is generally very large in that order. In the number of the upper incisor teeth (2) the *Hyrax* resembles both the Rodents and *Rhinoceros unicornis*; but the number of lower incisors is four. The upper incisors of *Hyrax* are not formed, like those of the Rodents, in the shape of a quadrangular prism, or in that of a cylinder curved and terminated by a truncation or a corner edge. They are triangular and terminate in a point, recalling to the observer the canines of the Hippopotamus. The lower incisors are laid forward like those of the Hog; they are flat and dentilated in youth, but soon become worn by attrition against the upper incisors. The molars represent those of the Rhinoceros, both in number and form, so that, were it not for the size, they might be mistaken for each other.

Molar tooth of *Hyrax*, magnified. Cuvier.

The condyle of the lower jaw is very different from anything observable among the Rodents, in which it is compressed longitudinally. In the *Hyrax* it is compressed transversely, as in the Pachyderms, and in all the other *Herbivora* which are not Rodents, being applied besides to a plane surface of the temporal bone, whereby a motion, more or less horizontal, from right to left, and from left to right, is permitted; and it is this that eminently distinguishes the articulation from that of all the *Carnivora*, where the condyle, although in truth transversal, enters into a deep hollow of the temporal bones, and permits of no other motion to the jaw than upwards



Skull of *Hyrax*. Cuvier.

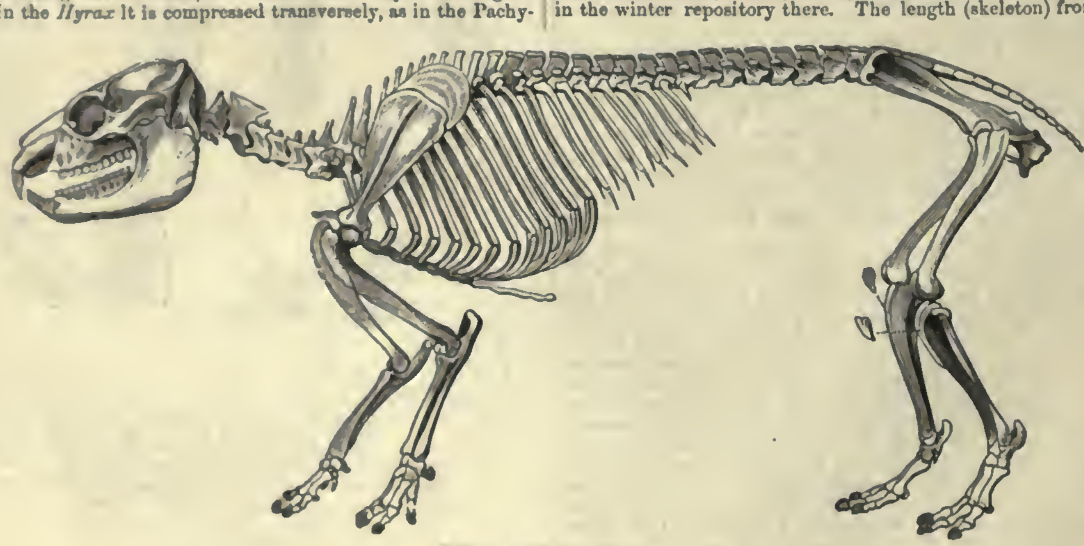
and downwards. After alluding to the form of the condyle and the dentition in the Kangaroos and *Phascolomys*, Cuvier goes on to remark that one of the most constant characters among the Rodents is the not having, at a certain age, more than a single parietal bone without suture, with two frontal bones, directly contrary to what occurs in man. In *Hyrax*, as in the Pachyderms and *Carnivora*, there are two frontal and two parietal bones. The zygomatic arch is constructed differently from that of the Rodents, and more conformably with that of Rhinoceros. In the molar teeth the construction and direction is rather that of the Pachyderms than of the Rodents.

In *Hyrax* the number of toes (four before and three behind) is precisely the same as in the Tapir. It is true, Cuvier observes, that some Rodents, and particularly the *Capybara* [HYSTRICIDÆ], have the same number, and that the last phalanges of the latter approach the flattened form of those of the Pachyderms; but their more elongated and free toes announce the family to which they belong. The *Hyrax* has the toes united by the skin down to the nail, as in the Elephant and Rhinoceros, and even more than in the Tapir and Hippopotamus.

Such are only a few of the leading points of agreement and disagreement in the bony structure of *Hyrax*, as considered relatively to the Rodents and Pachyderms.

In 1832 Professor Owen read to a meeting of the Zoological Society of London an account of the anatomical structure of *Hyrax Capensis*, which, while it was confirmatory of the anatomical description of Pallas generally, gave some additional facts, which will be readily appreciated by those who will compare his observations with the original description of *Cavia Capensis*, in the 'Spicilegia' and 'Miscellanea Zoologica' of Pallas.

The specimen, which was a full-grown male, had lived in the Gardens of the Society through the greater part of the summer, and died in the winter repository there. The length (skeleton) from the anterior surface of the upper incisors to the vent was 1 foot 5½ inches. The duodenum was not so loosely connected with the back part of the abdomen as in most of the Rodents; but it had throughout its course one entire investment of peritoneum. At its commencement it was not dilated, as in many Rodents. The cœcum seemed at first sight



Skeleton of *Hyrax*. Cuvier.

to have a great analogy to that of the Hare and other Rodents, being sacculated, and distended with a blackish pultaceous matter; but in form one would compare it rather with that of the Tapir, its magnitude arising more from its breadth than its length. The dilated part of the colon was bent in a sigmoid form, and the remainder was convoluted on a broad mesocolon, and at a distance of two feet from the dilated part (when unravelled) terminated between two conical cœca in a second dilated intestine. These singular cœca are minutely described by Professor Owen, who then makes the following observations:—"In looking through the vertebrata for an analogous formation of the intestinal canal, we shall find the *Hyrax* standing almost alone in this respect: among the *Mammalia* it is only in a few of the edentate species that the double cœcum is to be met with, as, for example, *Myrmecophaga didactyla*, Linn., and *Dasypus 6-cinctus*, Linn.; whilst in birds, although the double cœcum more generally prevails, yet an additional single cœcum, anterior to these, has only been found in a few species. This structure however completes the analogy, quoad the number of cœca; but, with respect to function, the cases are widely different: the single anterior cœcum of *Hyrax* evidently performs an important part in digestion; while in the bird it exhibits merely a trace of a structure peculiar to embryonic life. I should consider however the double cœcum of *Hyrax* as indicating an affinity to the group (*Edentata*) which intervenes, in the system of Cuvier, between the order it was originally placed in, and the one to which that great naturalist has transferred it. And it is interesting to find that while the facies of *Hyrax* so far simulates that of a Rodent as to have deceived the older naturalists, and to have concealed from them those unerring indications of its alliance with the *Pachydermata* which the osseous system exhibits; yet that nature, as if in confirmation of her abhorrence to the saltus, had left in the internal structure of this singular animal an impression borrowed from the type of the *Edentata*."

Professor Owen further remarks that although the stomach of some of the Rodents, as the Common Rat, and of the *Edentata*, as the *Manis*, exhibits a particular cuticular lining, yet it is among the Pachyderms that this structure is most prevalent. In *Hyrax* two-thirds of the stomach, on the cardiac side, are lined with a thick white and wrinkled cuticle.

The liver had the same form and number of lobes as described by Pallas. The middle lobe had the usual two notches, into the left of which the coronary ligament entered; but the right contained no gall-bladder, which in *Hyrax*, as in some of the Rodents and many of the Pachyderms, is deficient. Professor Owen observed that a compensation for this deficiency was however in some measure apparent in this animal; for the hepatic ducts, immediately on leaving the lobes of the liver, dilated into three globular receptacles, the united capacities of which would have equalled a moderate-sized gall-bladder. Professor Owen also observed that, in Pallas's 'Spicilegia Zoologica,' the peculiar insertion of the ureters is described with a note of admiration, and he stated that he was not aware that a parallel structure has since been discovered in any mammiferous animal possessing a urinary bladder. It is not however, he added, precisely in the fundus or summit of the bladder that the ureters open: they enter between the muscular fibres at the back part of the fundus, at the angles, analogous to the situation at which the Fallopian tubes enter the human uterus; but they run obliquely downwards and inwards for two lines before they terminate, leaving however a full inch of space between them and the orifice of the urethra. For what purpose this structure is designed in *Hyrax*, or whether the urine undergoes any change in consequence of it, is uncertain. "The chief peculiarity observed in the muscular system was a modification of the digastric muscle of the lower jaw, which arose, as in the Armadilloes, from the upper part of the sternum instead of the occiput or temporal bone; and was inserted into the whole ramus and angle of the lower jaw: it was of remarkable strength, being as large as the sterno-cleido-mastoideus in man. It is this muscle which occasions the peculiar fulness of the neck in the *Hyrax*." (Owen.)

In 1835 Mr. Martin dissected a second specimen of *Hyrax Capensis*, presented to the Society by Mr. Rudston Read. The total length of the animal, which was a young male, was 1 foot 4 inches, that of the head being 3½ inches. ('Poceedings of the Zoological Society' for 1835.)

Kolbe appears to be the first modern author who has noticed the *Hyrax* of the Cape; and he mentions it as a Marmot, a name adopted by Vosmaer and Buffon, the latter of whom also applies to it the term Daman, of which we shall presently have to speak. Blumenbach left it among the Rodents; and Pallas, who first gave a methodical and anatomical description of it, placed it under the genus *Cavia*, observing however that it differed remarkably from the congeners with which he arranged it. Linnæus gave the form the same place in his system under the name of *Cavia Capensis*. Pennant does not mention the animal in his 'Synopsis,' but in his 'History of Quadrupeds' he figures it as the Bristly Cavy, with the synonyms of *Agnus Filiorum Israel*, 'Prosp. Alp. Ægypt.;' Daman Israel, Buff.; Ashkoko, Bruce; *Hyrax Syriacus*, Gmel. and Schreb. Hermann however was the first who established the genus, and gave it the name of *Hyrax*. Pennant also notices the form under the appellation of Cape Cavy (*Cavia Capensis*, Pallas). Gmelin makes *Hyrax* the last genus of the *Glires*, and records two species, namely, *Hyrax Capensis* and *H. Syriacus*. We have seen the place assigned to it by Cuvier. Dr. Fischer arranges *Hyrax* under the order *Belluæ*, between *Elasmotherium*, an extinct genus, and *Dicotyles;* he gives three species, *Hyrax Capensis, H. Syriacus*, and *H. Hudsonius*, Schreb. (*Lipura Hudsonia* of Illiger). The latter is not a *Hyrax*. Dr. Gray places the genus in his sub-family *Rhinocerina*, belonging to the family *Elephantidæ*, the third family of his order *Ungulata*, observing that *Hyrax* is allied to *Caviina*, and giving the form a position between *Rhinoceros* and *Lipura* and *Elasmotherium*. M. Lesson arranges *Hyrax* under the order Pachyderms or *Belluæ* of Linnæus, between *Elasmotherium* and *Dicotyles*. Mr. Swainson ('Classification of Quadrupeds,' 1835) places *Hyrax Syriacus*, the Rock-Rabbit, next to *Rhinoceros*; and, after quoting Cuvier, remarks that "there is an obvious relation of some sort between this singular genus, of which three species are now known, and the *Glires;* but whether of analogy or affinity it is impossible to determine: for the present we place it as the gliriform type of the Pachyderms upon the sole authority of what M. Cuvier has said of its feet." In the next paragraph Mr. Swainson treats of *Megalonyx*. In the arrangement according to natural affinities, at the end of the volume, *Hyrax* is the last of the Pachyderms, the first 'tribe' of the order *Ungulata*. The next tribe is 'Anoplotheres,' and the first genus of that tribe *Sus*.

The generic characters of *Hyrax* are as follows:—Conformation of molar teeth like those of Rhinoceros. Two strong incisors without recurved roots in the upper jaw (and two small canines in youth). Body covered with thick hair, and beset here and there with erinaceous bristles. A simple tubercle in lieu of a tail. Six teats, two pectoral and four ventral. Four toes on each foot before, and three behind. Dental formula given in col. 174.

H. Syriacus, the Daman, the Hyrax of Syria, is brownish-gray above, and has the lower parts white; a yellowish tint intervenes between the two colours: the head and feet are more gray than the body. The separate hairs are ringed with yellowish, black, and white. The skin, where it is exposed, is of a blackish violet. Length about 1 foot; height about 11 inches.

This species has been supposed to be identical with the Ashkoko, or Askoko, of Bruce, who says that it is found in Ethiopia, in the caverns of the rocks, or under the great stones in the Mountain of the Sun, behind the queen's palace at Koscam. It is also frequent, he says, in the deep caverns in the rocks in many other places in Abyssinia; and he remarks that it does not burrow nor make holes, like the rat and the rabbit, nature having interdicted this practice by furnishing the animal with feet the toes of which are perfectly round, soft, and pulpy, the fleshy parts projecting beyond the nails, "which are rather broad than sharp, much similar to a man's nails ill grown; and these appear to be given him rather for the defence of his soft toes than for any active use in digging, to which they are by no means adapted."

Hyrax.

Bruce states that, "in place of holes, the animal seems to delight in less close or more airy places, in the mouths of caves or clefts in the rock, or where one projecting, and being open before, affords a long retreat under it, without fear that this can ever be removed by the strength or operations of man." He describes it as gregarious, and says that frequently several dozens of them sit upon the great stones at the mouth of caves warming themselves in the sun, and coming out to enjoy the freshness of a summer evening. "They do not," he continues, "stand upright upon their feet, but seem to steal along as in fear, their belly being nearly close to the ground, advancing a few steps at a time, and then pausing. They have something very mild, feeble like, and timid in their deportment; are gentle, and easily tamed, though when roughly handled at first they bite very severely." The same author says that these quadrupeds are found plentifully on

Mount Libanus, and that he has also seen them among the rocks at the Pharan Promontorium, or Cape Mahommed, which divides the Elanitic from the Heroopolitic Gulf, or Gulf of Suez. They seemed to him to be the same in all places; but, if there was any difference, those of the Mountain of the Sun were superior in size and fatness. He kept one some time, and gives an interesting account of its habits in confinement. This species is called *H. Abyssinicus* in the 'British Museum Catalogue.'

The captive specimen noticed by F. Cuvier had the appearance and somewhat of the habits of the Rodents, resembling the *Spermophili*. It was quick, lively, active, inquisitive, and tried to get into narrow openings or holes for concealment. It delighted in heat, exposing alternately different parts of its body to the sun. In cold weather it wrapped itself up in its hay or litter.

H. Capensis, the Klipdas. The following account of the habits of this animal is given by W. H. Rudston Read, Esq.:—It is found at the Cape of Good Hope, inhabiting the hollows and crevices of rocks, both on the summits and sides of hills, as well as near the sea-shore, even a little above high-water mark. It appears to live in families, and is remarkably shy in its wild state. In winter it is fond of coming out of its hole and sunning itself on the lea-side of a rock, and in summer of enjoying the breeze on the top; but in both instances, as well as when it feeds, a sentinel is on the look-out (generally an old male), which gives notice, usually by a shrill prolonged cry, of the approach of danger, or even the least movement of any suspicious object. It lives on the young shoots of shrubs, the tops of flowers, herbs and grass, particularly of all those which are aromatic; which occasions the necessity of paunching the animal as soon as killed, in order to make it fit for eating. The stomachs of those shot by Mr. Hennah were always much distended with food scarcely masticated. "A friend of mine," continues Mr. Read, "kept two young ones alive for some time, which became very tame; they would find him out when lying on the sofa or in bed (for they were suffered to run about the house), and, climbing up, shelter themselves on his breast within his waistcoat, or creep under the bed-clothes at his back, and, lying quiet, enjoy the warmth. The one brought home by Mr. Hennah, when allowed to run unconfined about the room, was inclined to be sociable, but was restless and inquisitive, climbing up and examining every person or thing in the cabin, and startling at any noise, which caused it instantly to run and hide itself. But from confinement it became savage and snarling, and tried to bite when anything was put near its cage. Both wild and in restraint it is remarkably clean in its habits, always frequenting and depositing its dung in one place. From its faintly crying in its sleep we may conclude that it dreams. I have also heard it chewing its food by night, when everything has been quiet, and after going into its sleeping apartment. In its food it was pleased with variety, eating first a few leaves of one plant and then of another, and greedily licking salt when given to it. In its passage home its food was Indian corn bruised, bread, raw potato, and onion, with a small quantity of water, which in drinking it partly lapped and partly sucked up. It was very sensible of cold; for when a candle was placed near the bars of its cage it readily acknowledged the little warmth given out by turning its side, and sitting still to receive the full benefit of the rays of heat. I am inclined to think that the female does not produce more than two young ones at a time, from having observed in several instances but two following the old ones. Its name at the Cape is the Dasse, which is I believe the Dutch for a badger." In Mr. Steedman's 'Wanderings,' the Dasse, or *Hyrax*, is stated to be an extremely quick and active little animal, skipping along the shelving ledges of the overhanging cliffs, and darting with incredible swiftness into the holes and crevices of the rocks, by which it frequently eludes the grasp of its pursuers. It is said to be preyed upon by the lions, hyænas, and some of the birds of prey of Africa. The 'Catalogue of the African Museum' states that *Aquila vulturina* resorts exclusively to high rugged mountains, where it preys upon *Hyrax Capensis*, the Dasse of the Cape colonists.

Mr. Read says that the flesh of the Cape Hyrax is very like that of a rabbit in flavour. Hemprich states that both the natives of Arabia and the boors of the Cape regard the urine of the *Hyrax* as medicinal.

The term שפן (Shaphan or Saphan) is to be found in the following parts of the Bible:—Levit. xi. 5.; Deut. xiv. 7; Psalm civ. 18; Prov. xxx. 26. In our English translation now in use this word is rendered 'coney,' and 'conies' in all the passages quoted; and so it is in Robert Barker's Bible (1615). In the Tigurine version, as given by Scheuchzer, Schaphan is translated (Levit. xi. 5) 'cuniculus,' and in the Vulgate, as given by the same author, 'choerogyllus.' In Psalms civ. 18, the Tigurine version given is "celsos montes ibicibus, et petras (dedit) confugium *Alpinis muribus*" (Alpine mice). In the vulgate is given—"montes excelsi cervis: petra refugium *herinaceis*" (Hedgehogs). In Prov. xxx. 26, the Tigurine version is printed "Cuniculi, gens minimè potens, attamen in petra domicilium suum collocant," with the following note to Cuniculi: "Quidem murem montanum esse putant, et videtur hic quadrare." The vulgate is printed "*Lepusculus*, plebs invalida, qui collocat in petra cubile suum."

We have seen that the *Hyrax* has been termed Daman by the French zoologists. Dr. Shaw speaks of the Daman Israel as "an animal of Mount Libanus, though common in other places of this country" (Palestine). "It is a harmless creature, of the same size and quality with the rabbit, and with the like incurvating posture and disposition of the fore teeth; but it is of a browner colour, with smaller eyes and a head more pointed. The fore feet likewise are short, and the hinder are nearly as long in proportion as those of the jerboa. Though this animal is known to burrow sometimes in the ground, yet, as its usual residence and refuge is in the holes and clefts of the rocks, we have so far a more presumptive proof that this creature may be the Saphan of the Scriptures than the jerboa. I could not learn why it was called Damau Israel, that is Israel's Lamb, as those words are interpreted." Though there is error in this description such as might be easily made by a casual observer, there can be no doubt that Dr. Shaw, in the passage quoted, alluded to the *Hyrax*: the words Daman Israel are probably mistaken for Ganam or Gannim Israel, as we shall presently have occasion to notice; "animal quoddam humile, cuniculo non dissimile quod *agnum filiorum Israel* nuncupant." ('Prosp. Alp. Ægypt.')

Dr. Harris states that Jerome, cited by Bochart, says that the שפנים are a kind of animal not larger than a hedgehog, resembling a mouse and a bear (the latter, Dr. Harris supposes, in the clumsiness of its feet), whence in Palestine it is called Αρκτομυς, the Bear-Mouse; that there is a great abundance of this genus in those countries, and that they are wont to dwell in the caverns of the rocks and the caves of the earth.

The 'Seventy' translate 'Saphan' by 'χοιρογρύλλιοι' in all the places quoted. This term, compounded of χοῖρος, a hog, and γρύλλη, a grunting, points curiously enough to a pachydermatous form. Bruce, in his travels, describes the Syrian Hyrax, as we have seen. He adds:—"In Amhara this animal is called Ashkoko, which, I apprehend, is derived from the singularity of those long herinaceous hairs, which, like small thorns, grow about his back, and which in Amhara are called Ashok. In Arabia and Syria he is called Israel's Sheep, or Gannim Israel; for what reason I know not, unless it be chiefly from his frequenting the rocks of Horeb and Sinai, where the children of Israel made their forty years' peregrination: perhaps this name obtains only among the Arabians. I apprehend he is known by that of Saphan in the Hebrew, and is the animal erroneously called by our translators Cuniculus, the rabbit or coney." Of this opinion are Pennant, Cuvier, and others among the zoologists; and though M. Lesson, in the introduction to his 'Manuel,' speaks of the rabbit (lapin), "which is supposed to be the Schaphan of the Hebrews, although it is more probable that it was the Rat of Pharoah (Rat de Pharaon)"—on what grounds he does not state—as a prohibited animal (Levit.; Deut.), there can be little doubt that the Shaphan, the "feeble folk" that "yet made their houses in the rock," belonged to the genus *Hyrax*.

In the Gardens of the Zoological Society there are three species, named *H. Capensis*, *H. Syriacus*, and *H. arboreus*. The last is from Western Africa.

HYSSOP. [LAMIACEÆ.]

HYSTATITE. [ILMENITE.]

HYSTRICIDÆ, a family of Animals belonging to the order *Rodentia*. According to Mr. Waterhouse ('Natural History of Mammalia') it has the following characters:—Molar teeth $\frac{4-4}{4-4}$; the muffle, or terminal portion of the muzzle clothed with small hairs; the skull with a large antorbital opening, through which a portion of the masseter muscle passes, as well as the infraorbital nerve; the lower jaw with the angular portion joined to the outer (not the under) surface of the bony covering of the inferior incisor; tibia and fibula distinct. The family is essentially a South American group; it may be divided into six minor sections, or sub-families, namely, *Hystricina*, *Dasyproctina*, *Echimyina*, *Octodontina*, *Chinchillina*, and *Caviina*; of those, the most highly-organised division which includes the Porcupines (*Hystrix* of Linnæus) has a wide geographical range, having representatives in the four quarters of the globe. With the exception of two species, the whole of the species forming the remaining five sub-families are exclusively found in the New World, being chiefly confined to South America: two or three species in the West Indian Islands, and about the same number in Central America form the exceptions.

The members of the sub-families *Hystricina*, *Dasyproctina*, and *Echimyina* increase in number towards the tropical portions of South America; whilst in the southern parts of that continent, the less highly-organised species only are found, these being members of the remaining three sub-families.

On the western side of the Southern Andes, but one of the sub-sections alluded to has representatives—the *Octodontina*.

The relations of the sub-families of the *Hystricidæ* may be expressed by arranging them as follows:—

Hystricina.

Dasyproctina . . . . . with rooted molar teeth.

Echimyina.

Caviina . . . . . *Octodontina* . with rootless molar teeth.

Chinchillina.

"By this mode of placing the groups," says Mr. Waterhouse, "we wish to express that the Agoutis (*Dasyproctina*) in their characters, partake of those of the three groups to which they are approximated; that certain members of the section *Echimyina* lead off to the *Hystricina*, whilst others approach more nearly to the *Chinchillina*; and lastly, that the Octodons are nearly related on the one hand to the *Echimyina*, and on the other to the *Chinchillina*: they bear the same kind of relationship to the Echimys group as do the *Arvicolæ* to the True Rats."

The following is the character of the sub-family *Caviina*:—Molar teeth rootless, divided by folds of enamel so as to form lobes having acute angles; the series of molars on opposite sides of the upper jaw converging, and nearly meeting in front; incisor teeth comparatively short, those of the lower jaw not being extended backwards as far as the springing of the angular portion, or descending ramus; four toes to the fore feet, and three to the hind; tail wanting, or rudimentary; upper lip entire; a strongly-developed horizontal ridge on the outer surface of the lower jaw; the angular portion of this jaw produced much beyond the condyloid portion, descending below the level of the dental portion, and with a curved lower margin; clavicles wanting.

The Cavies have almost invariably been associated with the Agoutis (*Dasyprocta* and *Cœlogenys*), and frequently the animals of both divisions have been linked together under the sectional name *Subungulata*, by the more recent writers, who thus adopt Illiger's name for the section and his views regarding it.

The nature of the affinity which exists between these two groups is by no means so near as is generally supposed.

Both groups belong to the same great family; and besides the characters which are peculiar to this family, the species of the genus *Dasyprocta* may be said to approach the Cavies, from the circumstance of their having the same number of toes to their feet, and being almost (or entirely) destitute of a tail; but this is weak evidence in favour of the supposition that there exists a very near affinity between the genera associated under the name *Caviina* and those arranged under the head *Dasyproctina*, such an affinity, in fact, as is indicated by the arrangement of these two groups in a section apart. A certain degree of importance must be given to the characters thus referred to, when we find them combined with numerous other peculiarities exhibited in the structure of the teeth, skull, and skeleton, as in the *Caviina*, but evidence of a distinct minor type, in the structure of these parts will be educed when we treat of the *Dasyproctina*.

Dolichotis, Desmarest; *Mara*, Lesson.—The limbs are long, the ears fully half as long as the head, pointed, broad at the base, and deeply emarginated behind; tail very short, and recurved; metatarsus with the anterior half clothed with hairs on the under surface; the hinder half as well as the heel, naked; molar teeth small, compared with the bulk of the skull; the three foremost of the upper jaw and the three hindermost of the lower, divided by folds of enamel, each into two equal lobes; the last molar of the upper jaw three-lobed as well as the foremost of the lower jaw.

D. Patachonica, the Patagonian Cavy; *Cavia Patachonica*, Shaw; *Dasyprocta Patachonica*, Desmarest; *Chloromys Patagonicus*, Lesson; *Mara Magellanica*, Lesson; *Dolichotis Patagonica*, Wagner. Fur dense and crisp; on the upper parts of the head and body gray, on the sides of a yellow rust-colour; chin, throat, and abdomen, white; rump black, but with a broadish white transverse band crossing immediately above the tail; limbs for the most part rusty yellow, but grayish in front. It inhabits Patagonia, ranging from about 48° 30′ to 37° 30′ S. lat., on the east coast, and extending into La Plata as far north as Mendoza.

"The Patagonian Cavy," Mr. Darwin observes, "is found only where the country has a desert character. It is a common feature in the landscape of Patagonia to see in the distance two or three of these Cavies hopping one after the other in a straight line over the gravelly plains, thinly clothed by a few thorny bushes and a withered herbage.

"Near the coast of the Atlantic the northern limit of the species is formed by the Sierra Tapalguen, in 37° 30′ S. lat., where the plains rather suddenly become greener, and more humid. The limit certainly depends upon this change, since near Mendoza (33° 30′) four degrees farther northward, where the country is very sterile, the animal again occurs.

"Its southern limit is between Ports Desire and St. Julian about 48° 30′ S. lat. From the same source we learn the following particulars relating to this Hare-like Cavy. It is a burrowing animal, but when found in the same districts with the Viscacha it will avail itself of the excavations of this latter animal for a retreat. The Patagonian Cavies wander at times to great distances from their homes, and usually two or three are seen together on these occasions. The animal in its mode of running more nearly resembles the Rabbit than the Hare, and though its limbs are long it does not run very fast; it seldom squats after the manner of the Hare, is very shy and watchful, and feeds by day; and in connection with this circumstance I may mention that the eyes, like those of the Kangaroos, are defended from the direct rays of the sun, by well-developed eye-lashes, which is not the case with ordinary Cavies.

"It generally produces two young at a birth, and brings forth in its burrow: its flesh is white when cooked, but rather dry and tasteless. The long legs and rather long erect ears, combined with the general form of the head, and the short recurved tail, have caused this animal to be very generally mistaken for the Hare, by casual observers; and we have pointed out certain other characters in which the resemblance is further carried out; it nevertheless is a Cavy in all the more essential details of structure.

"For size it greatly surpasses the common Hare, full-grown individuals weighing from twenty to thirty pounds, and indeed the Patagonian Cavy must rank amongst the largest of the Rodent tribe, though far surpassed by its aquatic congener, the *Capybara*."

Cavia, Klein; *Anœma*, F. Cuvier; Les Cobayes, Cuvier.—The limbs short and the ears likewise short; feet naked beneath; molar teeth nearly of equal size, each molar with two principal lobes.

C. rupestris, Rock-Cavy; *Kerodon Moco*, F. Cuvier; *K. cinereus*, Geoffroy; *Cerodon rupestris*, Wagner. Nails of the toes short, obtusely pointed, and scarcely projecting beyond the large fleshy pads with which the toes are terminated; fur soft, its general hue gray, tinted with rufous on the hinder part of the back; throat white, chest whitish; abdomen white suffused with pale orchreous yellow; sides of the face tinted with rufous; hinder part of the posterior limbs suffused with chestnut red; fore legs and tarsi whitish, tinted with rufous. The Rock-Cavy inhabits Brazil in rocky situations.

According to Prince Maximilian it inhabits the interior of Brazil, and is confined to rocky districts, where it seeks its retreat in holes amongst the fragments of the rocks. It is frequently met with at Belmonte, Rio Pardo, and Rio de St. Francisco (all nearly under the 16th parallel of south latitude), being found near the rivers, but always in the higher parts of their course. Its flesh is said to be well flavoured, on which account it is sought by the Indians, to whom it is known by the name of 'Hokê,' and by the Portuguese it is called 'Mokô.' The *C. rupestris* is superior in size to most other Cavies, stands higher on its legs, and is remarkable in its group for the comparative softness of its fur, and the structure of the nails of its toes.

C. Spixii, Spix's Cavy. Incisor teeth yellow; general colour of the animal gray, with a somewhat indistinct brownish tint on the back; the space between the eye and the ear whitish, a white patch behind each ear, and the throat and abdomen likewise white. It inhabits Brazil, Rio de Janeiro, Bahia, and the neighbourhood of the Amazonas.

The yellow colour of the incisor teeth, and the general gray hue of the fur, combined with a distinct white patch behind, and a second in front of each ear, are the leading characteristics of the species.

C. Boliviensis, Bolivian Cavy; *Galea Musteloides*, Meyen. Incisor teeth of an orange-yellow colour; general hue of the fur gray, with a very faint yellow tinge; throat and abdomen white; feet whitish. It inhabits Bolivia, occuring only at great elevations. Meyen informs us that the lofty plains on the pass of Tarna to the Lake of Titicaca, as well as those of Tajori (on the Andes 18° S. lat.) are inhabited by immense numbers of a small animal, which burrows and so undermines the ground, that every step of the horse was attended with danger. The animal was so shy that he was unable to procure a specimen; and indeed it was only seen from a distance. It is described as having a long and slender body, of a brownish red colour on the upper parts and pale on the under. Its length without including the tail appeared to be about eight inches. To this animal Meyen gives the name *Galea Musteloides*.

The characters of the genus *Galea* are derived from a skull found by Meyen at the entrance of one of the burrows of the little animal just referred to, and judging from Meyen's figures and descriptions it probably belongs to the Rodent named *C. Boliviensis*.

C. australis, the Southern Cavy; *Keredon Kingii*, Bennett. Incisor teeth white; head short, tarsi long; fur rather soft, its general hue gray, by no means dark; the eye edged with white, a whitish spot behind the ear; the chin and edge of the lower jaw likewise white. It inhabits Patagonia, from about the 39th parallel of latitude down to the Strait of Magalhaens. This little gray Cavy according to Mr. Darwin is common along the coast of Patagonia, from Rio Negro to the Strait of Magalhaens.

It is very tame, commonly feeds by day, and is said to bring forth two young at a birth. At the Rio Negro it frequents in great numbers the bottom of old hedges, and at Port Desire it takes up its abode amongst the ruins of the old Spanish buildings.

M. D'Orbigny observed the southern Cavy as far north as 39° S. lat., which it appears is its extreme range in that direction; and this author states that it lives in families, and digs deep burrows in the ground, preferring sandy declivities which are more or less overgrown with bushes; its burrows are said to have several outlets. The food of the southern Cavy consists of seeds and green herbage, and it has been observed to ascend trees to feed upon their fruits.

C. Aperea (Linnæus), Restless Cavy, or Guinea-Pig (*Aperea Braziliensibus*, Marcgrave ?). Domesticated it is called *C. Cobaya* by Marcgrave, Schreber, and Desmarest; *Mus Porcellus*, Linn.; Variegated Cavy, Shaw; Cochon d'Inde, Buffon. The Wild Guinea-Pig has the incisors white; fur long and somewhat coarse, on the upper part of the sides and body distinctly pencilled with black and dirty yellow; chest gray-brown, throat and abdomen pale dirty-yellow, or sometimes brown-gray. It inhabits the banks of the Rio Plata, and extends northward into Paraguay, Bolivia, and Brazil.

According to Mr. Darwin the animal is known by the name of *Aperea*, and it is exceedingly common in the neighbourhood of several towns on the banks of the Rio Plata, sometimes frequenting the sand hillocks, or the hedge-rows formed of the *Agave* and *Opuntia*; but marshy places covered with aquatic plants appear to be preferred. Where the soil is dry it makes a burrow, but otherwise it lies concealed amidst the herbage. It generally comes out to feed in the evening, and if the day be gloomy it will likewise make its appearance in the morning. In Bolivia, Mr. Bridges states this animal is confined to the low lands, and in this respect differs from the *Cavia Boliviensis*, which is always found at a considerable elevation. It is not uncommon in fields in the neighbourhood of Chuquisaca and Cochabamba; and takes shelter amongst the loose stones of the walls by which the fields are inclosed.

Dr. Rengger says that the *Aperea* is found throughout Paraguay, and extends southward as far as 35° S. lat., he has himself not only met with the animal (with which he is well acquainted) in those parts, but likewise in Brazil, both in Bahia and in Pernambuco.

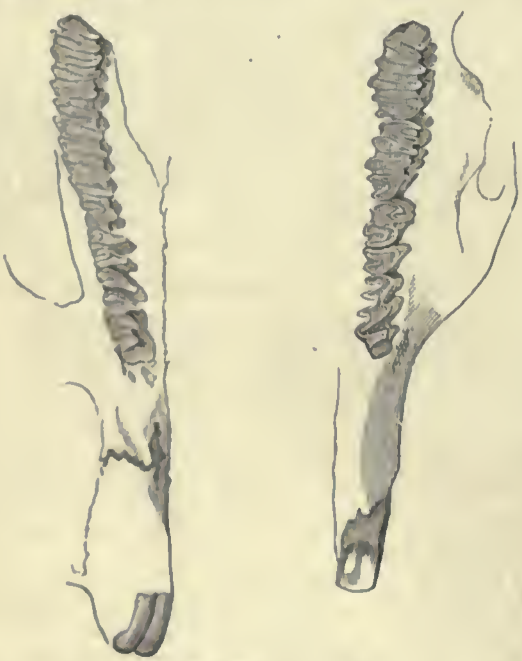
In Paraguay it generally frequents moist situations and near the borders of forests, but it never occurs either in the forests or in the open fields. It lives in little societies (according to the same author) of from six to fifteen individuals, in the impenetrable groves of Bromelias; and its presence is detected by numerous little beaten paths which it forms amongst these plants. It feeds early in the morning and after sunset in the evening, but never strays far from its home. The *Aperea* breeds but once in the year, and then has but one or two young. On this and other grounds Dr. Rengger thinks the *Aperea* is not the origin of the Domestic Guinea-Pig.

C. leucopyga, the White-Rumped Cavy. Incisor teeth white; on the upper parts of the animal of mixed brown black and brownish-yellow colours; throat, chest, and abdomen white. It inhabits Brazil.

Hydrochœrus, Brisson; *Capybara*, Marcgrave; *Capyigoua*, D'Azara; Cochon d'Eau of Des Marchais; Irabubo of Gumilla, Capivard of Froger, Capüguara of Dobritzhof, Cabiai of Buffon, Nümpoon of the Botocudo Indians.

$$\text{Dental formula :—Incisors, } \frac{2}{2}\text{; molars, } \frac{4-4}{4-4} = 20.$$

Molars compound, the posterior teeth the longest, and formed of numerous laminæ, which are simple and parallel; the laminæ of the anterior molars forked.



Teeth of *Capybara*. F. Cuvier.

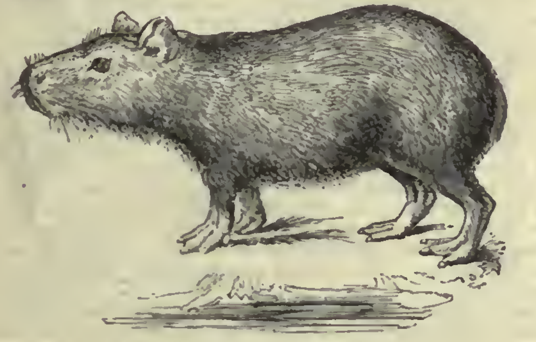
At a meeting of the Zoological Society of London (1832), Professor Owen, on the occasion of exhibiting a large old cranium of the *Capybara* belonging to M. De la Fons, remarked, that perhaps the most extraordinary instance of the enlarged views which result from unwearied observation of the internal structure of animals is afforded by Cuvier's bold enunciation of the affinity of the Elephant to that order of the *Mammalia* which contains the most minute forms of the class; and, in support of that affinity, adduced the alveolæ of the last molar tooth in M. De la Fons's specimen as illustrating an additional analogy between the molars of the Rodent and those of the Elephant, namely, that the number of transverse laminæ increases as the jaw enlarges with age, the whole number not coming into use at once.

"In the *Capybara*," says Professor Owen, "the posterior grinders, like those of the Elephant, present a greater number of component laminæ than the anterior ones, which are of earlier formation. Those of the upper jaw, according to the figure and description in the 'Ossemens Fossiles' (V. pl. 1, p. 24), are composed of eleven laminæ, of which all but the first, which is notched externally, are simple. In the figure too, it is worthy of observation that the last or eleventh lamina is imperfect, and exhibits a construction analogous to the imperfectly-formed laminæ or denticles in the elephant's grinder, namely, a division into component columns. In the work of F. Cuvier, 'Sur les Dents des Mammifères,' the number of laminæ in the last grinder of the upper jaw of the *Capybara* is stated as 'onze ou douze;' but eleven only are exhibited in the figure, and we may suppose therefore the doubt as to the precise number to be founded on uncertainty as to the propriety of considering the first deeply-notched lamina as single or double. In the cranium in the College Museum the number of the laminæ is twelve, the forked one being regarded as single. In M. De la Fons's specimen the alveolæ clearly indicate that the number of laminæ of the last molar had been thirteen, with the rudiment of the fourteenth; the extent of the grinding surface is however proportionally longer than would result from the additional laminæ alone; for as these laminæ do not cease to grow so long as the animal lives, they increase in thickness as age advances." ('Zool. Proc.')

Mr. Morgan ('Linn. Trans.' vol. xvi.) describes the stomach as formed by a single membranous bag; and, as in other mammiferous vegetable feeders in which this simple form of stomach is found, the cœcum as large and complicated in proportion. Finding nothing requiring particular notice in the rest of the alimentary canal, Mr. Morgan proceeded to examine the structure of the mouth and throat. After noticing the considerable extent of the grinding surfaces of the molar teeth, he remarks that it must be obvious how necessary such an arrangement of parts must be to the health of the animal, when the nature of its food and the simple structure and limited functions of its most important digestive organ are considered, a provision being thus made for the proper mastication of the hard vegetable substances upon which the animal must occasionally subsist. But Mr. Morgan found another structure, undescribed up to the time when he made his examination, by which the process of perfect mastication is rendered indispensable to the passage of the food from the mouth to the stomach. This structure, by which the possibility of swallowing any portion of unmasticated nutriment is prevented, is shown in an extraordinary formation of the velum palati mollis, or soft palate. In other animals this membrane generally forms an imperfect floating septum, suspended from the back part of the roof of the palate, and interposed between the cavity of the mouth and pharynx, but it was found in the *Capybara* and in some of its congeners to be much more extensive in its attachments, and different in its form and uses. On separating the jaws the mouth appears to terminate in a nearly blind pouch; for the communication with the pharynx seems as if shut by a strong membrane of a funnel shape, the concavity of which recedes towards the throat. "This membrane is an extended velum palati attached to the whole circumference of the fauces and root of the tongue, and is prevented from forming a complete septum by the existence of a small central circular aperture, by which a communication between the mouth and the pharynx is established for passage of food; so that through this small membranous funnel, or strainer (if I may be allowed the expression), it is physically impossible that any considerable portion of unmasticated nutriment should find its way, by natural means, from the mouth into the alimentary canal; and from this circumstance the first process towards digestion must be rendered certain and complete; for the grosser particles of food must remain in the mouth from the interposition of the membranous sieve or strainer, which is thus placed between the organs of mastication and those of digestion. Mr. Morgan observes that the same provision for the complete mastication of all solid substances, previous to their being swallowed, will be found in others of the same group, but he confines his well-executed descriptions and figures of the anatomy of these parts to the dissections he had made of the *Capybara*. To these descriptions and figures we refer the reader, offering only the conclusion to which Mr. Morgan comes as to the use of this conformation of the velum palati: this appears to him to have reference to the digestive organs, and to be confined almost entirely to the process of deglutition."

The size of the laminæ in the posterior molar teeth, and the increase in their number, indicate some approach to the pachydermatous form, and we find among some of the earlier zoologists who have noticed it a disposition to approximate it to the hogs. Thus Marcgrave says ('Piso,' book iii.), "*Capybara* inter porcos aquaticos sive fluviatiles recipitur, quia figura et natura bimulum porcum emulatur." Brisson's name *Hydrochœrus*, Water-Hog, and Des Marchais' Cochon d'Eau, point the same way. Linnæus, in his last edition of the 'Systema Naturæ' (12th), arranges it under the genus *Sus* (*Belluæ*), as *S. Hydrochœris*, and immediately after the *S. Tajaçu*, or Peccary, next to which animal it is placed in Piso's Marcgrave. Pennant in his 'Synopsis,' calls the *Capybara*, with River Hog (Wafer, in Dampier), as one of the synonyms, the Thick-Nosed Tapir; but in his 'History of Quadrupeds' he makes it the first species of his genus Cavy, giving it a place immediately before the Guinea-Pig. Gmelin (13th ed. 'Syst. Nat.') places it among the *Glires*, as the last species of the genus *Cavia*, immediately after the Guinea-Pig, *C. Cobaya*; by which arrangement the animal comes next to the Beaver (*Castor*). Cuvier makes *Hydrochœrus* a genus of his Rodents, giving it a position between *Lagomys* and the Guinea-Pig. Fischer brings it under the *Glires*, between *Lagomys* and *Dasyprocta*. Dr. Gray places it in the order *Glires*, family *Leporidæ*, sub-family *Hydrochœrina*; *Hydrochœrus* being the only genus of that sub-family, which stands between the sub-families *Caviina* and *Dasyporcina*. M. Lesson arranges it between *Kerodon* and *Cavia* (*Glires*). Mr. Swainson also places it at the head of the Cavies, *Cavia* (*Glires*).

H. Capybara (*Cavia Capybara* of Gmelin, *Sus Hydrochœris* of Linnæus) is the only species. .



Capybara (*Hydrochœrus Capybara*).

It is confined entirely to the New World, and found in the neighbourhood of the great rivers in Brazil, Guyana, and Paraguay; some say that it is found as high as the Isthmus of Darien.

Marcgrave states that the *Capybara* lives upon herbs and fruits; that it is a nocturnal animal, swimming across rivers and torrents in search of food, and raising such a horrible clamour as to have terrified the narrator before he knew the cause. He says that they wander in infinite congregations about the banks of the rivers, and as they are slow of foot, that they save themselves from the hunters by swimming, though, notwithstanding, immense numbers are killed. Pennant, who quotes Muratori, says that it runs slowly, swims and dives remarkably well, and keeps for a long time under water; feeds on fruits and vegetables; is very dexterous in catching fish, which it brings on shore and eats at its ease; sits up and holds its prey with its fore foot, feeding like an ape; takes its food in the night, and commits great ravages in gardens, keeps in large herds, and makes a horrible noise like the braying of an ass.

Some part of this last account seems rather highly coloured. We doubt very much, from the structure of the teeth and digestive organs, the alleged fact of its feeding much on fish; though Bewick, who gives by no means a bad figure of the animal, places a newly-caught fish before it, probably on the authority above quoted.

Marcgrave speaks of the flesh as sufficiently good food, especially if it be roasted: he says indeed that inasmuch as it yields in dignity to that of wild and domestic hogs, the head of the *Capybara* only is considered a delicacy. Pennant, on the contrary, in the account above alluded to, says that it grows very fat, and that the flesh, which is tender, is eaten, but it is added that the flavour is oily and fishy. Cuvier however speaks well of it. "C'est un bon gibier," says that author in his 'Règne Animal.' The majority of authors speak of it as being easily tamed and growing familiar; but one of the Capybaras which died at the Regent's Park was very morose to strangers, and all endeavours at conciliation were answered by stampings, cries, and malevolent attempts to strike with the fore feet and head. There is at present (1854) a specimen in the collection, which, although not very familiar, exhibits none of the malevolence of the first specimens. The habits of an animal however cannot be judged of from an individual shut up in a cage, deprived of all the accessories that make its life agreeable in a state of nature, and with a temper ruined by constant irritation, disappointment, and ill-health. Those who speak of the *Capybara* as being easily tamed had most probably opportunities of observing the manners of some of these quadrupeds where they were allowed that certain degree of liberty and indulgence without which an attempt to gain the confidence of animals is generally hopeless.

Professor Owen observes ('Zoology of the Voyage of H.M.S. Beagle,') that it is interesting to find that the continent to which this interesting aberrant form of Rodent is peculiar, should be found to contain the remains of an extinct genus, characterised by a dentition which closely resembles the Rodent type, but manifesting it on a gigantic scale, and tending to complete the chain of affinities which links the Pachydermatous with the Rodent and Cetaceous orders. [TOXODON.]

The next sub-family in Mr. Waterhouse's arrangement is the *Chinchillina*. An account of them is given under CHINCHILLIDÆ.

Sub-family *Octodontina*.—Molar teeth rootless, having but a single indenting fold of enamel on either side or rarely with an extra fold on the inner side of the molars of the lower jaw; zygomatic arch with angular process on the lower edge; hind feet with five toes or with sometimes four.

The species of this section inhabit the middle and southern parts of South America, occurring on both sides of the Andes. They are of small size, the largest known species scarcely surpassing the Common Squirrel in bulk. Some live almost entirely underground, and have the fore feet strong, and armed with powerful claws, fitted to their burrowing habits; others are found at the roots of trees, occasionally climbing amongst the branches of the shrubs of which the hedges are formed, or even (though rarely) ascending trees.

The *Octodontina* bear the same kind of relationship to the *Echimyina* as do the *Arvicolina* of the northern hemisphere to the true Rats: they agree with the *Echimyina*, in fact, in all essential points, but differ in having the molar teeth rootless, and almost always of a more simple structure. Accompanying the rootless molar teeth, we find that the incisors are almost always broader, and relatively less deep from front to back; and connected with these differences, the structure of the skull denotes increased powers in the muscles of mastication, the zygomatic arch being stronger, and the temporal fossæ more extended; generally in proportion as the incisor teeth increase in size, the cranium assumes a broader and shorter form, is more contracted between the orbits, and has the cerebral cavity proportionately smaller, and it is in those species which burrow and live almost entirely underground that these last-mentioned peculiarities are carried to the extreme.

From the other two sub-families of *Hystricidæ*, which are characterised by rootless molar teeth—the *Caviina* and *Chinchillina*—the Octodons may be distinguished by the hind feet being always provided with five well-developed toes. The presence of a distinct tail will prevent the Octodons from being confounded with the Cavies; and this organ being clothed with short hairs in the Octodons, gives to these animals a very different appearance to that of the bushy-tailed Chinchillas. The skull and dentition likewise furnish good distinguishing characters. The palate, as will be seen on comparing it with those of the Cavies and Chinchillas, is less contracted between the foremost molar teeth, the molar bone has a distinct angular projection on its under side (as in the *Echimyina*), and there is the same strong muscular ridge running obliquely forwards and downwards from the hinder root of the zygoma on the outer surface of the molar bone. The molar teeth are usually indented on each side by a single fold of enamel, and the crown of one of these teeth approaches more or less nearly to the form of the figure 8. The most marked exception is found in the lower molars of the genus *Habrocoma*. Five genera having well-marked distinguishing characters, are included in the present sub-family: their chief external peculiarities are as follows:—

I. Fore feet with four toes; ears very long. *Habrocoma*. [HABROCOMA.]

II. Fore feet with five toes.

- *A.* Ears large, or of moderate size.
  - *a.* Tail as long as the body, slightly bushy at the extremity. *Octodon*.
  - *b.* Tail shorter than the body, clothed throughout with small adpressed hairs. *Schizodon*.
- *B.* Ears very small, almost entirely hidden by the fur of the head.
  - *a.* Incisor teeth moderately broad; nails to the toes of the fore feet shorter than the toes. *Spalacopus*.
  - *b.* Incisor teeth very broad; nails to the toes of the fore feet longer than the toes. *Ctenomys*.

Octodon, Bennett (*Dendrobius*, Meyen).—Ears moderately large; tail nearly as long as the body, with long hairs at and near the point; five toes to the fore or hind feet; the claws small; incisor teeth moderate as to width, or somewhat narrow, convex in front; molar teeth each with a single indented fold of enamel on either side; the hinder half of the upper molars much narrower than the anterior portion; a small vertical plate (to protect the infra-orbital nerve) within the ant-orbital opening of the skull.

O. Degus, Cuming's Octodon; *Sciurus Degus*, Molina; *O. Cumingii*, Bennett, Wagner; *O. pallidus*, Wagner; *O. Cumingii*, Tschudi (?); *Dendrobius Degus*, Meyen; Chilian Squirrel, Shaw. Fur long and moderately soft; upper parts of the body pencilled with black and pale brownish-yellow; sides of the body chiefly of the latter colour; abdomen dirty yellow; feet white, faintly tinted with yellow; tail dusky above, dirty white beneath; the long hairs on the apicle third, black, or dusky. It inhabits Chili.

According to Mr. Darwin this species of Octodon may be seen by hundreds in the hedgerows and thickets in the central parts of Chili, where they make burrows close together, leading one into the other. They feed by day in a fearless manner, and are very destructive to fields of young corn; when disturbed, they all run together towards their burrows, the same way that rabbits do in England when feeding outside a covert. When running they carry their tails elevated; and often they may be seen seated on their haunches, like squirrels. According to Molina they lay up a store of food for the winter, and do not become dormant. According to more than one author, the

Octodon is seen occasionally to climb amongst the branches of the bushes. Mr. Bridges informs us that Cuming's Octodon has a very extended range, that gentleman having met with it as far north as 25° N. lat., and southward to the 35th parallel. In the province of Coquimbo, where the country is sterile, the little animal takes up its abode amongst the loose stones on the sides of the mountains, and is frequently met with in the holes of the Chinchillas. Its food consists of the herbage which grows at the roots of the hedges; in the winter months, when pressed by hunger, it feeds upon the tender bark of the *Mimosa Cavenia*, and also on that of the *Cestrum Palqui*. Mr. Bridges is inclined to believe that it breeds but twice in the year, and states that it has from four to six young at a birth.

O. Bridgesii, Bridges's Octodon. Fur very long and moderately soft; upper parts of the animal strongly pencilled with brown-yellow and black, the black prevailing on the back; abdomen white, suffused with pale brown, yellow, or cream-coloured; tail indistinctly tufted, dusky, excepting at the base beneath, where it is dirty white; feet grayish-white. It inhabits Chili, the province of Colchagua.

O. gliroides, Dormouse Octodon. Fur soft, ashy gray on the upper parts of the body, and white on the under; tail brown-black beneath to the extremity, which is somewhat tufted; feet white above.

Schizodon. — Ears moderate size; short tail, clothed throughout with short hairs: fore feet strong, the claws about equal to the toes in length; incisor teeth stout; molars each with a single deep fold of enamel on either side, dividing the tooth into two oval-shaped lobes, the long diameters of which are placed transversely, the lobes equal in size, or very nearly so, excepting in the hindermost molar of each jaw, in which the posterior lobe is considerably smaller than the rest; skull strong, rather short and broad, with a separate small canal for the infraorbital nerve; toes 5—5.

S. fuscus, Brown Schizodon. Fur tolerably long, moderately soft, and somewhat glossy; its general hue deep brown, pencilled black and yellow-brown; abdomen of a pale dirty yellow hue; feet dusky-brown. It inhabits the Southern Andes, eastern side.

Mr. Bridges, who discovered this animal, informs us that he met with it in the Valle de las Cuevas, on the eastern side of the Andes, about six leagues from the volcano of Peteroa (about 75° S. lat.), at an elevation of from 5000 to 7000 feet. Its favourite abode is stated to be in grassy situations near the mountain streams. In certain parts the ground is completely undermined by the burrows of these little animals, and whilst riding over these the horses of Mr. Bridges's party frequently plunged into the ground almost up to the hock. The valleys inhabited by the Schizodon are so elevated that they are covered with snow at least four months during the year, and Mr. Bridges is inclined to believe that, like the Spalacopus, the Schizodon lays up a store of food for the winter. It is a nocturnal animal, and it would appear lives almost entirely underground.

Spalacopus, Wagler; *Poephagomys*, F. Cuvier; *Psammoryctes*, Pöppig; *Psammomys*, Pöppig; *Bathyergus*, Pöppig. — Ears rudimentary; tail short, and clothed with short hairs; the nails of the toes of the fore feet rather shorter than the toes; incisor teeth moderately broad, those of the upper jaw distinctly directed forwards as well as downwards; molar teeth with the crowns shaped like the figure 8, the anterior and the posterior lobes being equal, excepting in the last tooth, the indenting fold of the enamel of one side of each tooth not meeting that of the opposite side; hindermost molar in each jaw smaller than the rest, and with the posterior lobe smaller than the anterior one.

S. Pöppigii, Pöppig's Spalacopus; *Poephagomys ater*, F. Cuvier, Waterhouse, Eydoux, and Gervais; *Psammoryctes noctivagus*, Pöppig and Wagner. Fur soft and very glossy, black, with an admixture of purple brown, the brown hue most distinct on the under parts of the animal; incisor teeth pale yellow, or yellow-white in front. It inhabits Chili, and lives almost entirely underground.

Ctenomys, De Blainville.—Ear rudimentary; eyes small; tail short; fore feet large and powerful, and armed with nails, which exceed the toes in length: incisor teeth very broad, the upper pair indistinctly convex in front, the lower pair flat at the same part; molars with two unequal lobes, the hindermost molar of each jaw much smaller than the rest, nearly cylindrical; skull very strong, short, and broad, the occipital portion much dilated, no separate canal for the infraorbital nerve. Geographical range from Brazil westward into Bolivia, and southward to the Strait of Magalhaens. It lives underground.

C. Braziliensis, Brazilian Ctenomys, De Blainville and others; *C. torquatus*, Lichtenstein. Fur soft, fine, and rather short, of a deep slate-gray next the skin and bright rusty-brown externally; on the under parts of the animal however the hairs are rusty-white at the point; the hairs on the feet short and harsh, as well as those of the tail, which latter are of a blackish-brown colour; hairs of the moustaches tolerably long. It inhabits Brazil, Paraguay, La Plata, and Bolivia.

There are three other species, *C. Boliviensis*, *C. leucodon*, and *C. Magellanicus*.

Sub-family *Echimyina* (*Echymidæ*, Bonaparte).—Molar teeth complicated, and these (with one or two exceptions only) rooted; malar-bone with a distinct angular process on the lower edge; both fore and hind feet with five toes.

Geographical Distribution.—One species of this section is found at the Cape of Good Hope, and a second in Western Africa. With these exceptions the group is confined to South America and the West Indian Islands. In South America the species of *Echimyina* are only known to occur in the northern and central portions; Paraguay appears to be their southern limit. On the west side of the Cordilleras none have been found.

Capromys; Isodon, Say.—Molar teeth rootless, each upper molar with a single deep fold of enamel on the inner side and two deep folds on the outer; incisor teeth narrow and convex in front; muffle broad, with a mesial longitudinal groove; upper lip slightly cleft; ears moderate; tail of moderate length, and somewhat sparingly clothed with hairs, which do not hide the scaly skin; feet naked beneath, and covered with small tubercles; nails of the toes large, and much curved; pupil of the eye vertical. But two species of this genus are known; they inhabit the island of Cuba.

C. pilorides, the Short-Tailed Capromys; *Isodon pilorides*, Say; *Capromys Fourneiri*, Desmarest. Tail shorter than the body; fur long, very harsh to the touch, strongly pencilled with black and rich yellow, or, on the hinder part of the body, with yellowish rust colour; ears, muzzle, throat, and chest, white, or nearly white; abdomen rusty yellow; toes whitish, or white; tail well clothed at the root with rust-coloured hairs, sparingly clothed with brown hairs beyond.

C. prehensilis, Prehensile-Tailed Capromys. Tail nearly equal to the head and body in length; fur moderate as to texture; on the upper parts of a mixed gray and rufous tint; neck yellowish; forehead, cheeks, and throat yellow-white; chest and abdomen white. Tail rufous at the base. Toes clothed with whitish hairs. It inhabits Cuba.

The *Capromys prehensilis* is known in Cuba by the name of Hutia Carabali, and is said to confine itself to parts of the forests which are remote from the habitations of man, and to be more shy and less tameable than the Hutia Congo, or *C. pilorides*. Like the last mentioned species it is an expert climber, and, according to M. Ramond de la Sagra, it confines itself to the uppermost branches of trees. The tail is prehensile at the extremity; and the animal, assisted by this organ, is enabled to cling with security to the small twigs of the trees, or to the parasitic plants with which they are overgrown, and amongst which it usually conceals itself.

Plagiodontia.—Molars rootless; those of the upper jaw with a single deep fold of enamel on the inner side, running obliquely forwards and inwards from near the posterior angle of the tooth, and a second deep fold entering from the outer side, near the anterior angle, and running in an opposite direction; molars of the lower jaw each with two deep folds on the outer side; toes 5—5; ears small; tail short, destitute of hair, and with a scaly skin. But one species of this genus is known, *P. Œdium*. It inhabits the Island of St. Domingo, and is evidently very nearly allied to the Capromys of the neighbouring island. Its short and naked tail, combined with certain differences observable in the structure of the molar teeth, furnish the chief distinguishing characters.

Myopotamus; Mastonotus, Wesmael.—Molar teeth semi-rooted, of which the hindermost in each jaw are the largest; each upper molar with two external and two internal deep folds of enamel; the lower molars with three internal folds and one indentation entering from the outer side; incisor teeth very large; palate much contracted between the front molar teeth; hind feet webbed; tail of moderate length, sparingly clothed with short hair.

Teeth of *Coypu*.

M. Coypus, the Coypu, *Mus Coypus*, Molina; *M. Castoroides*, Barrow; *Myopotamus Coypus*, Commerson, Geoff.; *Hydromys Coypus*, Geoff.; *Potamys Coypou*, Desmarest; *Myopotamus Bonariensis*, Rengger; *Mastonotus Popelairi*, Wesmael; *Guillinomys Chilensis*, Lesson; *Quoiuya* Azara; Coypu Rat, Shaw. Ears of moderate size; tail nearly equal to body in length; fur long; the under fur very dense and soft; upper parts of the animal pencilled with dusky and hrownish yellow, in about equal proportions; sides and under parts with the prevailing tint, brown-yellow; tip of muzzle and chin white; a yellow patch immediately beneath the ear-opening; feet dusky-brown.

Coypu Rat (*Myopotamus Coypus*).

Immatnre Specimens.—General hue rich brown, on the sides of the body inclining to yellow.

The Coypu is very nearly equal in size to the Beaver, and bears a considerable superficial resemblance to that auimal; its tail however is cylindrical, has a scaly skin, and is scantily clothed with hairs, short and stiff, like that of the Rat. It inhabits the rivers and streams of a great portion of South America, occurring on both sides of the Andes. On the eastern side it extends from Peru southward to the Rio Chupat, in 43° 20′ S. lat. In the eastern portions of Brazil the Coypu was not met with by the Prince of Nieuwied. On the west side of the Andes this animal ranges, according to Mr. Darwin, from the valleys of Central Chili (33° lat.) to 48° S., or perhaps even somewhat farther, but does not extend to Tierra del Fuego. Iu the Chonos Archipelago, Mr. Darwin states, these animals, instead of inhabiting fresh-water, live exclusively in the bays and channcls which extend between the innumerable small islets of that group. They make their burrows within the forest, at a short distance from the rocky beaches.

The inhabitants of Chiloe, who sometimes visit this archipelago for the purpose of fishing, state that the Coypus here do not live solely on vegetable matter, as is the case with those inhabiting rivers, but that they sometimes eat shell-fish. The Coypu is said to be a bold animal, and to fight fiercely with the dogs employed in chasing it. Its flesh is white and well flavoured. At Buenos Ayres an extensive trade is carried on in the skins of the Coypus, there called Nutrias, or Otters.

Cercomys.—The molar teeth of eqnal size, or very nearly so; the crowns of a rounded form; those of the upper jaw with a deep fold of enamel entering from the inner side and occupying the outer half of the tooth; molars of the lower jaw like those of the upper, but with the areas and enamel fold reversed in position; feet uormal; tail long and scaly; ears moderately large; fur moderate as to texture.

C. cunicularius, the Cercomys. Ears moderately large; tail about equal to the head and body in length; tarsus long; fur moderate as to texture; its general tint deep-brown; the sides of the body of a paler hue, and the under parts impure white. It inhabits Brazil.

Petromys.—The molar teeth very nearly equal in size and rooted; their crowns of a quadrate form, placed obliquely in the jaw, so that the inner front angle is the most forward; each tooth with a single indenting fold of enamel on either side; the folds of opposite sides meeting in the mesial line of the tooth; incisor teeth small and compressed, rather deeper than wide, and flat in front. Body clothed in fur of the ordinary kind; ears rather small, hairy; feet small; toes 5—5; the thnmb exceedingly small, but provided with a small nail. Tail about equal to the body in length, well covered with moderately long hairs, which gradually increase in length towards the apex of the organ, where they are longest.

P. typicus, the Petromys. Fur moderately long and soft; prevailing colonr rufous brown; head (with the exception of the muzzle, which is rufous) and fore parts of the body grayish-brown; throat inclining to white; abdomen palish rufous-yellow; tail of the same colour as the body at the root; the remaining portion black. It inhabits South Africa.

Dactylomys.—Four toes to the fore feet, and these armed with short convex nails; the intermediate pair of toes long. The series of molar teeth of opposite sides of the upper jaw converging and nearly meeting in front; all the molars relatively large; those of the upper jaw each composed of two separate lobes, which are contracted and pointed ou the iuner side of the tooth, and broad, and with a deep fold of enamel on the outer side; the foremost molar of the lower jaw with oue external and two internal folds of enamel, and the remaiuing molars each with two lohes, of which oue, forming the hiuder part of the tooth, is narrow and transverse: the other is broad on the inner side of the tooth, where it has a deeply indenting enamel fold.

D. typus, the Typical Dactylomys; *Echimys dactylinus*, Geoffroy, Desmarest, and F. Cuvier; *Loncheres dactylina*, Fischer. Hairs of the fur long and somewhat harsh; upper parts of the body freckled with black and yellow; under parts, as well as the head and feet, dirty yellow-white; the hairs ou the upper surface of the head very long, especially towards the hinder part; tail longer than the head and body taken together. It is probably a uative of Brazil.

Loncheres; *Nelomys*, Jourdan, I. Geoffory, and Pictet; *Phyllomys*, Lund.; *Isothrix*, Wagner.—Short and broad feet; ears somewhat small; molar teeth rather large, and longer than broad; those of the upper jaw each with two prinoipal transverse folds of enamel, often completely dividing the tooth; and those of the lower jaw with one exerual and two internal folds of enamel. Palate narrow, most so between the foremost molars.

L. cristata, White-Crested Loncheres; *Echimys cristatus*, Geoff., and Desm.; *L. paleacea*, Illiger and Lichteustein; *Nelomys cristatus*, aud *N. paleaceus*, Geoff.; *Myoxus chrysurus* (Gilt-Tailed Dormouse), Shaw; *Hystrix chrysurus*, Schreber. Upper parts and sides of the body covered with broad spines; general colour brown; dark on the back, reddish on the sides of the body, and pale on the abdomen; upper surface of the head white; the hairs on this part stiff, and very long, especially towards the occiput; region of eye and occiput black; tail black, with the apical half (or more or less) white. It inhabits Guyana and Para.

L. Blainvillii, the Black-Tailed Loncheres; *Nelomys Blainvillii*, Jourdan and Geoffroy. General hue of the whole of the animal bright sienna-yellow; chin, throat, and in fact the whole of the under parts, pure white; fore feet also white; hiud feet yellow; tail nearly as long as the head and body together, and with black hairs, excepting at the root, where the hairs are of the same yellow hue as those of the body. It inhabits Brazil, in the vicinity of Bahia, and is likewise found in a small island (island of Deos) off the coast of Bahia.

L. armata, Strong-Spiued Loncheres; *Mus hispidus*, Lichtenstein; *Nelomys armatus*, Geoffroy. Upper parts of the body armed with strong and broad spines; tail about equal to the body in length, with spines on the upper surface at the root, and scattered small whitish hairs beyond; general hue brown, but pencilled with yellow; under parts dirty pale yellow; muzzle rufous. It inhabits Guyana.

L. obscura, Dusky Loncheres. Brown freckled with yellow; belly yellowish; tail equal to the head and body in length, and provided with very short scattered hairs. It inhabits Brazil.

L. picta; *Nelomys pictus*, Pictet. Brownish-white; a large oblong browu patch on the upper surface of the head; back and shoulders, as well as the tail, brown; but the latter with the terminal portion, and likewise the basal portion beneath, dirty white; tail rather longer than the head and body taken together. It inhabits Bahia and Brazil.

Echimys (*Echinomys*), Wagner.—The feet narrow and moderately long; upper molar teeth with one internal indenting fold of enamel, and one or two folds on the outer side.

E. Cayennensis, Cayenne Echimys; *E. setosus*, Geoffroy; *E. Myosuros*, Lichtenstein; *E. leptosoma*, Lichtenstein and Brants.; *Mus cinnamomeus*, Lichtenstein; *Loncheres anomala*, Kühl; *L. Cayennensis*, Fischer; *E. longicaudatus* (?), Rengger; *Echinomys leptosoma*, Waguer. Tail nearly as long as the head and body together; ears large; tarsi long, upper parts of the body chiefly covered with spines; sides likewise with spines, but with a considcrable admixture of hairs; upper parts of the animal of a dusky brown colour; sides of the body, aud more especially of the head, suffused with rufous; under parts white. It inhabits Guyana and Brazil.

E. albispinosus, White-Spined Echimys. Tail scaly and with short hairs; head, upper parts and sides of body, with spines, those on the upper parts black at the extremity, and those on the flanks white; general hue on the upper parts brown, and of the flanks rufous; the whole under parts are pure white. It inhabits Bahia and Brazil.

E. hispidus, Strong-Spined Echimys. About equal to the Black Rat (*Mus Rattus*) in size; tail very nearly equal to the head and hody in length, and well covered with longish hairs, excepting at the base; ears small; broad and strong spines cover the whole upper parts and sides of the animal, commencing on the back of the head; upper parts rusty brown; feet, sides, and under parts of the body, rust-coloured. It inhabits Bahia and Brazil.

E. brachyurus, Short-Tailed Echimys; *E. spinosus*, Desmarest and Rengger; *Mus spinosus*, Lichtenstein; *Loncheres rufa*, Licht. Spines narrow and hidden by the fur; ears moderate; tail about as long as the body; tarsus long; general colour rich brown (pencilled black and rufous); under parts dirty white; feet dark brown. It inhabits Paraguay and Bolivia.

E. inermis, the Spineless Echimys. Feet moderately long; tail rather shorter than the head and body taken together, and clothed with long hairs, which entirely hide the scales; fur soft, and without any mixture of soft hairs; general hue brown-yellow; under parts yellowish-white. It inhabits Bahia and Brazil.

E. antricola, the Cave-Echimys; *Nelomys antricola*, Lund.; *E. apereoides*, Lund. Body stout; the muzzle thick; ears short; tail long, and well-clothed with hairs; upper parts of the animal gray-brown, with an admixture of rusty yellow: under parts white; the hairs of the fur harsh and adpressed. It inhabits the interior of Brazil.

Aulacodus.—Four toes to the hind feet; tail short; incisor teeth very broad, those of the upper jaw with one internal fold and two external folds of enamel; skull short and broad, with the occipital crest much elevated, a vertical plate on the upper part of the anterior root of the zygomatic arch, forming the outer boundary of a groove for the infraorbital opening.

A. Swinderianus, the Aulacodus, or Ground-Rat. Body covered with stiff and bristly hairs on all parts; general hue brown, pencilled with black and yellow, or sometimes with dirty yellowish-white; tail dusky above, whitish below. It inhabits Sierra-Leone, the neighbourhood of the Gambia, and South Africa.

Sub-family *Dasyproctina*. — Animals with semi-rooted molars arranged in parallel series, the cranium elongated; nasal bone destitute of a descending process on the lower edge; a tolerably distinct postorbital process formed chiefly by the frontal bone, but in part likewise by the squamosal; scapula with the emargination in the fore parts of the spine, but moderately deep; clavicles wanting; feet formed for running, with the toes 5—3 or 5—5, terminated by sub-solid nails with one but little arched; tail rudimentary; body clothed with hair only; no admixture of spines. Habitat, South America—ranging from the northernmost parts southward to Paraguay and Bolivia; occurs likewise in some of the West India Islands. The species of this sub-family will be found under AGOUTI and CŒLOGENYS.

Sub-family *Hystricina*.—This sub-family embraces the animals familiarly known as Porcupines.

The genus *Hystrix* of Linnæus embraces those Rodents whose covering consists, for the most part, of a kind of offensive and defensive armour, in the shape of spines or quills, instead of hairs.

Cuvier, who places the Porcupines between the genus *Myopotamus* and the genus *Lepus*, observes that they are to be recognised at the first glance by the stiff and pointed spines with which they are armed, after the manner of the Hedgehogs among the Carnassiers. Their molars are, he proceeds to state, four in number, with a flattened crown, variously modified by layers of enamel, which leave deep intervals; their tongue is rough with spiny scales; their clavicles are too small to be applied to the sternum and omoplate, and are only suspended by ligaments. Many of them live in burrows, and have much the habits of Rabbits. Their grunting voice, joined to their large and truncated muzzle, has, he says in conclusion, caused them to be compared to the Hog, whence their French name Porc-Epic, and, he might have added, their English appellation.

He divides the group into—1, the Porcupines properly so called (*Hystrix cristata*, Linn.); 2, *Atherura*, Cuv. (*Hystrix fasciculata*, Linn.); 3, Les Ursons, (Erétisons, F. Cuv.; *Hystrix dorsata*, Linn.); and 4, Les Coendous (Synœthères, F. Cuv.; *Hystrix prehensilis*, Linn.; and *Hystrix insidiosa*, Licht.).

Dr. J. E. Gray makes the *Hystricidæ* the second family of the order *Glires*, with the following character:—Cutting teeth two in each jaw, lower truncated; grinders 4—4 in each jaw, rooted, compound; tongue and body covered with spines; clavicles none.

† Tail short.

1. *Hystrix*. 2. *Acanthia*.

†† Tail elongated.

3. *Erythizon*. 4. *Spygurus*. 5. *Sinethurus*, F. Cuv. (*Synœtheres?*).

This family is placed by Dr. J. E. Gray between the *Muridæ* and *Leporidæ*.

Mr. Waterhouse, in his tabular view of the distribution of the *Rodentia*, laid before the Zoological Society of London, in November, 1839, makes the sub-family *Hystricina* consist of the *Hystricidæ*, the *Octodontidæ*, the *Chinchillidæ*, and the *Caviidæ*. To Europe and North Asia he gives one species of *Hystricidæ* (*Hystrix*); to North America one (*Erethizon*); to Africa one (*Hystrix*); to India and the Indian Islands two, namely, one *Hystrix* and one *Atherura*; to South America and the West Indian Islands he gives five, namely, three of *Cercolabes* and two of *Synœtheres*.

In his 'Natural History of the Mammalia' (1848), Mr. Waterhouse gives the arrangement which we have followed in this article.

Hystrix, Linn.—This genus is distinguished by the head being more or less convex, and by the development of the bones of the nose, which are very much extended; temporal and orbital fossæ very small; parietal bones depressed, occipital and sagittal crests projecting very much; tail short, not prehensile; feet plantigrade, the anterior tetradactyle, the posterior pentadactyle, armed with large nails.

M. F. Cuvier gives to the Porcupines (*Hystrix* and the Acanthions) the following

Dental formula:—Incisors, $\frac{2}{2}$; molars, $\frac{4-4}{4-4} = 20$.

Teeth of *Hystrix*. F. Cuvier.

H. cristata, the Italian or African Porcupine, or Common Porcupine. When full grown about two feet in length; longest spines exceeding a foot. General colour grizzled dusky-black, resulting from an intermixture of various shades of white, brown, and black. Upper part of the head and neck furnished with a crest of long lighter-coloured hairs capable of being raised or depressed at pleasure. Hair on the muzzle and limbs very short, almost black on the limbs; that of the neck and under parts brownish, and of considerable length. On the fore part and sides of the neck a whitish band; all the remaining parts of the back and sides, including the rump and upper parts of the hinder legs, armed with spines, which are longest on the centre of the back. The spines almost of the thickness of a goose-quill in the middle, supported at the base by a slender pedicle, and terminating in very sharp points, striated longitudinally, and ringed alternately with black and white; the rings an inch or more broad. Their usual position is lying nearly flat upon the body with the points directed backwards; when the animal is excited they are raised by means of the subcutaneous muscles almost at right angles with the body, and then present a very formidable appearance. They are not capable of being detached by the animal. The tail-quills are, as it were, cut off in the middle, and consequently open at the ends, and produce a loud rustling noise when the animal agitates its tail. (Bennett.)

This is the Ὕστριξ of Aristotle and the Greeks; and, according to Agricola, the Ἀκανθόχοιρος of the latter; *Hystrix* of the Romans; Istrice of the Italians; Porcépis of the French; Stachelschwein, Dornschwein, and Porcopick, of the Germans; and Porcupine of the British.

The Porcupine is a nocturnal animal, sleeping in its burrow during the day, and coming forth at nightfall to seek its food, consisting principally of roots, fruits, and tender leaves. Thunberg states that its usual food near the Cape, where it is called Yzer-Varken, is the root of that beautiful plant the *Calla Æthiopica*, which grew even in the ditches about the gardens; but he adds that it will frequently deign to put up with cabbages and other vegetables, and sometimes commits great depredations in those gardens. The story of its power of shooting its quills to a distance at its enemy, is merely glanced at by Aristotle ('Hist. Anim.,' ix. 39), but dwelt upon by Pliny with his usual love for the marvellous. ('Hist. Nat.,' viii. 35.) Ælian, Oppian, and Claudian have repeated this tale with exaggerations. In suddenly raising his spiny armour, a loose quill may be detached by the Porcupine; but the power of ejaculation to a distance does not exist. There are usually several openings to the Porcupine's burrow, and it hybernates, but only for a short time. Mr. Bennett quotes Thunberg, not without observation on his credulity, for the use which he was told the Ceylonese Porcupine makes of the tail-quills. Thunberg was informed that it had "a very curious method of fetching water for its young, namely, the quills in the tail are said to be hollow, and to have a hole at the extremity; and that the animal can bend them in such a manner as that they can be filled with water, which afterwards is discharged in the nest among the young."

Pennant says, "These animals produce a bezoar; but according to Seba, only those which inhabit Java, Sumatra, and Malacca. These bezoars were very highly valued, and have been sold for five hundred crowns a piece. It has also been pretended that a stone was procured from the head of this animal infinitely more efficacious than other bezoars (Tavernier); but this may be placed among the many impositions of oriental empiries." In September, 1833, the Secretary of the Zoological Society called attention to a young *Hystrix cristata* which had been recently brought forth in the menagerie, being the first instance of such an occurrence in this species, and respecting which he added that observation of the young while sucking confirmed the correctness of Blumenbach's statement that the nipple is nearly axillary.

Common Porcupine (*Hystrix cristata*).

"Histrices," says Pliny ('Hist. Nat.,' viii. 35), "generat India et Africa." Agricola, in his book 'De Animantibus Subterraneis,' remarks, "Hoc animal gignit India et Africa, unde ad nos nuper allatum est." Pennant states that it inhabits India, the sand-hills on the south-west of the Caspian Sea, Southern Tartary, Persia, Palestine, and all parts of Africa. He adds that it is found wild in Italy, and is brought into the markets of Rome, where it is eaten; but that it is not originally a native of Europe. (For this last he quotes Agricola.) The specimens from Italy are generally rather smaller, and have shorter quills.

Colonel Sykes has described a species under the name of *Hystrix leucurus* (Sayal of the Mahrattas) as *Hystrix caudâ albâ*. He states that the animal appears to be distinct from the European species, which it closely resembles in form and covering. It is nearly a third larger. All the spines and open tubes of the tail are entirely white, which is not the case in *Hystrix cristata*. The spines of the crest also are so long as to reach the insertion of the tail. The ears are much less rounded, and the nails are shorter, infinitely deeper, and more compressed, and with deep channels below. The white gular band is more marked; and, finally, the Asiatic species is totally destitute of hair—spines, where wanting, being replaced by strong bristles even down to the nails. ('Zool. Proc.,' 1830, 1831.) Mr. Hodgson notes this species among the *Mammalia* of Nepaul, as inhabiting the central and lower regions. ('Zool. Proc.,' 1834.) Mr. Waterhouse gives the two following species of *Hystrix*:—

H. Hodgsoni, Crestless Nepaul Porcupine; *H. alophus*, Hodgson. General hue brown-black; head brown; in the visible portions of the quills the black prevails over the white, but numerous very long and slender quills are almost entirely white, the spiny bristles which form the chief covering of the animal are rather long and slender, and have long hair-like points. It inhabits Nepaul.

H. Javanica, Java Porcupine; *Acanthion Javanicum*, F. Cuvier and Van der Hoven; *H. fasciculata*, Muller; *H. brevispinosa*, Wagner; *Acanthion Javanicum*, Gray. Body for the most part covered with stiff and somewhat depressed spines, which are distinctly grooved on the outer surface, and have prickly points; under half of the back and the tail covered with quills, the quills rather short, those at the end of the tail hollow, and pedunculated; general tint brown (or sometimes black), freckled with dirty-yellow; the stouter quills brownish-yellow, with a sub-terminal broad dusky ring; the longer and more slender quills with the exposed ends dirty-yellow. It inhabits Java, Sumatra, and Borneo.

Atherura, Cuv. (*Acanthion?* F. Cuv.).—Neither the head nor the muzzle convex; tail long but not prehensile; feet like those of *Hystrix*.

A. cristata, *Hystrix fasciculata*, Shaw; Le Porcépic à Queue en Pinceau, Buff.

Cuvier describes this species as having the spines of the body hollowed into a furrow forwards, and having the tail terminated by a fasciculus of horny flattened strips (lanières cornées aplaties), constricted at intervals (etranglées d'espace en espace).

Mr. Bennett ('Gardens and Menagerie of the Zoological Society') remarks, that although tolerably described and figured by Buffon, this species had been lost to science until within two years from the time he wrote (1830), when it was recovered almost simultaneously both in its original habitat and in a very distant quarter of the globe. Sir Stamford Raffles, he observes, had cursorily referred to it, and he presumes that the authority on which it was formed into a new genus by Cuvier was a skeleton and skin transmitted from India by M. Diard in the year 1823. Nearly at the same time, he tells us, a living individual was brought to England and presented to the Zoological Society by Lieutenant Vidal, who accompanied the expedition for the formation of the projected colony at Fernando Po, where these animals were found in such plenty as to afford a staple article of food to the inhabitants. It has been conjectured, he adds, on very probable grounds, that they are not indigenous in the island, but had been brought thither from the East by the Portuguese, who were formerly settled there; but he observes that the space interposed between the two regions can scarcely be regarded as conclusive evidence of their having been introduced into the colony, while there are such striking instances of animals common to India and the west of Africa as are furnished by the lion, the leopard, &c.

Mr. Bennett proceeds to state that in the teeth and in the organs of motion it corresponds, as Baron Cuvier has noticed, with the Common Porcupine, from which it differs chiefly in the form of the head; the line of its profile, instead of being elevated into a curve of large extent, passing in almost a straight direction from the occiput to the extremity of the nose. In these respects, Mr. Bennett remarks in continuation, it agrees with F. Cuvier's genus *Acanthion*, founded on this very character observed by the latter on two skulls preserved in the Paris Museum, the one from Java, the other, in all probability, from Africa. These coincidences would have induced Mr. Bennett to consider the two genera as identical, were it not that Baron Cuvier has omitted all mention of that established by his brother, although the materials for comparison were fully at his disposal. F. Cuvier moreover enumerates them both in his genera of *Mammalia*.

Mr. Bennett further observes that Linnæus founded his *Hystrix macroura* on Seba's figure; but Buffon having quoted neither Seba nor Linnæus, Dr. Shaw took it for granted that this was a different animal, and consequently gave it a new name—*H. fasciculata*. Mr. Bennett entertained however but little doubt, notwithstanding some trifling discrepancies in the figures, that Sir Stamford Raffles was right in his conjecture that they both represent one and the same species.

The following is Mr. Bennett's accurate description:—"The differences between this species and the Common Porcupine are obvious at the first glance. Its general colour is nearly the same, but with less intermixture of brown. The upper parts of the body, the outer sides of the limbs, and the head, neck, and face, are of this dusky hue; but the under parts, inside of the limbs, fore part of the neck, and throat, are of a grayish-white, with the exception of a darker band which crosses the breast in front of the fore legs. The spines commence upon the back of the head, where they are little more than an inch in length, and extend to the root of the tail, occupying nearly the whole of the back and sides. The longest are scarcely more than from four to five inches in length, and extend to the root of the tail, occupying nearly the whole of the back and sides. They are mostly white at the base and black towards the extremity, but many of them are black throughout, and others black above and white beneath. All of them are marked on the upper surface by a deep and broad groove running the whole of their length, and terminate in very sharp points. The skin in which they are implanted appears perfectly white, and where the spines are most numerous is scarcely furnished with a single hair. A few slenderer spines running into long black bristles are occasionally intermixed with the others. The greater part of the tail is bare both of hairs and spines, and covered only by flat blackish scales disposed in rings, the tip alone being surmounted by a tuft of long flat bristles having the form neither of hairs nor of quills, but bearing a close resemblance, as Buffon has aptly remarked, to narrow slips of parchment cut in an irregular manner. This tuft is of a whitish colour, and about two inches in length. The entire length of the body in our specimen is little more than a foot, and that of the tail from four to five inches. The whiskers are very long; the eyes small and black; and the ears short, round, and naked."

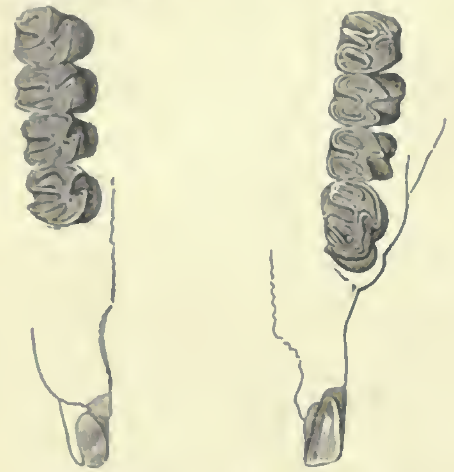
The author last quoted states that, like the rest of its tribe, this species sleeps during the day, and becomes in some degree active only on the approach of night. Its intelligence, he adds, is equally limited, and its manners equally fretful with those of the common species, like which, "it raises its spines when irritated or disturbed, stamps with its feet upon the floor of its cage, and swells and looks big in its defensive armour."

It is found in the Celebes Islands (Seba); Asia (Linn.); Malay Peninsula (Buffon); Isles of the Indian Archipelago (Pennant); Sumatra (Sir Stamford Raffles); Fernando Po (Vidal).

Erethizon (F. Cuvier).—Cranium flat; muzzle short and not convex; tail moderate; quills short and half hidden in the hair.

E. dorsatum; *Hystrix dorsata*, Linn. Ears short, hid in the fur; head, body, legs, and upper part of the tail covered with soft, long, dark-brown hair; on the upper part of the head, back, body, and tail, numbers of sharp strong quills, the longest on the back, the least towards the head and sides, the longest three inches, but all hid in the hair; intermixed are some stiff straggling hairs, three inches longer than the rest, tipped with dirty-white; under side of the tail white; four toes on the fore feet, five behind, each armed with long claws, hollowed on their under side; the form of the body is exactly that of a beaver, but is not half the size. One which Mr. Banks brought from Newfoundland was about the size of a hare, but more compactly made; the tail about six inches long. (Pennant.)

The following is from F. Cuvier's figure of the teeth of *Erethizon*, *Synœtheres*, and *Sphiggurus*.



Teeth of *Erethizon*, &c. F. Cuvier.

These animals vary in intensity of colour. Pennant alludes to one entirely white in the possession of Sir Ashton Lever.

This is the *Cavia Hudsonis*, Klein; *Hystrix Hudsonius*, Brisson; *H. pilosus*, Catesby; *H. dorsata*, Linnæus; L'Urson, Buffon; Canada Porcupine, Forster, Pennant, and others; Cawquaw of the Cree Indians; and Ooketook of the Esquimaux.

The Canada Porcupine is a sluggish animal. Hearne says that the Indians going with packets from fort to fort, often see them in the trees, but not having occasion for them at the time, leave them till their return, and should their absence be a week or ten days, they are sure to find the porcupines within a mile of the place where they had before seen them. Mr. Hutchins states that, in walking, the tail is drawn along the snow, making a deep track, which is often the means of betraying the animal; but that its haunts are most readily discovered by the barked trees on which it has fed, which if barked the same winter, are sure signs of their vicinity. They are, he says, usually found on the branches, and, on approaching them, they make a crying noise like a child. Then the tree is cut down, and the animal killed by a blow on the nose. Sir John Richardson informs us that this species is found on the banks of the Mackenzie, as high as lat. 67°, and that, according to American writers, it ranges as far south as lat. 37°. He adds, that it is said to be very rare in Virginia, but to be numerous in some parts of Kentucky; and that it is reported to have multiplied greatly, of late years, near Oneida Lake in the state of New York. (Cozzens.) Sir John Richardson further states that in the Fur Countries it is most numerous in sandy districts covered with the *Pinus Banksiana*, on the bark of which it delights to feed; that it also eats the bark of the larch and spruce firs, and the buds of various kinds of willow; and that, in the more southern districts, it is said to feed chiefly on the bark and leaves of the *Pinus Canadensis* and *Tilia glabra*, and to be fond of sweet apples and young maize, which it eats in a sitting posture, holding the food to its mouth with the fore-paws. "It is," continues Sir John, "readily attacked by the Indian dogs, and soon killed, but not without injury to its assailants, for its quills, which it erects when attacked, are rough, with minute teeth directed backwards, that have the effect of rendering this seemingly weak and flexible weapon a very dangerous one. Their points, which are pretty sharp, have no sooner insinuated themselves into the skin of an assailant, than they gradually bury themselves, and travel onwards until they cause death by wounding some vital organ. These spines, which are detached from the porcupine by the slightest touch, and probably by the will of the animal, soon fill the mouths of the dogs which worry it, and unless the Indian women carefully pick them out, seldom fail to kill them. Wolves occasionally die from the same cause. The Canada Porcupine makes its retreat amongst the roots of an old tree, and is said to pass much of its time in sleeping. When disturbed, it makes a whining or mewing noise. It pairs in the latter end of September, and brings forth two young ones in April or May. Its flesh, which tastes like flabby pork, is relished by the Indians, but is soon nauseated by Europeans. The bones are often deeply tinged with a greenish-yellow colour. Like other animals which feed on coarse vegetable substances, it is much infested by intestinal worms. The quills or spines are dyed of various bright colours by the native women, and worked into shot-pouches, belts, shoes, and other ornamental articles of dress." ('Fauna Boreali-Americana.')

Synœtheres (F. Cuvier).—Muzzle large and short; head convex in front; spines short; tail very long, naked at the end, and prehensile, like that of an Opossum (Sarigue) or of a Sapajou; feet with only four toes, armed with claws.

S. prehensilis; Hystrix prehensilis, Linn. Nose short and blunt; long white whiskers; beneath the nose a bed of small spines; top of the head, back, sides, and base of the tail, covered with spines; the longest on the lower part of the back and tail, 3 inches in length, very sharp, white, barred near their points with black; adhere closely to the skin, which is quite naked between them; are shorter and weaker as they approach the belly; on the breast, belly, and lower part of the legs are converted into dark-brown bristles; feet divided into four toes; claws very long; on the place of the thumb a great protuberance; tail 18 inches long, slender, and taper towards the end; the last 10 inches almost naked, having only a few hairs on it; has, for that length, a strong prehensile quality. (Pennant.)

This appears to be the Cuandu (major) of Marcgrave and Piso; Orico Cachero and Espinho of the Portuguese; Hoitzlacuatzin of Hernandez (?); the Brazilian Porcupine of authors.

The Brazilian Porcupine appears very much to resemble the Canada Porcupine in its habits, living in woods, sleeping by day, and feeding on fruits, &c. by night. Marcgrave states that its voice is like that of a sow. The quills are stated to have the same penetrating and destructive quality as those of the Canadian species. It is a sluggish animal, climbing trees very slowly, and holding on with its prehensile tail, especially in its descent. It grows very fat, and the flesh is said to be white and well-tasted. Our cut is taken from a living specimen in the Gardens of the Zoological Society, Regent's Park.

Brazilian Porcupine (*Synœtheres prehensilis*).

The genus *Sphiggurus* appears to be founded on the Coui of Azara.

Fossil Hystricidæ.—Cuvier ('Ossemens Fossiles,' vol. v. part 2, p. 518) states that Mr. Pentland found in the Val d'Arno, near San Giovanni, in the same sandy beds which contain so many bones of large quadrupeds, a molar tooth exactly resembling that of a great porcupine, but which appeared to be fossil. Remains of Porcupines have been found by Messrs. Falconer and Cautley in the Sewalik Hills.

HYSTRIX. [HYSTRICIDÆ.]

I

IANTHINA. [JANTHINIDÆ.]

IBACUS. [SCYLLARIANS.]

IBALIA. [GALLICOLÆ.]

IBE'RIS, a genus of Plants belonging to the natural order *Cruciferæ.* It consists of annual, perennial, and slightly shrubby species, chiefly inhabiting Europe, and particularly the northern shores of the Mediterranean Sea. It has the pouch ovate or roundish notched; valves boat-shaped, winged at the back; seeds one in each cell; petals unequal, two outer ones largest; filaments simple. Two are found in the north of Europe, one of which, *I. amara*, is British. The species are remarkable, among other things, for their flowers growing in close corymbs, and being much more developed on one side than the other, next the circumference of the corymb. This irregularity, connected with either a pure white or a rich purple of varying tints, gives the plants a strikingly beautiful appearance; and hence they are in many cases cultivated in gardens as objects of ornament, under the name of Candy-Tuft, in allusion doubtless to their having been first procured from Candia. *I. sempervirens* and *I. Gibraltarica* are particularly well-suited for beautifying rock-work.

IBERITE, a Mineral, allied to *Gigantholite.* [GIGANTHOLITE.]

IBEX. [CAPREÆ.]

IBIS. [ABOU-HANNES; TANTALIDÆ.]

IBLA. [CIRRIPEDIA.]

IBYCTER. [FALCONIDÆ.]

ICELAND-MOSS. [CETRARIA.]

ICELAND-SPAR. [CALCAREOUS SPAR.]

ICE-PLANT. [MESEMBRYANTHEMUM.]

ICE-SPAR. Transparent Crystals of *Felspar, Anorthite,* and *Ryacolite* are called by this name.

ICHNEUMON. [HERPESTES.]

ICHNEUMON, a genus of Insects belonging to the order *Hymenoptera*, section *Terebrantia*, and family *Pupivora*, in the arrangement of Latreille. The genus, as defined by Linnæus, included such pupivorous *Hymenoptera* as are furnished with veined wings (the anterior pair presenting in their disc several complete or closed cells), filiform or setaceous vibratile antennæ composed of a great number of articulations, and an ovipositor of various length and complicated structure. The Linnæan genus now constitutes a group including a great many well-marked genera and an immense assemblage of species. All these are remarkable for the habits of their larvæ, which are parasitic in the bodies of other insects. These bodies the perfect Ichneumons perforate by means of their ovipositors, and there lay their eggs. This destructive habit gave rise to the name by which they are known; a comparison being drawn between them and the Egyptian Ichneumon (*Herpestes Ichneumon*) [HERPESTES], the quadruped celebrated as the destroyer of serpents and crocodiles.

The history of these insects has attracted much attention among naturalists, and many elaborate memoirs have been written upon them. The purpose they serve in the economy of nature has been well described by Kirby and Spence: "The great body of the ichneumon tribe is principally employed in keeping within their proper limits the infinite host of lepidopterous larvæ, destroying, however, many insects of other orders. Such is the activity and address of the *Ichneumonidæ* that scarcely any concealment, except perhaps the waters, can secure their prey from them; and neither bulk, courage, nor ferocity avail to terrify them from effecting their purpose. They attack the ruthless spider in his toils; they discover the retreat of the little bee that for safety bores into timber, and though its enemy ichneumon cannot enter its cell, by means of her long ovipositor she reaches the helpless grub, which its parent vainly thought secured from every foe, and deposits in it an egg which produces a larva that destroys it. In vain does the destructive *Cecidomya* of the wheat conceal its larvæ within the glumes that so closely cover the grain; three species of these minute benefactors of our race, sent in mercy by Heaven, know how to introduce their eggs into them, thus preventing the mischief they would otherwise occasion, and saving mankind from the horrors of famine. In vain also the *Cynips*, by its magic touch, produces the curious excrescences on various trees and plants, called galls, for the nutriment and defence of its progeny; the parasite species attached to it discovers its secret chamber, pierces its wall, however thick, and commits the destroying egg to its offspring. Even the clover weevil is not safe within the legumen of that plant; nor the wireworm in the earth from their ichneumonidian foes." ('Introduction to Entomology,' vol. i. p. 267.)

The development of these parasites within the bodies of other insects was for a long time a source of much speculation among early philosophers, who fancied that occasionally one animal had the power of becoming transformed into another. The eggs of the genus *Ophion* are of a singular form, being somewhat bean-shaped and attached near one end to a long slender and curved peduncle, by which they are attached to the body of the victim. The larva itself, when hatched, retains this position, and thus lives upon the juices of the insect it attacks. The larvæ which reside like intestinal worms within the bodies of caterpillars, as the Microgastere, which infest the caterpillars of the white butterfly, carefully avoid touching the vital organs of the creature they inhabit, living only upon the fatty matter until they attain their full size and are ready to assume the pupa state, when they pierce the skin of the caterpillar (which soon dies), spin for themselves cocoons beneath its body, and undergo their transformations. The larvæ of the majority of these insects spin a silken cocoon, in which they undergo the pupa state. In some cases this is rendered unnecessary by their peculiar habits, as for instance, the *Aphidii*, which undergo their transformations within the indurated skin of the *Aphis*, of which they have devoured the interior.

The perfect insects are found flying amongst trees and plants, and especially frequenting the heads of umbelliferous flowers, whence they derive a great portion of their nourishment. Some species whose females are furnished with a very long ovipositor are found on the trunks of trees, stumps of wood, &c., evidently searching for wood-eating larvæ, in which they deposit their eggs; whereas those which have short ovipositors, seek external-feeding larvæ for the same purpose. When taken in the fingers they immediately disengage their terebra from the sheath and attempt to sting, causing a slight irritation for the moment, but so trifling is it that it is evident no very powerful poison can be introduced into the wound. They fly very rapidly. M. Wesmael has described a remarkable gynandromorphous specimen, having the head and thorax with the organs attached thereto of the female sex, while the abdomen and its appendages are masculine. In the last Linnæan edition of the 'Systema Naturæ,' 77 species were described as belonging to the genus *Ichneumon.*

Modern naturalists have elevated the genus *Ichneumon* into a family *Ichneumonidæ*, which is again divided into two sub-families *Genuinæ* and *Adscitæ.* The former comprises the largest species of the family, and is not only distinguished by having two recurrent nerves, but also by having the nerve which separates the first cubital or submarginal cell from the external discoidal cell, either entirely or nearly obliterated, whereby these two cells become confluent. No genuine *Ichneumon* has yet been described in which this structure does not exist. Moreover the second cubital or submarginal cell (the area specularis of Fallen) is very greatly reduced in size, being sometimes petiolated, but often entirely obsolete. It is in this minute area, or in the space which it should typically occupy, that the second recurrent nerve is inserted. M. Wesmael also adds the existence of an articulation between the second and third dorsal segments of the abdomen.

Amongst the *Ichneumonidæ* may be noticed the genera—*Pimpla*, in which the ovipositor and its sheathe are often greatly elongated, being in some exotic species 3 or 4 inches long; *Ophion*, having the abdomen greatly compressed and sabreshaped; *Euceros* and *Joppa* having the antennæ dilated in the middle (of the former genus males only have been observed); and *Hellwigia*, having the antennæ strongly clavate at the extremity in both sexes. The interesting genus *Agriotypus* is remarkable for its long curved petiole to the abdomen, spotted wings, and spined scutellum; the radial cell is short, whence, as well as in the form of the abdomen, it appeared to Latreille to form the connecting link between the *Ichneumonidæ* and *Proctotrupidæ.* Its palpi and the cubital cell of the fore wings however evidently prove its affinity with the true *Ichneumonidæ;* although Mr. Halliday, on account of the want of articulation between the second and third dorsal segments of the abdomen, has formed it into a distinct family; but this latter character is proved by such genera as *Chelonus, Sigalphus*, &c., to be but of secondary importance amongst the *Ichneumonidæ.*

Ichneumonides Adsciti, or *Braconidæ*, are characterised by having only one recurrent nerve, which unites with the nerve almost always present, extending between the first cubital and externo-discoidal cells; the second submarginal cell being often as large as the preceding, and not receiving a recurrent nerve; and the non-existence of articulation between the second and third dorsal segments of the abdomen.

In *Agathis* and some *Microdi* and *Microctoni* the nerve between the first cubital and externo-discoidal cell is obliterated, as in the genuine *Ichneumon.* M. Wesmael divides this sub-family as follows:—

* *Endodontes.* — Having the teeth of the mandibles directed inwardly; the mandibles meeting together when shut. Divisible into—

1. *Polymorphi.*—Clypeus entire; abdomen 6-7-jointed; posterior part of the vertex convex, second submarginal cell (when present) large.

2. *Cryptogastri.*—Clypeus entire, posterior part of the vertex convex; abdomen dorsally presenting not more than two transverse sections; second submarginal cell (when present) large.

3. *Areolarii.*—Clypeus entire; vertex more or less emarginate behind; abdomen 6-7-jointed; second submarginal cell (when present) very small.

4. *Cyclostomi.*—Clypeus deeply notched, leaving a circular aperture between it and the jaws; abdomen generally 6-7-jointed; second submarginal cell (when present) large.

** *Exodontes.*—Having the teeth of the mandibles directed outwards, the mandibles when closed not touching each other. Mr. Haliday adds as a distinct sub-family the *Aphidii* and allied genera, which have the articulation between the second and third abdominal segments flexible. Mr. Westwood however regards them as a group equivalent with Wesmael's other sections, and which it might perhaps be more natural to arrange either before or after the *Polymorphi*, with which they are united by Wesmael.

The habits of the *I. Adsciti*, or *Braconides*, present no broad distinction from the rest of the family. Many of the genera present peculiarities of structure, as for instance the coalition of the dorsal segments of the abdomen in *Chelonus*, *Sigalphus*, *Rhitigaster*, and the gaping mandibles of *Alysia*; the rostrated front of *Agathis*, and the existence of a stigma on the front margin of the posterior wings of the males in *Heterospilus* and *Hecabolus*.

(Westwood, *Introduction to the Modern Classification of Insects.*)

ICHNOCARPUS (from ἴχνος, a footstep, vestige, and κάρπος, a fruit, in reference to the slender follicles), a genus of Plants belonging to the natural order *Apocynaceæ*. It has a salver-shaped corolla, 5-cleft calyx, and inclosed stamens; sagittate anthers, free from the stigma. The species are climbing shrubs with opposite leaves; the flowers in branched terminal panicles, white, and inodorous.

I. frutescens has a twining stem, oblong-lanceolate leaves tapering to both ends, axillary peduncles very long and racemose. It is a native of Ceylon and Nepaul. The flowers are small and purple; the leaves deep green above and pale beneath. According to Dr. Royle, it is sometimes used in India as a substitute for sarsaparilla, and it is also mentioned by Afzelius in his 'Remedia Guinensia,' as a medicinal plant.

I. fragrans has oblong lanceolate leaves tapering to both ends, and axillary trichotomous spreading peduncles. It is a native of Nepaul, and has large handsome flowers.

I. Afzelii is a glabrous shrub with twining stems, oval acute leaves at the base, oblong or lanceolate as they approach the top. The corollas are white and sweet-scented. It is a native of Sierra Leone, and about the river Bascha, in woods and among bushes.

I. Loureirii has a frutescent stem, ovate oblong leaves, lateral 3-flowered peduncles. It is a native of Zanzibar. All the species of *Ichnocarpus* grow well in a mixture of loam, peat, and sand, and cuttings strike readily in sand under a hand-glass.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica.*)

ICHTHYOLOGY. The branch of science which comprehends a knowledge of the structure, nature, and forms of Fishes is thus called. The general structure and classification of Fishes is treated of in this work under the head of FISH, and all the more important and British genera will be found under their generic names, or the families to which they belong, as AMMODYTES; CORYPHÆNA; CLUPEIDÆ; SQUALIDÆ.

ICHTHYOPHTHALMITE. [APOPHYLLITE.]

ICHTHYOSAURUS, literally Fish-Lizard (Ἰχθύς: Σαῦρος), the generic name given by Mr. König to the extinct fossil animal noticed by the late Sir Everard Home, under the appellation of *Proteosaurus*, and by Wagler under the name of *Gryphus*.

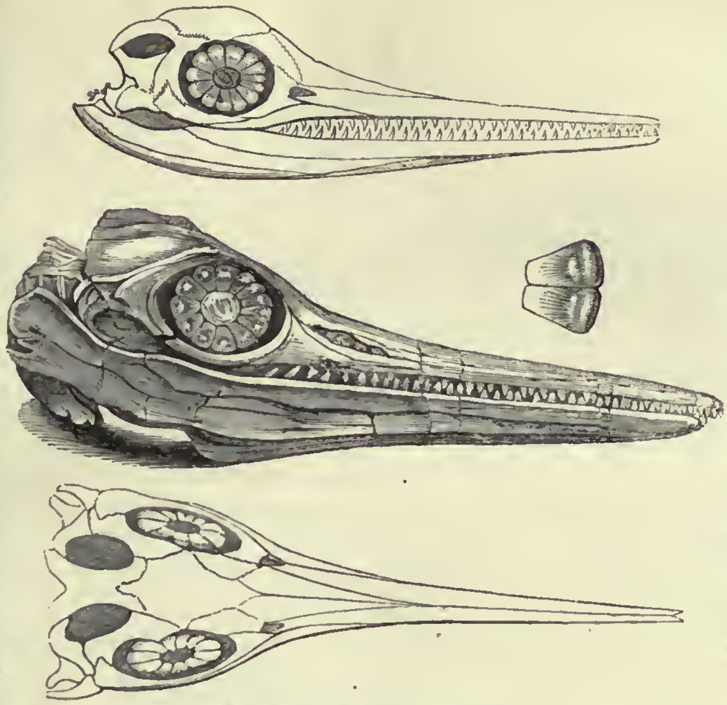
We are indebted to Sir Henry De la Beche and the Rev. W. D. Conybeare principally for pointing out and illustrating the structure of this extraordinary creature; and that at a time when the materials were far more scanty than they are at the present day. Dr. Jäger, Mr. Hawkins, Dr. Buckland, Sir Philip de Malpas Grey Egerton, and Professor Owen, have all contributed to throw light on the organisation of a being that has long ceased to exist; and the anatomy and animal economy of this tyrant of the seas of former ages is now nearly as well known as that of the porpoise which revels in the ocean that washes the shores of our existing continents and islands. We ought also to add that we are deeply indebted for an early knowledge of the remains of this creature to the indefatigable exertions of a lady—Miss Anning, of Lyme Regis, who diligently collected the first remains of the bones of the *Ichthyosaurus* from the cliffs of Lyme Regis.

"If," writes Dr. Buckland, in his 'Bridgewater Treatise,' "we examine these creatures with a view to their capabilities of locomotion, and the means of offence and defence which their extraordinary structure afforded to them, we shall find combinations of form and mechanical contrivances which are now dispersed through various classes and orders of existing animals, but are no longer united in the same genus. Thus, in the same individual, the snout of a porpoise is combined with the teeth of a crocodile, the head of a lizard with the vertebræ of a fish, and the sternum of an *Ornithorhynchus* with the paddles of a whale. The general outline of an *Ichthyosaurus* must have most nearly resembled the modern porpoise and grampus. It had four broad feet or paddles, and terminated behind in a long and powerful tail. Some of the largest of these reptiles must have exceeded thirty feet in length." We shall now endeavour to give a sketch of the organisation of these Enaliosaurians.

The osteology of the head agrees in many points with that of the crocodile, but the orbit of the eye is much larger, and the nostril is not, as in that genus, placed near the point of the snout, but near the anterior angle of the orbit, as in some other lizards. The teeth, which in some cases amount to a hundred and eighty, are not incased in deep and distinct sockets as in the crocodiles, though the rudiments of an alveolar separation may be traced in the small ridges between the teeth running along the furrow of the maxillary bone in which they are set. The succession of teeth is managed much after the same manner as that which obtains in the crocodiles [CROCODILIDÆ], the young tooth budding up at the base of the old tooth, where, as it grows, its lateral pressure sets the absorbents at work; the base of the old tooth is thus partially removed, and, as the new tooth advances, is finally displaced to make room for its more efficient successor. The elongated jaws in which these instruments of destruction are arranged are made up, as in many of the crocodiles and the other lizards, of many thin bony plates, so as to produce a union of lightness, elasticity, and strength. "It is obvious," says Dr. Buckland, in the interesting work above quoted, "that an under jaw so slender and so much elongated as that of a Crocodile or *Ichthyosaurus*, and employed in seizing and retaining the large and powerful animals which formed their prey, would have been comparatively weak and liable to fracture if composed of a single bone. Each side of the lower jaw was therefore made up of six separate pieces, set together in a manner which will be best understood by a reference to the figures. This contrivance in the lower jaw to combine the greatest elasticity and strength with the smallest weight of materials, is similar to that adopted in binding together several parallel plates of elastic wood or steel to make a crossbow; and also in setting together thin plates of steel in the springs of carriages. As in the carriage-spring or compound-bow, so also in the compound-jaw of the *Ichthyosaurus*, the plates are most numerous and strong at the parts where the greatest strength is required to be exerted; and are thinner and fewer towards the extremities, where the service to be performed is less severe. Those who have witnessed the shock given to the head of a crocodile by the act of snapping together its thin long jaws, must have seen how liable to fracture the lower jaw would be were it composed of one bone only on each side: a similar inconvenience would have attended the same simplicity of structure in the jaw of the *Ichthyosaurus*. In each case therefore the splicing and bracing together of six thin flat bones of unequal length and of varying thickness, on both sides of the lower jaw, affords a compensation for the weakness and risk of fracture that would otherwise have attended the elongation of the snout. Mr. Conybeare points out a further beautiful contrivance in the lower jaw of the *Ichthyosaurus*, analogous to the cross-bracings lately introduced in naval architecture."

Hitherto the structure of the skeleton of the *Ichthyosaurus* is, as we have seen, sauroid; but we now come to a part of its bony frame, and a very principal part, which is formed on the ichthyoid or fishy type. The vertebral column, consisting of more than one hundred vertebræ, each of which is hollow and fashioned after the manner of those of fishes, to facilitate the progress of the animal through the watery medium in which it existed, is constructed for a swimming, not a walking animal; and the sauroid type is here departed from in favour of a conformation demanded by the habits of the animal. A peculiarity in this part of the structure is noticed by Sir E. Home, the annular part of the vertebra being neither consolidated with its body, as in quadrupeds, nor connected by a suture, as in crocodiles; but remaining always distinct, and articulating by a peculiar joint, resembling a compressed oval ball-and-socket joint. Mr. Conybeare observes, in addition, that this mode of articulation co-operates with the cup-shaped form of the intervertebral joints in giving flexibility to the vertebral column, and assisting its vibratory motions; for had these parts been consolidated, as in quadrupeds, their articulating processes must have locked the whole column together, so as to render such a motion of its parts impossible; but by means of this joint every part yields to that motion. (Buckland, 'Bridgewater Treatise.')

Sir Philip Egerton, in his paper 'On Certain Peculiarities in the Cervical Vertebræ of the Ichthyosaurus, hitherto unnoticed' ('Geol. Trans.,' 1836), has demonstrated that the first and second cervical vertebræ (in some species at least) are anchylosed; and he further notices a very remarkable feature which at once distinguishes these vertebræ from the other bones of the spinal column. He shows that on the under surface of each bone there exists an unusual enlargement in the form of a solid wedge-shaped process, placed transversely to the smaller diameter of the vertebræ. By this arrangement four triangular planes are produced. "The first and largest is based upon the lower anterior margin of the atlantal socket, having its apex directed downwards and backwards until it meets the apex of a similarly-shaped though smaller plane proceeding downwards and forwards from the posterior margin of the atlas. The third, of like shape and size with the second, extends from the anterior margin of the axis, and joins the apex of the fourth, which inclines forwards from the posterior portion of the same bone. This fourth plane is considerably smaller than the others, and corresponds in size with a fifth, placed on the anterior border of the third cervical vertebra. When therefore the three anterior vertebræ are in their natural position the arrangement of the five planes is as follows:—the first and largest occupies the lower front of the atlas; the second and



Head and Sclerotic Plates of *Ichthyosaurus*.

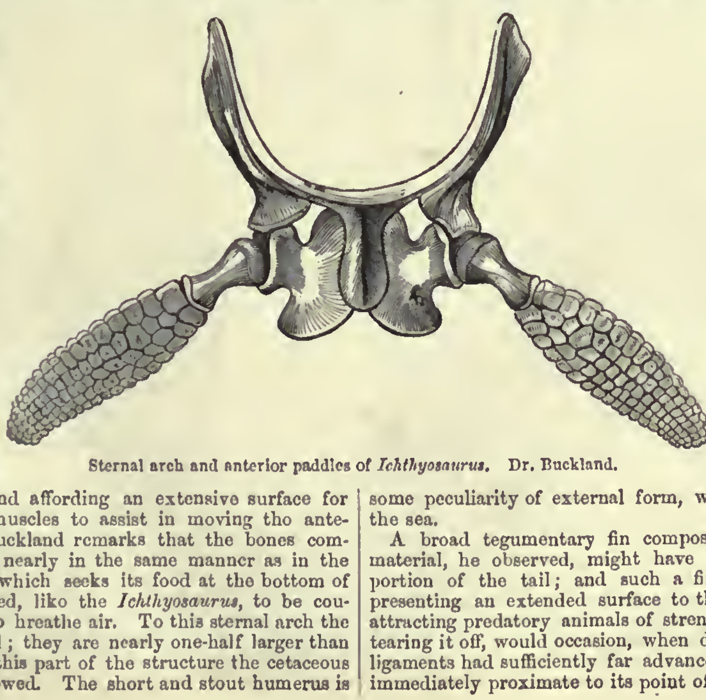
third, by the union of their bases, produce a triangular socket on the under surface of the atlas and axis; and a second smaller socket is formed between the axis and the third vertebra by a similar disposition of the fourth and fifth planes." Sir Philip adds that the second bone of the series is frequently found with the atlas and axis, and is not uncommonly fixed in its position by anchylosis. The third bone he states to be of rare occurrence, in consequence of its diminutive size, and he thinks that in some species it is probably altogether wanting. He designates these bones as Subvertebral Wedge-Bones. The reader will find in the same interesting memoir many valuable observations on the structure and articulation of the cervical vertebræ, the combined result of which, and of the reduction of the intervertebral cavities, must, as Sir Philip remarks, have been a considerable increase of power in this part of the spinal column; and he further states that, proceeding from the lumbar vertebræ towards the head, the column attains its minimum diameter about the fifth cervical vertebra, from which point to the occiput it increases in size very rapidly.

The ribs appear to be constructed more upon the sauroid type, for they are continuous along the vertebral column from the head to

Lower jaw of *Ichthyosaurus*. Dr. Buckland.

the pelvis; they are slender and mostly bifurcated at the end, and many of them are united in front across the chest. Intermediate bones, analogous to the sternal and intermediate costal cartilages in the crocodiles and the sterno-costal arcs in *Plesiosaurus*, united the ribs of the right side to those of the left. Dr. Buckland is of opinion that this structure was probably subservient to the purpose of introducing into their bodies an unusual quantity of air, the animal being by these means enabled to remain long beneath the water without rising to the surface for the purpose of breathing.

In the sternum we find a combination of bones admirably adapted for resistance. Of this part of the bony framework Mr. Conybeare says,—"The form of the sternal arch and the broad surfaces of the clavicles is such as to impart great strength to the chest, enabling the animal to breast the most disturbed waters, and affording an extensive surface for the attachment of powerful muscles to assist in moving the anterior extremities;" and Dr. Buckland remarks that the bones composing this arch are combined nearly in the same manner as in the *Ornithorhynchus* of Australia, which seeks its food at the bottom of lakes and rivers, and is obliged, like the *Ichthyosaurus*, to be continually rising to the surface to breathe air. To this sternal arch the anterior paddles are articulated; they are nearly one-half larger than the posterior paddles, and in this part of the structure the cetaceous type appears to have been followed. The short and stout humerus is followed by the bones of the fore arm; and these are succeeded by numerous regularly-disposed polygonal bones, exceeding, in some species, the number of one hundred, which form the paddle or fin. In form these bones differ both from the phalanges of lizards and whales.



Sternal arch and anterior paddles of *Ichthyosaurus*. Dr. Buckland.

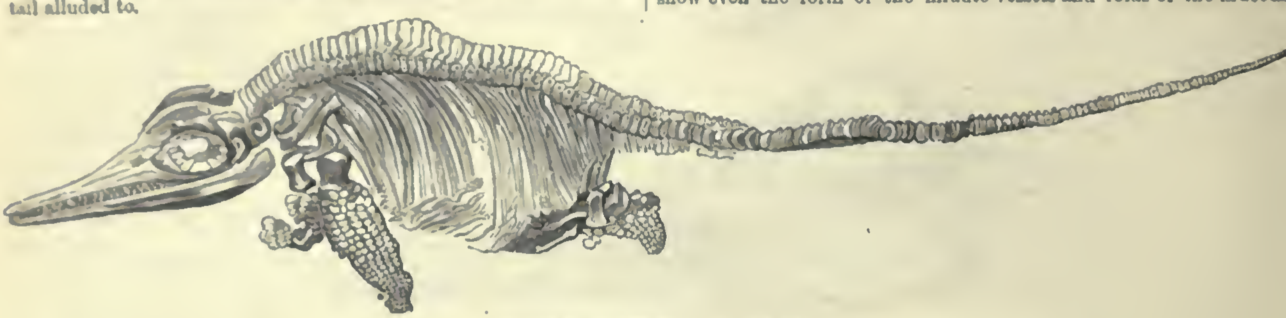
The bones of the pelvis closely resemble those of the crocodile, and, as Sir H. De la Beche and Mr. Conybeare observe, the femoral bone and posterior paddle are altogether analogous to the humerus and anterior paddle; but, contrary to the development of the posterior extremities of quadrupeds in general, they are very considerably smaller, nearly in the proportion of one to two.

Dr. Buckland, with reference to the posterior extremities, or paddles, observes, that these are wanting in the Cetaceans, and that they possibly compensate for the absence of the flat horizontal tail with which those animals are furnished. In a paper, 'On the Dislocation of the Tail, at a certain Point, in the Skeletons of many Ichthyosauri,' read by Professor Owen, before the Geological Society of London, the author commenced his observations by referring to the skeleton of the existing *Cetacea*, and pointing out how slight is the indication afforded by the caudal vertebræ of the large terminal fin, which forms in that class so important an organ of locomotion; and the improbability that its presence would have been suspected had the *Cetacea* been known only by their fossil remains, in consequence of the fin having consisted entirely of decomposable and unossified material.

He stated that the depressed flattened shape of the terminal vertebræ, which gives the only indication of the horizontal fin (and which character is not present in all the *Cetacea*), is not recognisable in the skeletons of the *Ichthyosauri* and *Plesiosauri*; but he proceeds to describe a condition of the tail in the skeletons of the *Ichthyosauri* which, he conceives, affords an indication of a structure in the extinct animal analogous to the tegumentary fin of the *Cetacea*, and which has not been suspected by the authors of the conjecturally-restored figures of the *Ichthyosauri* already published. The condition alluded to is described as an abrupt bend of the tail, about one-third of its whole length distant from the end, and at the 30th caudal vertebra in the *Ichthyosaurus communis*; the broken portion continuing beyond the dislocation as straight as in the part which precedes it. As there is no appearance of a modification of structure in the dislocated vertebræ, indicative of the tail having possessed more mobility at that point than at any other, and as the dislocation has taken place at the same point in seven specimens examined by the author, he conceives that it must be due to some cause operating in a peculiar manner on the dead carcass of the *Ichthyosaurus*, in consequence of some peculiarity of external form, while it floated on the surface of the sea.

A broad tegumentary fin composed of dense but decomposable material, he observed, might have been attached to the terminal portion of the tail; and such a fin either by its weight, or by presenting an extended surface to the beating of the waves, or by attracting predatory animals of strength sufficient to tug at, without tearing it off, would occasion, when decomposition of the connecting ligaments had sufficiently far advanced, a dislocation of the vertebræ immediately proximate to its point of attachment. The two portions of the tail, with the rest of the skeleton, would continue to be held together by the dense exterior integument, until the rupture of the parietes of the abdomen at some yielding point had set free the gases generated by putrefaction; and the skeleton, having undergone certain partial dislocations, from the decomposition of the more yielding ligaments, would subside to the bottom, and become imbedded in the sedimentary deposits, exhibiting the fracture of the tail alluded to.

Treatise' (pl. 14), which shows a large mass of fish scales, chiefly referrible to the *Pholidophorus limbatus*, intermingled with coprolites throughout the entire region of the ribs, and in the more matured coprolites themselves. Dr. Buckland, to whom we are indebted for the history of these curious bodies, says, speaking of the intestinal canal of the *Ichthyosauri*:—"Besides the spiral structure and consequent shortness of the small intestine, we have additional evidence to show even the form of the minute vessels and folds of the mucous



Ichthyosaurus communis. Dr. Buckland.

With respect to the relative position of this conjectured caudal tegumentary fin of the *Ichthyosaurus*, Professor Owen could not perceive any indication of its horizontality in the forms of the vertebræ which he supposes to have supported it; and he regards the superaddition of posterior paddles in these air-breathing marine animals as a compensation for the absence of that form of fin which is so essential in the *Cetacea*, for the purpose of bringing the head to the surface of the sea to inhale the air. On the other hand a vertical caudal fin seems especially required by the short-necked and stiff-necked *Ichthyosauri*, in order to produce with sufficient rapidity the lateral movements of the head, which were needed by those predatory inhabitants of the ancient deep; while in the *Plesiosaurus* such a fin would be unnecessary, in consequence of the length and mobility of the neck; and Professor Owen concluded by stating, that in those skeletons of *Plesiosauri* in which the tail is perfect it is straight, and presents no indication of the partial fracture or bend which is so common in the tails of *Ichthyosauri*.

Figures of the tails of five specimens of *Ichthyosauri*, belonging to the species *I. communis*, *I. tenuirostris*, and *I. intermedius*, accompanied the paper.

Professor Owen has since ascertained that the terminal caudal vertebræ of the *Ichthyosaurus* are compressed or flattened from side to side in a remarkable degree; a circumstance, he observes, confirming the accuracy of the conjecture of the verticality of the caudal fin, and the best proof perhaps of its actual presence in the living animal.

That the *Ichthyosauri* enjoyed the sense of smelling in a considerable degree can hardly be doubted from the structure and position of the nostrils, nor is there any reason for supposing that they were not gifted with the sense of taste; but their power of vision must have been great, and indeed Dr. Buckland justly speaks of the enormous magnitude of the eye as very much exceeding that of any living animal, and as being the most extraordinary feature of the head. He alludes to a skull of *Ichthyosaurus platyodon* in the collection of Mr. Johnson at Bristol, and remarks that in this specimen the longer diameter of the orbital cavity measures fourteen inches. The eye has, as Mr. Conybeare remarks, its sclerotica composed of a bony or rather scaly substance, subdivided into thirteen plates, as will be seen in the cut (cols. 201, 202), where two of these plates are represented separately. Mr. Conybeare, in the passage to which we have referred, goes on to state that he had then before him the eye of a middle-sized lizard from Germany, which has a structure exactly similar, excepting that the plates were more numerous: this, he states, was pointed out to him by the late Mr. Miller; and he adds that the Chameleon and *Iguana* have similar osseous laminæ, as has the Tortoise, but that in this latter animal they form, as in birds, the anterior disc. This conformation was highly important to the adjustment of an organ whose functions were demanded both above and below the surface of the water. [BIRDS.] The sense of hearing appears to have been sufficiently developed, and that of touch was probably about upon a par with the sensations of the modern cetaceans.

An enormous expansion of the jaws, which were so constructed as to bear the shock of the most violent collision, and were furnished with a constant succession of teeth, formed an organ of seizure well fitted to the voracity of an animal that not only preyed upon fishes and other marine animals, but, like the ravenous pike of our fresh-waters, fed upon its own congeners and even species. The prey was transmitted into a stomach, which must have been nearly co-extensive with the cavity of the body, and the contents were thence made to pass through an intestinal canal which appears to have resembled, as Dr. Buckland observes, the spiral intestines of some of the swiftest and most voracious of our modern fishes.

The evidence upon which this assertion is made is to be found in various specimens, like that in the Oxford Museum, from the lias at Lyme Regis, and figured by Dr. Buckland in his 'Bridgewater

membrane by which it was lined. This evidence consists in a series of vascular impressions and corrugations on the surface of the coprolite, which it could only have received during its passage through the windings of this flat tube. If we attempt to discover a final cause for these curious provisions in the bowels of the extinct reptile inhabitants of the seas of a former world, we shall find it to be the same that explains the existence of a similar structure in the modern voracious tribes of sharks and dog-fishes. As the peculiar voracity of all these animals required the stomach to be both large and long, there would remain but little space for the smaller viscera; these are therefore reduced, as we have seen, nearly to the state of a flattened tube, coiled like a corkscrew around itself; their bulk is thus materially diminished, whilst the amount of absorbing surface remains almost the same as if they had been circular. Had a large expansion of intestines been superadded to the enormous stomach and lungs of the *Ichthyosaurus*, the consequent enlargement of the body would have diminished the power of progressive motion, to the great detriment of an animal which depended on its speed for the capture of its prey. The above facts, which we have elicited from the coprolitic remains of the *Ichthyosauri*, afford a new and curious contribution to our knowledge both of the anatomy and habits of the extinct inhabitants of our planet. We have found evidence which enables us to point out the existence of beneficial arrangements and compensations even in those perishable yet important parts which formed their organs of digestion. We have ascertained the nature of their food and the form and structure of their intestinal canal; and have traced the digestive organs through three distinct stages of descent, from a large and long stomach, through the spiral coils of a compressed ileum, to their termination in a cloaca, from which the coprolites descended into the mud of the nascent lias. In this lias they have been interred during countless ages, until summoned from its deep recesses by the labours of the geologist to give evidence of events that passed at the bottom of the ancient seas in ages long preceding the existence of man." ('Bridgewater Treatise.')

Coprolite of *Ichthyosaurus.* Dr. Buckland.

a, Magnified scale of *Pholidophorus limbatus* imbedded therein (internal view); *b*, external view of the same.

The external integument appears to have been a simple naked skin unprotected by any defence; it probably resembled in some degree the dermal covering of the cetaceans.

The structure of these reptiles have been sometimes referred to as supporting the doctrine of the transmutation of species, and these animals have been regarded as transitionary forms from the Fish to the Reptile. Professor Owen thus refers to this opinion, in his 'Report on British Fossil Reptiles,' made to the British Association in 1839 and 1840 :—

"The nearest approximation to the organisation of fishes is made by the *Ichthyosaurus*, an extinct genus which appears to have been introduced into the ancient seas subsequent to the deposition of the strata inclosing the remains of the thecodont lizards. The ichthyic characters of this genus of marine Saurians are not of a very important kind, being limited, like modifications of the mammalian type in whales, to a relationship with locomotion in water, while all the modifications of the skeleton which are connected with the respiratory, digestive, or generative functions, are conformable with the highest or Saurian type of reptiles—such as the cranial anatomy (the large size of the intermaxillary bones excepted), the dental structure, which corresponds with that of the posterior teeth in alligators; the articulation of the neurapophyses to the bodies of the vertebræ; the complicated pectoral arch; the sternum, and complete abdominal cincture of ribs, &c. The circle of numerous imbricated sclerotic bones reaches its maximum of development in the *Ichthyosaurus*; but this is an exaggeration of a structure feebly shadowed forth in some existing Saurians, and more strongly shown in birds, rather than a repetition of the simple bony sclerotic cup in fishes. By no known forms of fossil animals can we diminish the wide interval which divides the most sauroid of fishes from an *Ichthyosaurus*. This most extraordinary reptile is a singular compound in which ichthyic, cetacean, and ornithic characters are engrafted upon an essentially Saurian type of structure. The *Ichthyosaurus* is therefore just such a form of animal as might be expected, were specific forms unstable, to demonstrate a mutation of characters or some tendency towards a progressive development into a higher and more consistent type of organisation; nor is the field for testing the transmutation theory less ample than the subject is favourable. We have the opportunity of tracing the *Ichthyosauri*, generation after generation, through the whole of the immense series of strata which intervene between the new red-sandstone and the tertiary deposits. Not only however is the generic type strictly adhered to, but the very species which made its first abrupt appearance in the lowest of the oolitic series maintains its characters unchanged and recognisable in the highest of the secondary strata. In the chalk formations, for example, the genus *Ichthyosaurus* quits the stage of existence as suddenly as it entered it in the lias, and with every appreciable osteological character unchanged.

"In the different species of the *Ichthyosaurus* founded upon minor modifications of the skeleton, several appear contemporaneously in the strata where the genus is first introduced; and those which remain the longest manifest as little change of specific as of generic characters. There is no evidence whatever that one species has succeeded or been the result of the transmutation of a former species. The tenuirostral *Ichthyosaurus* existed at the same time, and under the same external influences, as the stronger and shorter-jawed *Ichthyosaurus communis*; just as the tenuirostral *Delphinus Gangeticus* co-exists at present with the short-jawed porpoise.

"If the relative periods of existence of the different Enaliosaurian reptiles were not well ascertained, and room were allowed for conjecture as to their successive appearance on this planet, it would be as easy as seductive to speculate on the metamorphoses by which their organic framework, influenced by varying conditions during a lapse of ages, might have been gradually modified, so as to have successively developed itself from an Ichthyosaur to a Plesiosaur, and thence to a Crocodile.

"We may readily conceive, for example, the fish-like characters of the vertebral column of the *Ichthyosaurus* to have been obliterated by a filling up of the intervertebral cavities through ossification of the intermediate elastic tissue, and the Plesiosaurian type of vertebra to be thus acquired. The normal digits of the fin might be supposed to become strengthened and elongated by more frequent reptation on dry land, and thus to cause an atrophy of the supernumerary fingers; phalanges of a more saurian figure might have been produced by the confluence of a certain number of digital ossicles; the head might be shortened by a stunted growth of the intermaxillary bone, and thus be reduced to Plesiosaurian proportions. The teeth might become more firmly fixed by the shooting of bony walls across their interspaces, as in the young Crocodiles.

"If we now elongate the bodies of the vertebræ, reduce some twenty pairs of anterior ribs to hachet-bones, place the fore paddles at a corresponding distance from the head, and the hind paddles proportionately nearer the tail, little more will be required to complete the transmutation of the Ichthyosaur into the Plesiosaur. If next, in adaptation to a gradual change of surrounding circumstances, the jaws of the Plesiosaur become lengthened to the proportions of those of the Tenuirostral Ichthyosaur, but at the expense of the maxillary instead of the intermaxillary bones, preserving the socketed implantation of the teeth; if, to balance the elongation of the jaws the neck at the same time shrank to nearly its former Ichthyosaurian proportions, with some slight modification of the Plesiosaurian type of the vertebræ; if a further development and a more complete separation of the digits of the fore and hind members were to take place, so that they might serve for creeping as well as swimming; if the exposure of the surface to two different media, and of the entire animal to perils of land as well as of sea, were to be followed by the ossification of certain parts of the skin, and the acquisition by this change of a dermal armour—such we might conceive to be the leading steps in the transmutation of the Plesiosaur into the Teleosaur.

"And if the three forms of extinct Saurians, whose changes of specific and generic characters have thus been speculated on, had actually succeeded each other in strata successively superimposed in the order in which they have here been hypothetically derived from one another, some colour of probability might attach itself to this hypothesis, and there would be ground for searching more closely into the anatomical and physiological possibilities of such transmutations. *Ichthyosaurus*, *Plesiosaurus*, and *Teleosaurus* are however genera which appear contemporaneously on the stage of vital existence: one neither preceded nor came after the other. How the transmutation theory is to be reconciled to these facts is not obvious; nor to these other, viz., that the Teleosaur ceases with oolite, while the Ichthyosaur and Plesiosaur continue to coexist to the deposition of the chalk, and disappear together alike unchanged; the Ichthyosaur manifesting as little tendency to develop itself into a Plesiosaur, as this to degrade itself into the more fish-like modification of the Enaliosaurian type."

One of the finest collections of the remains of these animals existing is that in the British Museum. Altogether "there are about thirty very fine specimens, including the most interesting of the separate crania, paddles, vertebral columns, &c., besides a great number of isolated bones, parts of skulls and jaws, coprolites, and other remains of *Ichthyosauri*." (Mantell.)

The following are the species of this genus which have been at present made out:—

I. tenuirostris (Conybeare). It is characterised by the great length and slenderness of the jaws, which resemble in this respect the maxillary organs of the Gavial, or *Teleosaurus*. The length of the mouth is produced by the elongation of the intermaxillary bones and of the dentary bones of the lower jaw. The malar bone is remarkably long and slender. The cranium is flat, and the orbits are very large. The teeth slender, 60 to 90 on each side the upper jaw, and 60 on each ramus of the lower jaw. The anterior extremities, or paddles, are much larger than the posterior pair, and very strong and massive. The shafts of the humerus and femur are relatively long, and their distal ends broad. This species attains a length of 13 or 14 feet; the largest teeth are an inch and a half in length. It was named by Mr. Hawkins *I. chirostrongulostinus* (Round-Boned-Paddle Fish-Lizard). It is figured in his remarkable work on these creatures.

I. intermedius (Conybeare). The teeth are more acutely conical than in *I. communis*, and the striæ less prominent, but are less slender than in the preceding species. The maxillary portion of the skull is relatively shorter, and converges more regularly to the front than in *I. communis*, and the teeth are longer, more slender, and numerous. This species has been the most commonly found, and ranges throughout the Lias formation of England. There are two specimens in the British Museum, one 7 feet in length, the other 6 feet.

I. longipennis. The species thus named in the British Museum is from the Lias of Whitby in Yorkshire. Dr. Mantell says that he is not aware of any description of this species.

I. communis (Conybeare). The skull is wide behind, and rapidly contracts to the base of the jaws, which are prolonged and sub-compressed. The teeth are relatively large, round, conical, and longitudinally furrowed, the base being expanded and deeply grooved, 40 to 50 on each side the upper jaw, and 25 to 30 in each ramus of the lower jaw. The anterior paddles are three times longer than the posterior pair, and are proportionately broader, and contain a greater number of ossicles than in other species. This character induced Mr. Hawkins to call it *I. chiropolyostinus* (Many-Boned-Paddle Fish-Lizard). There are 8 metacarpal bones and 212 ossicles. The humerus is relatively shorter and stouter than in any other species. It has 17 sclerotic plates to the eye. This is one of the larger species of the genus, as some of the specimens indicate a length of 14 feet. It is supposed this species had a large tegumentary caudal fin, which is rendered probable by the laterally compressed form of the terminal caudal vertebræ, as first ascertained by Sir Philip Egerton.

I. platyodon (Conybeare). This is the largest of the species, and specimens have been procured 30 feet in length. The orbit in some specimens is 1 foot in diameter, and the teeth $2\frac{1}{2}$ inches in length. The teeth are distinguished by the form of the crown, which is conical and subcompressed, and has a sharp ridge on each side; the base is not grooved as in the teeth of *I. communis*. This character of the teeth suggested the specific name. The dental formula is $\frac{45-45}{40-40}$. The vertebræ are about 120 in number. The anterior and posterior paddles are equal in size. This structure induced Mr. Hawkins to name this species *I. chiroligostinus* (Few-Boned-Paddle Fish-Lizard). The humerus is short in proportion to its breadth. The femur is proportionately larger than in other species.

I. lonchiodon (Owen). The teeth are more slender in proportion to their length than in the other species. Their base is cylindrical and regularly fluted; the transverse section of the crown is nearly circular, not compressed. The paddle is relatively less than in the last species.

A specimen of this species in the British Museum measures 15 feet in length, and was obtained by Miss Anning at Lyme Regis. The great interest of this fossil consists in the fact that the parts of the os hyoides are in a state of preservation.

I. longirostris. A specimen from Whitby is about 6 feet in length. It has a remarkably slender and elongated muzzle. It is not otherwise in a well-preserved condition, and Dr. Mantell says that it is not figured or described.

I. latifrons (König). It is characterised by the great breadth of the fore part of the cranium and the large size of the parietal foramen. The periphery of the vertebræ is flatter than in those of other species. The upper portion of the circle of sclerotic plates remains in the orbit in the specimen in the Museum.

With regard to the geological distribution of these animals, they abound throughout the Lias and Oolitic Formations. The chief repository has been hitherto considered to be in the Lias at Lyme Regis, but, as Dr. Buckland states, they abound along the whole extent of this formation throughout England, from the coasts of Dorset, through Somerset and Leicestershire, to the coast of Yorkshire. The Lias of Germany and France contains them. "The range of the genus *Ichthyosaurus*," says Dr. Buckland, "seems to have begun with the Muschelkalk, and to have extended through the whole of the Oolitic period into the Cretaceous Formation. The most recent stratum in which any remains of this genus have yet been found is the Chalk Marl at Dover, where they have been discovered by Dr. Mantell: I have found them in the Gault near Benson, Oxon." ('Bridgewater Treatise.')

ICHTHYOSIA'GONES (Rüppel), one of the many names (as *Aptychus*, Von Mayer; *Solenites* and *Tellinites*, Schlotheim; *Trigonellites*, Parkinson; *Lefadites*, Germar) which have been given to the pair of shelly bodies found in many of the Oolitic Rocks, and not unfrequently in the mouths of *Ammonites* at Solenhofen, so as to prove their connection with the animal which inhabited that shell. By Ruppell and Voltz they were conceived to form an operculum. The two valves meet on a strait toothless hinge-line, their free edges forming the remaining two sides of a triangle rounded at its apex. The substance of the shell is transversely fibrous; its inner surface concentrically striated with lines of growth. (Parkinson, *Org. Rem.*, pl. xiii. fis. 9, 10, 12.)

I'CICA, a genus of Plants belonging to the natural order *Burseraceæ*. It has a small obtusely 5-toothed calyx; 5 petals inserted under the disc, recurved, sessile, valvate; 10 stamens shorter than the petals inserted with them; a cup-shaped disc with 10 crenatures at the margin; a sessile 5-celled ovary with two collateral pendulous ovules in each cell; a very short style; a 5-angled stigma; a globose obtuse 1-3-celled drupe with thick and fleshy dissepiments; resinous seeds without albumen. The species are shrubs or trees with unequally pinnate leaves, and white flowers seated on panicled racemes which are terminal or axillary.

I. heterophylla has ternate or pinnate leaves, with stalked, ovate, acuminated, entire, simply-veined leaflets; the racemes simple, rather shorter than the leaves. This plant is the *I. Aracouchini* of Aublet. It is a tree 50 feet in height, growing in Guyana, on the banks of the river Conron, where it is called by the natives Aracouchini. When an incision is made in the bark of this tree a yellow balsamic aromatic fluid exudes, which retains its fluidity a long time after exposure to the air. This fluid is used by the Guyanese as an application to wounds. A resin is found also in the seeds, and the natives of Guyana carry the nuts about with them on account of the scent they give out. These nuts they often send as presents to their friends. The Caribs also use the exudation for mixing with oil, with which they anoint their bodies.

I. heptaphylla has 5-7-stalked oblong acuminated leaflets, with the racemes few-flowered, somewhat corymbose, and six times shorter than the petiole. It is a small tree, a native of the woods of Guyana, where it is called Arbre d'Encens. The whole plant is sweet-scented, and like the last species yields a clear balsamic fluid when it is wounded. It is burned as a perfume, and used as a remedy in dysentery. The seeds are contained in a viscid pulp which hardens into a gray resin, and is used by the natives for burning as a perfume. The Carib name of this tree is Arouaou.

There are several species of *Icica*, all of which yield the same transparent fluid, resembling turpentine in many of its properties. *I. Icicariba*, a native of Brazil, yields a resin, which is brought into the market under the name of Gum Elemi, but is not the true gum of that name. *I. decandra* is found in the woods of Guyana, where it is called Chipa. The fluid which exudes from it yields on evaporation a resin. *I. altissima* grows in Guyana. There are two varieties of this tree, known by the name of White Cedar and Red Cedar. The latter is a very durable wood, and is used for making household furniture, boats, canoes, &c.

(Don, *Dichlamydeous Plants*; Burnett, *Outlines of Botany*; Lindley, *Flora Medica*.)

ICOSA'NDRIA, one of the classes in the sexual system of Botany invented by Linnæus. The name literally means 20 stamens, but it was only applied by Linnæus to plants having an indefinite number of stamens inserted into the calyx.

ICTERIA. [MERULIDÆ.]
ICTERUS. [STURNIDÆ.]

I'CTIDES, a name given by M. Valenciennes to the Benturongs, a genus of Plantigrade *Mammalia*, which F. Cuvier had previously referred to the genus *Paradoxurus*. It is the *Arctictis* of Temminck.

F. Cuvier, in his 'Dents des Mammifères,' states that he published, under the name of *Paradoxurus albifrons*, in the 9th volume of the 'Mémoires du Muséum,' the figure of an animal which had been sent to him from Calcutta by M. Alfred Duvaucel; and that he conjectured, from the external characters and the general physiognomy, that the animal which it represented belonged to the genus *Paradoxurus*. Having subsequently examined the teeth (an examination which he states he owed to M. Valenciennes, who had found the skin and the head of the animal in the cabinet of Brussels, and had obtained them through the complaisance of the director, M. Drapier), F. Cuvier states that there is much resemblance in the dentition to that of *Paradoxurus*. *Ictides* belongs, he thinks, to the family of Civets, which is characterised by a tubercular molar tooth in the lower jaw, and by two similar molars in the upper jaw; and he thinks that it is 'sans contredit' most approximated to *Paradoxurus*, though it approaches *Procyon* nearer than that genus, that is to say, the teeth of *Ictides* show an increase of thickness, and have become more tuberculous. He places it between the Civets, &c., and the Suricates.

Cuvier, who gives *Ictides* a position between *Ailurus* [PANDA] and the Coatis (*Nasua*), says that it still bears some resemblance to *Procyon* in its dentition; but he remarks that the last three molars of the upper jaw are much smaller and less tuberculous, and that this is especially true of the last of all in each jaw, which is very small and nearly simple.

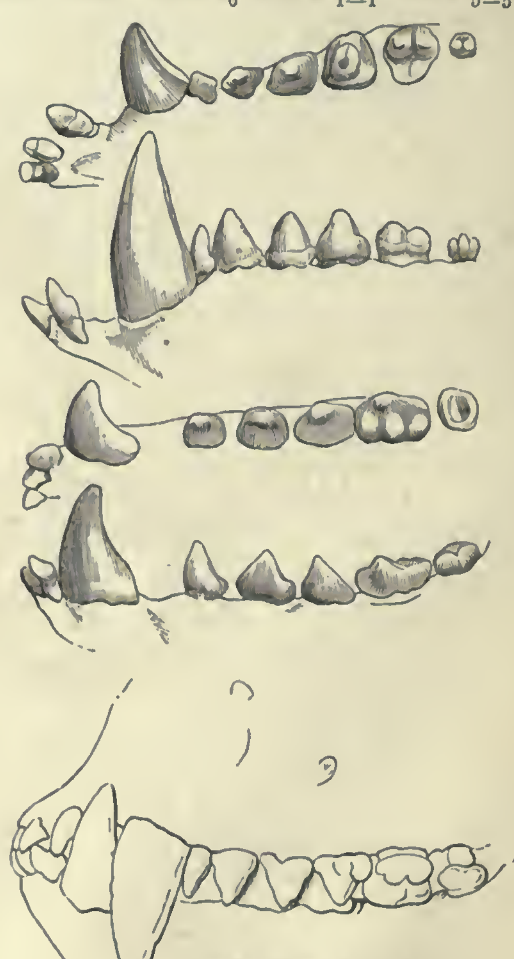
Dr. J. E. Gray gives *Arctictis* as a synonym of *Ictides*, in his subfamily *Viverrina*, the fourth of his family *Felidæ*.

M. Lesson thinks that the genus approaches nearer to *Procyon* than to *Paradoxurus*, but he arranges it between *Ailurus* and *Paradoxurus*.

Mr. Swainson, adopting Temminck's name, which, if it appeared first with a generic description, ought to be retained, makes the form the first genus of his family *Didelphidæ*, or Opossums, observing that it is not marsupial.

It has the following characters:—Head rather short, muzzle pointed; ears, which are small, tufted with long hairs; tail long, hairy, prehensile; feet with five toes on each foot.

Dental Formula:—Incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{5-5}{5-5} = 36$.



Teeth of *Ictides*. F. Cuvier.
One-sixth larger than nature.

The author of the 'Analytical Notice of Books' ('Zool, Journ.,' vol. ii.) says, when reviewing the 'Histoire Naturelle des Mammifères,' Nos. xli.-l., that between the Viverrine Family and that which is composed of the Racoons and Bears there had existed a considerable gap, which is now in a great measure filled up by the newly discovered forms, the Benturong and the Pauda. The external appearance, he remarks, of the *Ictides* corresponds in some degree with both that of the civets and racoons, having the plantigrade motion of the latter and the slender snout of the former. It is indeed completely plantigrade, and has on each foot five toes armed with strong compressed claws, apparently adapted for climbing. "Its tail, the thickness of which at its commencement is almost monstrous, is prehensile beneath, without being terminated by a naked skin, like that of *Ateles*, but resembling entirely the tail of the Sajous. The eye, like that of the domestic cat, has the pupil vertically elongated; the habits of the *Ictides* are consequently nocturnal. The ears are small and rounded; and the nostrils are surrounded by a muzzle, which is divided into two portions by a deep sulcus. The hairs are long and thick, and a peculiar character is given to the physiognomy by the moustaches, which are very voluminous on the lips, the eyes, and the cheeks, and by the pencil of long and numerous hairs which terminates the ears. The cry is intermediate between those of a cat and a dog." The species are found in India.

I. albifrons. Fur gay; hairs long, silky, black at the base, and white in their extreme third, shorter on the head and limbs; sides of the snout, forehead, pencils of the ears (which are edged with white), black; upper part of the snout and forehead white; iris yellow; belly gray, with shorter hairs than those on the upper parts of the body. Size, that of a very large domestic cat. In another specimen the sides of the snout, and the tail, its extremity excepted, were gray. It inhabits Bootan, Nepaul (Kâchar: though they occasionally occur in the central region of Nepaul. Hodgson).

Sir Thomas Stamford Raffles describes the gait of this Benturong as low and crouching, the body being long and heavy, and the legs short. The tail, thick at its insertion, gradually tapers to the extremity, where it curls upwards. In climbing trees the animal is assisted by this tail, which is strong. One that was kept alive many years by Major Farquhar partook both of animal and vegetable food. Slow in motion, and timid in disposition, the animal sleeps much during the day: the night is the season of its comparative activity. Two other species have been described.

ICTINIA. [FALCONIDÆ.]

IDALIA. [NUDIBRANCHIATA.]

IDE, a Fish. [LEUCISCUS.]

IDIA, Lamouroux's name for a genus of recent *Polyparia*, allied to *Sertularia* (Linn.).

IDMO'NEA, a genus of Animals belonging to the order *Polyzoa*, described by Lamouroux as closing the group *Milleporidæ*. It is ramose, the branches triquetral in section, celluliferous on two faces, cells prominent in transverse rows. One species, the *I. atlantica*, inhabits the British seas. Several have been found fossil in the Oolite and Calcaire Grossier. [POLYZOA.]

IDOCRASE, a Mineral, also called *Vesuvian*, *Pyramidal Garnet*, &c. This mineral occurs crystallised and massive; the crystals are either attached or imbedded. Primary form a square prism. Cleavage parallel to the primary planes, distinct, and less so parallel to the diagonals of the prism. Fracture uneven, slightly conchoidal, or rather undulated. Hardness 6·5. Scratches glass readily, and even quartz. Colour various shades of brown, black, gray, blue, green, and yellow. Streak white. Lustre vitreo-resinous, translucent, and transparent. Refraction double. Specific gravity 3·08 to 3·4. By the blowpipe it is fusible with ebullition into a yellowish transparent globule, and with borax gives a glass tinged green with oxide of iron.

The massive varieties are amorphous; the structure is fibrous, granular, or compact.

Idocrase is met with both in primitive and volcanic countries. It occurs in the masses ejected from Vesuvius: the crystals are sometimes of large dimensions.

It was found originally in the neighbourhood of Vesuvius, and since in many other parts of the world. Different varieties have been called by different names: thus, *Cyprine* is cupreous or blue Idocrase; *Loboite*, greenish-yellow; *Egeran*, found near Eger, in Bohemia, is of a liver-brown colour; *Xanthite*, found at Ainsty, New York. The following are analyses by Klaproth and De Kobell:—

	Klaproth.		De Kobell.
Silica	35·50	42·00	35
Alumina	33·00	16·25	22
Lime	22·25	34·00	36
Oxide of Iron	7·50	5·50	5
Oxide of Manganese	0·25	Trace.	
	98·50	97·75	98
	Vesuvius.	Siberia.	Mussa.

IDOTEA. [ISOPODA.]

IDRIALIN, a Mineral Resin of a grayish or brownish-black colour, with a grayish lustre, occurring in the Cinnabar mines of Idria.

IDYA, Oken's name for those Beröes which are formed after the manner of *Beröe ovata*. [ACALEPHÆ.]

IDYIA (Rafinesque), a genus of *Crustacea* to which Desmarest alludes, among other such genera, as knowing nothing of them beyond their names.

IERAX. [FALCONIDÆ.]

IEREA, the generic name of a fossil Polypifer from the blue clays of the Vaches Noires (Calvados), described by Lamouroux, who is doubtful of its affinities, but ranks it among his *Polyparia actinaria*. Broun places it among the *Siphoniæ*.

IGNATIA, a genus of Plants belonging to the natural order *Loganiaceæ*. One of the species of this genus, *I. amara*, yields the St. Ignatius's Beans of India, where, under the name of Papeeta, they are said to be a remedy for cholera. No proof has been afforded of their efficacy in this disease, and Dr. Lindley ('Vegetable Kingdom') says that convulsions and giddiness are known to follow their exhibition when given in an over-dose.

IGUANA. [IGUANIDÆ.]

IGUA'NIDÆ, an extensive family of Saurians, of which the genus *Iguana* may be considered the type. Messrs. Duméril and Bibron, in their 'Erpétologie' (1837), treat of these reptiles under the name of Lézards Iguaniens, ou Sauriens Eunotes. In 'the Catalogue' of the Specimens of Lizards in the British Museum,' the *Iguanidæ* with the *Agamidæ* [DRACONINA] constitute the tribe *Strobilosaura*.

Before giving the genera and species as arranged by Dr. J. E. Gray, we give a sketch of the organisation of the *Iguanidæ*.

The skull is always articulated by a single condyle situated below the great occipital foramen which opens a passage for the nervous chord. The configuration of the head presents great differences, dependent on the conformation of the bones of the cranium, the face, or jaws.

The number of cervical vertebræ is most frequently six, and this region is generally short, but it is strong. There are often articulated trachelian apophyses, which are in reality the rudiments of ribs. The dorsal vertebræ, meaning by that term the vertebræ which carry the ribs, vary much in number in the different genera. The first lumbar vertebræ are like the dorsal, except that they are without the articular facets which characterise the latter. Generally there are but two pelvic vertebræ, which carry the ileum or pelvis. The ribs are in general slender, weak, rounded, and of the same form, though they vary in their curvature, according as the trunk is cylindrical, depressed or compressed in the thoracic region. The first or anterior ribs are joined to the lateral parts of the sternum, or to a series of small bones which occupy the lower part of the breast; or they are united to each other on the mesial region nearly in the same manner as in the chameleons, for this disposition occurs in *Polychrus* and *Anolis*. In the Dragons the posterior ribs are free and prolonged in the thickness of the skin of the sides, in order to sustain the sort of parachute extended on the lateral parts of the body between the anterior and posterior limbs. All the species of the family have two pairs of limbs always apparent, and terminated by toes, the number of which varies but little. Their conformation and respective length have been used as generic characteristics principally in the case of *Anolis*, and some others which have offered some particularities, such as *Sitana*. The presence of a shoulder formed of two bones, and that of a pelvis, separates these Saurians from the Serpents.

The general form of the body and the disposition of the skeleton scarcely vary, except in the proportions of the different regions of the spinal column, especially in that of the tail and in the configuration of the vertebræ, the spinous and transverse processes of which correspond to the external state of compression or depression. In the greater number of species, as in those of *Lophyrus*, *Basiliscus*, *Polychrus*, and *Iguana*, the region of the back presents a well-defined projection, sustained by the series of spinous apophyses which often form that crest which has caused Messrs. Duméril and Bibron to name the family *Eunotes*. This disposition is most manifest in *Basiliscus* and *Agama*; whilst in *Stellio* and *Uromastix* the dorsal spines project but little. The bodies of the vertebræ which constitute the tail are much shorter in those species in which that part is not long, *Phrynocephalus* for instance, than in those which have it excessively prolonged. In these last, take *Iguana* and *Anolis* for example, there is another peculiarity, namely, that the bodies or central and cylindrical parts of the caudal vertebræ, which are large and dilated at their extremities for articulation, have, at the same time, the mesial portion more slender and fragile, so that it is in this portion that fracture often takes place, which is followed by a reproduction and consequent deformity which the tail often in that case presents. M. Rousseau (père) found in the skeletons of those Saurians which had undergone mutilation of the tail a long cartilaginous cone in lieu of distinct vertebræ; and Carus has remarked, that the spinal chord is not renewed in this cartilaginous stem, which is produced in lieu of the caudal vertebræ.

With regard to the senses, sight and hearing appear to be very well developed in this family; and taste seems to be present in a very fair degree, but not smell; touch moderate. The eyes of all the Iguanians are furnished with moveable lids; the orbit in which they are placed varies in its extent and in conformity with the limits which result from the bones of the face and cranium. The greater part have a superciliary arch, which is sometimes tuberculous and very projecting, as in *Ophryoessa* and *Hypsibates*. Messrs. Duméril and

Bibron state, that up to the time when they wrote they knew of no species in which observers had detected a linear pupil, though it is asserted that some are nocturnal. With the exception of some genera, *Otocryptis* and *Phrynocephalus* in particular, in which the tympanum is not apparent, all the Iguanians have an auditory canal, more or less enlarged at its external orifice on a level with the surface of the head; sometimes, as in some species of *Agama*, it is only a simple slit, the entrance of which is protected by some pointed and as it were spiny scales. The sense of smelling does not seem to be much developed in the Saurians generally, but in the family under consideration it appears to be at a very low rate, for there is no anfractuosity in the air-sinus; the external orifices of the nostrils have but little humidity, and are very small. They are situated generally near the extremity of the muzzle, and approach each other above; they open within the mouth by a simple slit to which the tongue may be applied, and seem principally, if not entirely, destined to aid in respiration.

The tongue is in general short, large, and mobile at its extremity; but it is not deeply divided at its end, which is free. The base is not retracted into a sheath, and this is a character which distinguishes it in particular from that of the Varanians and Chameleons. Wagler has employed the term *Pachyglossi* to denote this disposition. The organ is always humid, and covered with a glutinous secretion: its papillæ, which vary in form, being in some instances conical, and in others scaly, or laid like tiles (entuilées), in a direction from the front backwards, appear to be destined for the perception of sapid substances; but its principal office seems to be to direct the movement of the food submitted to the action of the teeth, and to assist in deglutition. The os hyoides, to which it is fastened, presents important modifications in different genera. Its horns are much prolonged in some species, and serve to support the dewlap, or longitudinal fold of the integuments under the neck and jaw, in *Sitana*, *Basiliscus*, *Draco*, &c., and especially in *Anolis*, as particularly noticed and demonstrated by Mr. T. Bell.

The organs of digestion present nothing very remarkable in this family. The stomach seems to be a continuation of the œsophagus, but the fibres and wrinkles are most often in another direction. There is no true cardia. The ventriculus, properly so called, is often conical, and the pylorus is not distinguishable except by a slight narrowing, which is rather elongated in *Stellio*, *Iguana*, &c. In *Polychrus*, *Galeotes*, and *Lyriocephalus*, the pylorus is but little marked, on account of its shortness and the thinness of its parietes. The intestines vary in length. In species which have the tail very long, as the Iguanas, the extent of the digestive tube is not much more than one-third of the total length of the spinal column. There is no apparent distinction, in some cases, evident between the small and large intestines, so that there is often no cœcum, as in *Cordylus*, *Agama*, and *Sitana*; whilst on the contrary in *Iguana*, *Galeotes*, and *Lyriocephalus*, there is a true cul-de-sac at the termination of the small intestine where it opens into the greater canal. The pancreas is voluminous in *Iguana*, *Istiurus*, and *Lyriocephalus*. The form and situation of the spleen vary. It is most frequently placed at the middle of the mesentery, under the stomach; sometimes on the right, as in *Iguana*; sometimes on the left, or at the middle of the lower portion of the stomach, as is observable in the greatest number.

The organs of circulation and respiration present no remarkable difference from those of other Saurians, and the same may be said of the organs of generation.

The integuments present various modifications. We have the polyedrous tubercles of *Grammatophorus*; the spines of the neck in *Agama*; those of the tail in *Doryphorus*, *Strobilurus*, *Stenocercus*, *Uromastix*, and *Trachycyclus*; the carinated scales of *Ophryoessa*, *Leiosaurus*, *Tropidogaster*, and *Ecphymotes*; the cutaneous expansions of the different regions of the dorsal and caudal crests in the greater number of genera, but especially in *Iguana*, *Istiurus*, and *Basiliscus*; those of the nape on the occiput in *Corythophanes* and *Basiliscus*; of the flanks in *Draco* and *Callisaurus*; and of the neck, under the form of a dewlap, in *Sitana*, *Draco*, and *Iguana*; or in the lateral parts in front of the shoulders, as in *Chlamydosaurus*. The pores, whether of the thighs, sometimes in a simple line, somtimes in two longitudinal and parallel rows, or in front of the anus, are employed by Messrs. Duméril and Bibron in the classification of genera in their synoptical table. The toes are in general elongated and terminated by crooked nails; *Anolis* alone presents a peculiar dilatation under the penultimate phalanges. The shorter the toes and the nails, the less nimble the animal.

Messrs. Duméril and Bibron state that in their anatomical researches they have found the ventriculus of many species filled with debris of vegetables, such as flowers, leaves, and seeds, in considerable quantity, which led them to the conclusion that many are herbivorous; but they remark that this is scarcely in accordance with the form of the teeth, none of which have tubercular crowns, nor composed of apparent enamel and osseous cement. It should however be remembered that the teeth of most of the species are by no means ill-adapted for cropping vegetable substances. The family are generally nimble. The compressed and lengthened tail of many species is most useful as an instrument of progression when swimming across the inundated savannahs, and their crooked nails assist them in climbing trees and pursuing the smaller animals on which they occasionally prey.

The *Iguanidæ* are all inhabitants of warm climates. Only one belongs to Europe, the Common Stellio, which is found also in Africa and Asia. Several inhabit Australia.

The genus *Iguana* is the type of this family. This name was given by Laurenti to a genus of Saurians, in which he included various forms, such as *Agama*, *Lophyrus*, *Calotes*, &c. Daudin separated from this heterogeneous collection *Agama*, *Draco*, and *Basiliscus*; and Wagler, striking out the word *Iguana* from his nomenclature, divided the genus *Iguana* as left by Daudin into the genera *Hypsilophus*, *Metopoceros*, and *Amblyrhynchus*. Messrs. Duméril and Bibron restore the name. The genus *Iguana*, as adopted by them, includes *Hypsilophus* and *Amblyrhynchus* of Wagler, and is thus characterised:—

A very large thin dewlap (fanon) under the neck. Cephalic plates polygonal, unequal in diameter, flat or carinated. A double row of small palatal teeth. Maxillary teeth with their edges finely dentilated. A crest on the back and tail. Toes long and unequal. A single row of femoral pores. Tail very long, slender, compressed, covered with small equal imbricated carinated scales.

Common Iguana (*Iguana tuberculata*).

They give the following description of the genus as thus modified:— The species composing this generic group are principally remarkable for the cutaneous prolongation which constitutes over the whole extent of the lower part of the head and neck a very deep and very thin dewlap or pouch, the free border of which describes a curved line, and is dentilated at the part nearest the chin. The skin is irregularly folded on the sides of this dewlap, behind which there is another transversal fold which is obliquely prolonged upon each shoulder. There are also cuticular folds on the lateral regions of the neck and trunk. The head of the Iguanas is moderately long, and has the form of a pyramid with four faces. The neck is slightly compressed. The upper part of the body is convex and rounded, the under part flattened. The limbs are long. The toes unequal, and sometimes denticulated on their edges; the five toes of the posterior feet are graduated; the third and the fourth of the hand are equal in length. The tail, which is very long and very slender, is flattened slightly from right to left from its origin. The top and sides of the head are protected by polygonal scales varying in size, among which some are convex, some flat, some carinated, and some even strongly tuberculous. The subocular regions however are only furnished with small angular roundish scales with a slightly convex surface. It is worthy of remark that the part of the skull which is situated between the orbits is protected by two longitudinal series of large angular plates, whilst in *Metopoceros* and *Cyclurus* this same part of the cranium is paved with small polygonal scales. A row of strong, angular, oblong, and often carinated scales adheres to the lower edge of the orbital circle. The lips are furnished with large scaly plates, which are ordinarily quadrangular. There is also on each branch of the lower jaw a row of large scales, the last of which is enormous in some cases, presenting a diameter the quadruple of that of the others. The scales which cover the upper part of the neck and the body are slightly imbricated. They are small, square, or lozenge-shaped, surmounted by a keel which does not divide them in the middle, but which extends from their infero-posterior angle to their supero-posterior angle. In stuffed individuals, the skin of which has been distended, there is around the scales of the upper part of the body a circle of small grains which recalls in a degree the mode in which the scaly covering of the Varanians is formed. The lower part of the neck is paved with scales, which are smooth and multifaced. There are rhomboidal and imbricated scales on the dewlap. On the other parts of the body are rhomboidal tile-like scales (entuilées), and those among them which are not carinated are found upon the thighs, the soles of the feet, and the under side of the toes. The inferior region of these is protected by a band of enlarged scutellations which are imbricated, and surmounted with three keels, of which the middle one is weak and the lateral ones very prominent. The upper part of each toe is covered by a single row of scales; but each side of the lateral parts of the anterior toes has two rows, whilst the external side of the posterior toes has three, making six rows of scales on each anterior toe, and seven on each posterior toe. Besides being imbricated the scales of the tail form verticillations, or complete rings, which cease to be distinguishable when they reach towards the extremity.

All the Iguanas have femoral pores, the number of which varies according to the sex, as Messrs. Duméril and Bibron suppose; and they think that the number would in that case be less in the females than in the males. These pores, which are placed in a single row, are surrounded by small scales disposed as the petals of a flower are disposed round its disc.

The *Iguanæ* have the upper parts of the body surmounted by a paleaceous crest of some height, which is continuous from the nape to the extremity of the tail. This crest is composed of strongly compressed scales, which are pointed and sometimes curved backwards, gradually diminishing in height as the end of the tail is approached. The nostrils are situated on the sides of the muzzle, and very near the extremity; their aperture is large, and opened in the middle of a large scale, which forms a convex circle around them, and gives them a tubulous appearance. The tympanal membrane extended over the auditory opening is very large and circular.

The teeth of the *Iguanæ*, which have an especial interest on account of their resemblance to those of the extinct *Iguanodon* [IGUANODON], vary according to the ages of individuals; and Messrs. Duméril and Bibron state that they are assured that fewer exist in young subjects than in adult individuals. The first twelve or fourteen maxillary teeth, both above and below, are nearly rounded, pointed, and a little arched; all the others are narrow and compressed, with an angular summit, which is very finely dentilated on its edges. They are not, Dr. Buckland observes, lodged in distinct sockets, like the teeth of crocodiles, but fixed along the internal face of the dental bone, to which they adhere by one side of the bony substance of their root.

Teeth of *Iguana*. Dr. Buckland.

There is a double row of small teeth on each side of the vault of the palates.

The Iguanas are herbivorous, and indeed the structure of their teeth would lead to the conclusion that herbs formed their staple. Messrs. Duméril and Bibron never found anything but leaves and flowers in the stomachs of the individuals which they opened. Mr. Broderip saw a living *Iguana* about two feet long in a hothouse at Mr. Miller's nursery-gardens near Bristol. It had refused to eat insects and other kinds of animal food, until happening to be near some kidney-bean plants that were in the house for forcing, it began to eat their leaves, and was from that time forth supplied from these plants. Dr. Buckland, who quotes this, states, in addition, that in 1828 Sir Edward Belcher found in the island of Isabella swarms of Iguanas that appeared to be omnivorous; they fed voraciously on the eggs of birds and the intestines of fowls and insects. The Iguanas live a great deal in trees, and will take to the water, swimming with ease. Mr. Broderip saw an *Iguana* enter and cross a small pond in the Zoological Gardens at the Regent's Park. The fore feet were motionless during the passage of the animal across the water. Several specimens of these animals have from time to time been in the collection of the Zoological Society in Regent's Park.

The species of *Iguana* are found in Mexico, South America, and the Antilles. Some are considered as very delicate food.

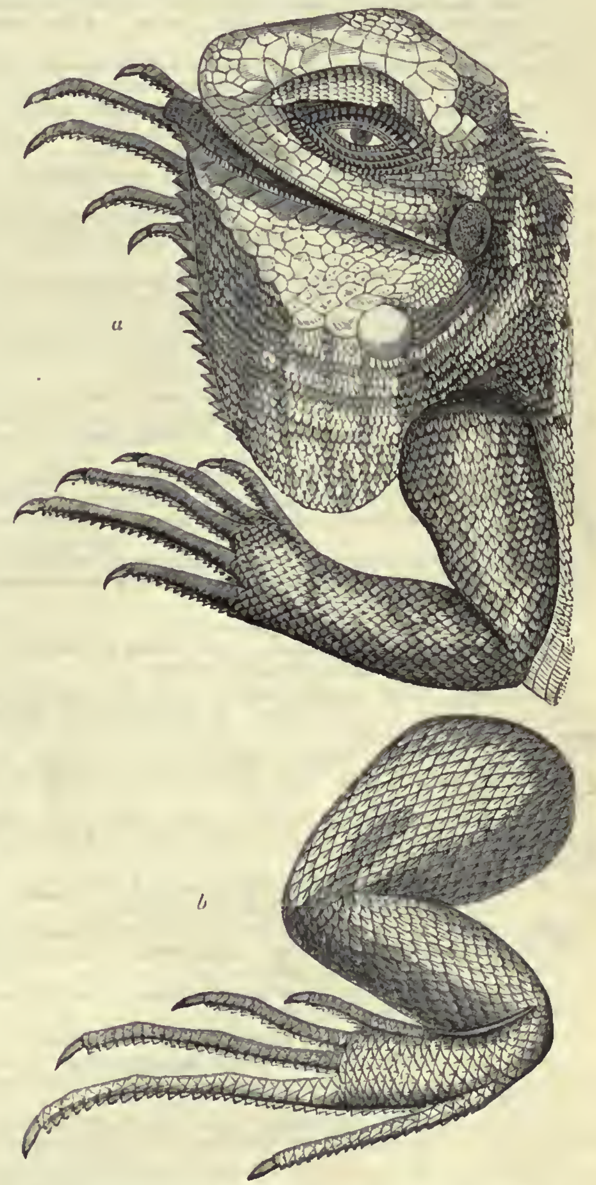
There are only three species admitted by Messrs. Duméril and Bibron:—

I. tuberculata is the Common Iguana. This species has been described by a great many names. Thus, Spix, in his work on the 'Reptiles of Brazil,' has, under the names of *I. squamosa*, *I. viridis*, *I. cærulea*, *I. emarginata*, and *I. Lophyroides*, represented *I. tuberculata* of Laurenti, L'Iguane Ordinaire d'Amerique of Cuvier, the Common Iguana, at five different epochs of its life.

The figures will give some idea of this animal, which is yellowish-green below, and above of a green more or less deep, becoming sometimes bluish, and at others of a slate colour. In general there are on the sides of the body brown stripes or zigzags edged with yellow. There is frequently a line of the latter colour traced obliquely on the front of the shoulder. Some individuals are sprinkled with brown; others have the limbs spotted with brown on a black ground. The tail is surrounded with large brown rings, which alternate with others of green or yellowish. Length seldom exceeding five feet.

It inhabits a great part of South America, and also the Antilles.

It is considered excellent for the table. *Delicatissima* and *sapidissima* are among the specific names that have been assigned to it. It is not however deemed very wholesome, and is even considered injurious to those who have suffered from certain diseases.



a, Head and anterior extremity of *Iguana tuberculata*, two-fifths of the natural size; *b*, hind foot, same size.

Wagler makes this species the type of his genus *Hypsilophus*.

We present a synopsis of the other genera and species of this family from the 'British Museum Catalogue:'—

I. Body compressed, covered with rings of squarish small often keeled scales. Perchers.

A. Nostril lateral, below the eye-ridge; toes slender, simple; back not crested; interparietal plate small.

a. Throat compressed, toothed in front; third and fourth toes nearly equal; eyes prominent.

1. *Polychrus.*—Femoral pores distinct; scales of back and sides equal. *P. marmoratus*, the Camaleao; Brazil and West Indies.

2. *Sphærops.*—Femoral pores none; scales of sides larger. *S. anomalus*, the Brazilian Chameleon.

3. *Urotrophus.*—Scales circular, smooth; tail-end revolute. *U. Vautieri.* Brazil.

4. *Ecphymotes.*—Scales rhombic, keeled; head 4-sided. *E. Fitzingerii*, Fitzinger's Ecphymotes; Brazil. *E. undulatus*, the Waved Ecphymote; Brazil. *E. obtusirostris*, the Blunt-Headed Ecphymote; Mexico. *E. acutirostris*, the Ecphymote; Brazil.

5. *Læmanctus.*—Scales rhombic, keeled; head dilated and rounded behind. *L. longipes*, the Long-Legged Læmanctus; Mexico.

B. Nostril lateral; toes simple or fringed; back crested; interparietal plate small.

a. Femoral pores distinct.

* Throat-pouch large, compressed; tail compressed.

6. *Iguana.*—Scales of back moderate; throat-pouch toothed in front. *I. tuberculata*, the Common Iguana; West Indies. *I. rhinolophus*, the Rhinoceros Iguana; St. Christopher's, West Indies. *I. delicatissima*, the Naked-Necked Iguana; Tropical America.

7. *Aloponotus.*—Scales of back very minute; throat-pouch simple in front. *A. Ricardi*, Aloponotus; St. Domingo.

** Throat rather dilatable, with a cross-fold behind; middle hind toes toothed on the outside.

† Tail compressed with uniform keeled scales.

8. *Brachylophus.*—Head-shields flat; femoral pores 1-rowed. *B. fasciatus*, the Banded Brachylophe; South America.

9. *Metapoceros.*—Head-shields flat; central frontal with a horn; femoral pores 2-rowed. *M. cornutus*, the Horned Iguana; St. Domingo.

10. *Trachycephalus.*—Head-shields convex; hinder outer toe short. *T. subcristatus*, the Rough Head; Charles Island, Galapagos.

11. *Oreocephalus.*—Head-shields conical, very rugose; the outer hinder toe elongate. *O. cristatus*, the Marine Oreocephalus; Galapagos.

†† Tail with rings of spinose scales.

12. *Cyclura.*—Head-shields small, with 2 rows of large shields on the muzzle; tail compressed. *C. M'Leayii*, M'Leay's Cyclure; Cuba. *C. nubila*, the Clouded Cyclure; Mexico. *C. Collii*, Colly's Cyclure; Jamaica.

13. *Ctenosaura.*—Head- and muzzle-shields small, uniform; tail roundish, crested. *C. acanthura*, Shaw's Ctenosaure; California, West Indies, Tropical America. *C. pectinata*, Weigmann's Ctenosaure; Mexico.

14. *Enyaliosaurus.*—Head- and muzzle-shields small, uniform; tail depressed, with 5 longitudinal spinose ridges. *E. quinquecarinatus*, the Armed-Lizard; Demerara.

b. Femoral pores none.

* Hinder toes fringed on the side, outer webbed at the base; throat with a cross-fold behind.

15. *Basiliscus.*—Head elongate, with an erect crest behind; the back and tail with a fin-like crest. *B. Americanus*, the Basilisc; Tropical America, Guyana.

16. *Corythæolus.*—Head elongate, with a low compressed crest behind; back and tail with a low toothed crest. *C. vittatus*, the Corythæole; Honduras.

17. *Thysanodactylus.*—Head short, with a low toothed crest, convex behind; back and tail with a low toothed crest. *T. bilineatus*, the Edged-Toe; South America.

** Toes all slender, simple, or slightly serrated on the sides; outer hind toes quite free; head short.

† Occiput compressed and produced behind; throat-pouch compressed.

18. *Corythophanes.*—Nape crested; throat-pouch toothed in front. *C. cristata*, the Corythophane; Mexico.

19. *Chamæleopsis.*—Nape not crested; throat-pouch simple. *C. Hernandesii*, the Qualtapalcalt; Mexico.

†† Occiput convex; throat with a cross-fold behind.

20. *Enyalius.*—Tail round, not crested; toes all simple. *E. rhombifer*, the Lozenge-Marked Enyalius; South America. *E. bilineatus*, the Two Streaked Enyalius; Brazil.

21. *Ophryoessa.*—Tail compressed; hinder toes slightly serrated on the outer edge. *O. superciliosa*, the Eye-Browed Ophryoessa; America.

C. Nostril superior, above the eye-ridge, subapical; toes dilated under the last joint but one, very unequal, and united together at the base; throat-pouch distinct, largely dilatable; femorial pores none; head sub-shielded; interparietal distinct.

a. Scales of belly granular.

22. *Chamæleolis.*—Back and tail with a bony crest; toes dilated. *C. Fernandina*, the Cuban Chamæleolis; Cuba.

b. Scales of the belly imbricated, flat.

23. *Xiphosurus.*—Toes dilated; tail with a bony crest. *X. velifer*, the Crested Anolis. *X. Ricordii*, Ricord's Anolis; St. Domingo. *X. cristatellus*, the Smaller-Crested Anolis; West Indies.

24. *Dactyloa.*—Toes dilated; back and tail with a crest of compressed scales. *D. equestris*, the Equestrian Anolis; Cuba. *D. Edwardsii*, Edwards's Anolis; Jamaica.

25. *Rhinosaurus.*—Toes dilated; back with a slight fold formed of two series of small scales; rostral plate horizontal; nose produced. *R. gracilis*, the Sharp-Nosed Anolis; Bahia.

26. *Anolius.*—Toes dilated; back simple, or with a slight crest formed of two series of small scales; rostral erect; nose rounded. *A. Leachii*, the Large-Cheeked Anolis; South America and West Indies. *A. occipitalis*, the Occipital Anolis; West Indies. *A. lineatus*, the Lined Anolis; Martinique. *A. Cepedii*, the Alligator Anolis; West Indies. *A. marmoratus*, the Marbled Anolis; Martinique. *A. porcatus*, the Ridge-Nosed Anolis; Cuba. *A. principalis*, the Carolina Anolis; North America. *A. flavescens*, the Yellowish Anolis; North America. *A. Richardii*, Richard's Anolis. *A. punctatus*, the Dotted Anolis; Brazil. *A. nebulosus*, the Clouded Anolis; Cuba and Texas. *A. lineatopus*, the Lineated Anolis. *A. maculatus*, the Spotted Anolis; West Indies. *A. pulchellus*, the Beautiful Anolis; Martinique. *A. vermiculatus*, the Vermiculated Anolis; Cuba. *A. stenodactylus*, the Slender-Toed Anolis; Jamaica. *A. reticulatus*, the Netted Anolis; Tropical America. *A. fusco-auratus*, the Chilian Anolis; Chili. *A. æneus*, the Bronzed Anolis; Tropical America. *A. lucius*, the Pike-Headed Anolis; Cuba. *A. Goudotii*, Goudot's Anolis; Martinique. *A. punctatus*, the Green Anolis; Brazil. *A. bullaris*, the Red-Throated Anolis; Martinique. *A. Valencienii*, Valencienne's Anolis.

27. *Acantholis.*—Toes dilated; back simple, with scattered tubercles. *A. Loysiana*, the Acantholis; Cuba.

28. *Draconura.*—Toes scarcely dilated; back simple; tail round. *D. nitens*, the Shining Draconure; Surinam. *D. chrysolepis*, the Golden Draconure; West Indies.

29. *Norops.*—Toes slender, not dilated; back simple; tail round. *N. auratus*, the Golden Norops; Surinam.

II. Body subtrigonal or depressed. Terrestrial.

D. Body subtrigonal, covered with large generally keeled scales, directed obliquely towards the back; head generally shielded, superciliary and interparietal shields distinct; throat smooth, or with a cross fold behind; toes simple.

a. Caudal and dorsal scales similar.

* Femoral pores distinct; interparietal plate large.

30. *Tropidolepis.*—Back not crested; throat with a fold on each side; nostril superior, subapical. *T. undulatus*, the Waved Tropidolepis; North America. *T. torquatus*, the Collared Tropidolepis; Mexico. *T. formosus*, Mergmann's Tropidolepis; Mexico. *T. spinosus*, the Spinose Tropidolepis. *T. horridus*, the Horrid Tropidolepis; Mexico. *T. grammicus*, the Spotted Tropidolepis; Mexico. *T. microlepidotus*, the Small-Scaled Tropidolepis; Mexico. *T. variabilis*, the Variable Sceloporus; Mexico. *T. aureus*, the Bronzed Sceloporus; Mexico. *T. scalaris*, the Spotted Sceloporus; Mexico.

** Femoral pores none; anal pores distinct, marginal; back and tail not crested; interparietal plate small.

31. *Leiodera.*—Nostril lateral on the face-ridge; scales of the sides of the neck and back large; rhombic sides simple. *L. Chilensis*, the Chilian Leiodera; North Chili. *L. Gravenhorstii*, Gravenhorst's Leiodera; Chili. *L. gracilis*, the Slender Leiodera; Valparaiso and Patagonia.

32. *Leiolæmus.*—Nostril lateral on the face-ridge; scales of the sides of neck granular, of back rhombic, sides simple. *L. cyanogaster*, the Blue-Bellied Leiolæmus; Valdivia. *L. Bellii*, Bell's Leiolæmus; Chili. *L. Bibronii*, Bibron's Leiolæmus; Chili. *L. lineatus*, the Lineated Leiolæmus; Chili. *L. nigromaculatus*, the Black-Spotted Leiolæmus; Chili and Coquimbo. *L. inconspicuus*, the Inconspicuous Leiolæmus; Chili. *L. pictus*, the Painted Leiolæmus; Chili and Valparaiso. *L. tenuis*, the Dotted Leiolæmus; Valparaiso and Chili. *L. signifer*, the Hebrew-Marked Leiolæmus; Peru. *L. maculatus*, the Small-Scaled Leiolæmus; Peru. *L. Fitzingerii*, Fitzinger's Leiolæmus; Patagonia. *L. Darwinii*, Darwin's Leiolæmus; North Patagonia. *L. Kingii*, Captain King's Leiolæmus; Patagonia. *L. Weigmanii*, Weigmann's Leiolæmus; Bahia Blanca, Peru, Monte-Video, and Maldonado.

33. *Ptydogerus.*—Nostril lateral on the face-ridge; scales of the neck granular, of back rhombic; sides with a crest of keeled scales. *P. pectinatus*, the Ptygodere.

34. *Proctotretus.*—Nostril above the face-ridge; scales of the neck granular, of back rhombic; small sides simple. *P. multimaculatus*, the Proctotrete; Bahia Blanca, and Patagonia.

*** Femoral and anal pores none.

† Interparietal plate linear, small; head shields rather regular.

35. *Leiocephalus.*—Back and tail crested; scales of throat, back, and tail, rhombic, moderate. *L. Herminieri*, Herminier's Roquet; Martinique. *L. carinatus*, the Keeled Roquet; West Indies. *L. M'Leayii*, the Cuban Roquet; Cuba. *L. Schreibersii*, Schreibers's Roquet; Cuba. *L. Grayii*, Gray's Roquet; Charles Island and Galapagos. *L. ornatus*, the Shoulder-Spotted Roquet; Tropical America.

36. *Stenocerus.*—Back and tail lowly crested; scales of back rhombic, of the tail large, spinose. *S. rosciventris*, the Stenocere; Bolivia.

37. *Trachycyclus.*—Back and tail not crested; scales of back rhombic,

of tail large, spinose. *T. marmoratus*, the Trachycyclus; Brazil and Rio Grande.

†† Interparietal plate large; back or tail crested.

38. *Taraguira.*—Back not crested; scales of back small, of the throat granular; tail round, with a slight crest, and moderate scales; ear toothed in front. *T. torquata*, the Taraguira; Rio Janeiro and Brazil. *T. Darwinii*, Darwin's Taraguira; Brazil and Abrolhos Inlet. *T. Smithii*, Smith's Taraguira; Brazil.

39. *Microlophus.*—Back and tail lowly crested; scales of the back unequal, small; tail with moderate scales; the ear toothed in front. *M. Peruvianus*, the Microlophe; Peru, Copispo, and Iquique.

40. *Oplurus.*—Nape with a small crest; scales of back large, of the sides small; tail round, with rings of large spinose scales. *O. Braziliensis*, the Brazilian Oplurus; Brazil.

41. *Strobilurus.*—Nape, back, and tail, slightly crested; scales of back moderate; tail with rings of large spinose scales. *S. torquatus*, the Strobilurus; Brazil.

42. *Uraniscodon.*—Nape and back lowly crested; scales of the back large, rhombic; sides of body and throat simple; tail round, slender, with moderate scales, slightly keeled above. *U. pictum*, the Painted Uraniscodon; Brazil.

43. *Plica.*—Nape and back lowly crested; scales of the back small; sides with two folds; the throat with groups of spines; tail round, slender, keeled above with moderate scales. *P. umbra*, the Plica; North America (?) and Georgia (?). *P. punctata*, the Dotted Plica; Tropical America.

E. Body depressed, with small scales; back rarely crested; tail conical.

a. Sides rounded; femoral and preanal pores none; eyebrow scales small.

44. *Leiosaurus.*—Tail with granular scales; scales under the eye all small. *L. Bellii*, Bell's Leiosaurus; South America. *L. fasciatus*, the Banded Leiosaurus; South America.

45. *Diplolæmus.*—Tail with granular scales, with an elongated scale under the eye. *D. Darwinii*, Darwin's Diplolæmus; Patagonia. *D. Bibronii*, Bibron's Diplolæmus; South America and Chili.

46. *Tropidurus.*—Tail round, with rings of large scales; nape lowly crested, interparietal (?). *T. cyclurus*, the False Quetz Palea; Brazil.

47. *Uranocentron.*—Tail depressed with rings of large scales; nape not crested; interparietal small. *U. azureum*, the Doryphore; Brazil.

b. Sides rounded; femoral and preanal pores distinct, near vent.

48. *Phrymaturus.*—Tail round, with rings of large scales; the nape not crested. *P. Palluma*, the Palluma; Chili.

c. Sides with a slight fold; scales uniform; body roundish.

49. *Callisaurus.*—Ventral scales smooth; femoral pores distinct. *C. draconoides*, the Callisaurus; California.

50. *Tropidogaster.*—Ventral scales 3-keeled; femoral pores none. *T. Blainvillii*, the Tropidogaster.

d. Sides serrated; body very depressed; femoral pores distinct.

51. *Phrynosoma.*—Head spinose; back and tail with scattered tubercular scales. *P. Douglasii*, Douglas's Phrynosoma; California. *P. orbiculare*, the Tapayaxin; Mexico. *P. Blainvillii*, the Crowned Tapayaxin; California. *P. cornutum*, the Texian Tapayaxin; Arkansas, North America, and Texas.

IGUANODON (Iguana and ὀδοὺς (ὀδόντος), a tooth), a genus of extinct Reptiles of large size, discovered by Dr. Mantell, and named by him from the resemblance of its teeth to those of the recent *Iguana*. As the discovery of this animal is one of great interest in the records of British Palæontology, and illustrates the success attendant upon accurate investigation in this department of human inquiry, we give the history of it in Dr. Mantell's own words:—

"Soon after my first discovery of bones of colossal reptiles in the strata of Tilgate Forest, some teeth of a very remarkable character particularly excited my curiosity, for they were wholly unlike any that had previously come under my observation; even the quarrymen, accustomed to collect the remains of fishes, shells, and other objects imbedded in the rocks, had not observed fossils of this kind; and, until shown some specimens which I had extracted from a block of stone, were not aware of the presence of such teeth in the stone they were constantly breaking up for the roads. The first specimen that arrested my attention was a large tooth, which, from the worn, smooth, and oblique surface of the crown, had evidently belonged to an herbivorous animal; and so entirely resembled in form the corresponding part of an incisor of a large pachyderm ground down by use that I was much embarrassed to account for its presence in such ancient strata, in which, according to all geological experience, no fossil remains of *Mammalia* would ever be discovered; and as no known existing reptiles are capable of masticating their food, I could not venture to assign the tooth in question to a saurian.

"As my friend Mr. (now Sir Charles) Lyell was about to visit Paris, I availed myself of the opportunity of submitting it to the examination of Baron Cuvier, with whom I had the high privilege of corresponding; and, to my astonishment, learned from my friend, that M. Cuvier, without hesitation, pronounced it to be an upper incisor of a Rhinoceros.

"I had previously taken this tooth, and some other specimens, to a meeting of the Geological Society in London, and showed them to Dr. Buckland, Mr. Conybeare, Mr. Clift, and other eminent men who were present, but without any satisfactory result; in fact, I was discouraged by the remarks that the teeth were of no particular interest, as there could be but little doubt they belonged either to some large fish allied to the *Anarhicas Lupus*, or Wolf-Fish, the crowns of whose incisors are of a prismatic form, or were mammalian teeth obtained from a diluvial deposit. Dr. Wollaston alone supported my opinion, that I had discovered the teeth of an unknown herbivorous reptile, and encouraged me to continue my researches. And, as if to add to the difficulty of solving the enigma, some metacarpal bones which I soon after discovered in the same quarry, and forwarded to Paris, were declared to belong to a species of Hippopotamus. Subsequently a dermal horn, or tubercle, from the same stratum, was declared by competent authorities to be the lesser horn of a Rhinoceros; and Dr. Buckland, with the generous kindness which marked his character, wrote to guard me against venturing to publish that these teeth, bones, and horn were found in the 'iron-sand formation,' with which the Tilgate beds were then classed, as there could be no doubt they belonged to the superficial diluvium; and as the upper beds of the conglomerate in which these first specimens were found was only covered by loam and vegetable earth, there was no clear stratigraphical evidence to support a contrary opinion. Other specimens however were soon procured by stimulating the diligent search of the workmen by suitable rewards, and at length teeth were obtained which displayed the serrated edges, the longitudinal ridges, and the entire form of the unused crown. I then forwarded specimens and drawings to Baron Cuvier, and repaired to London, and with the aid of that excellent man the late Mr. Clift, ransacked all the drawers in the Hunterian Museum that contained jaws and teeth of reptiles, but without finding any that threw light on the subject. Fortunately, M. Samuel Stuchbury, then a young man, was present, and proposed to show me the skeleton of an *Iguana*, which he had prepared from a specimen that had long been immersed in spirits; and, to my great delight, I found that the minute teeth of that reptile bore a closer resemblance in their general form to the fossils from Tilgate Forest than any others with which I was able to institute a comparison. It was not however until I had collected a series of specimens exhibiting teeth in various stages of maturity and detrition that the correctness of my opinion was admitted, either as to the character of these dental organs, or the geological position of the rocks in which they were imbedded." ('Petrifactions and their Teachings.')

From their first discovery the teeth of this animal have excited the greatest amount of interest on account of their peculiar structure. In his report to the British Association, on the 'British Fossil Reptiles,' Professor Owen gives an elaborate account of their structure and functions:—

"The teeth of the *Iguanodon*," says the Professor, "though resembling most closely those of the *Iguana*, do not present an exact magnified image of them, but differ in the greater relative thickness of the crown, its more complicated external surface, and still more essentially in a modification of the internal structure by which the *Iguanodon* equally deviates from every other known reptile. As in the *Iguana*, the base of the tooth is elongated and contracted, while the crown is expanded and smoothly convex on the inner side. When first formed it is acuminated, compressed, its sloping sides serrated, and its external surface traversed by a median longitudinal ridge, and coated by a layer of enamel; but beyond this point the description of the tooth of the *Iguanodon* indicates characters peculiar to that genus. In most of the teeth that have hitherto been found three longitudinal ridges traverse the outer surface of the crown, one on each side of the median primitive ridge; these are separated from each other, and from the serrated margins of the crown, by four wide and smooth longitudinal grooves. The relative width of these grooves varies in different teeth; sometimes a fourth small longitudinal ridge is developed on the outer side of the crown. The marginal serrations which at first sight appear to be simple notches, as in the *Iguana*, present under a low magnifying power the form of transverse ridges, themselves notched so as to resemble the mammillated margins of the unworn plates of the elephant's grinder. Slight grooves lead from the interspaces of these notches upon the sides of the marginal ridges. These ridges or dentations do not extend beyond the expanded part of the crown; the longitudinal ridges are continued farther down, especially the median ones, which do not subside till the fang of the tooth begins to assume its subcylindrical form. The tooth at first increases both in breadth and thickness; it then diminishes in breadth, but its thickness goes on increasing; in the large and fully-formed teeth the fang decreases in every diameter, and sometimes tapers almost to a point. The smooth unbroken surface of such fangs indicates that they did not adhere to the inner side of the maxillæ, as in the *Iguana*, but were placed in separate alveoli, as in the Crocodile and Megalosaur; such support would appear indeed to be indispensable to teeth so worn by mastication as those of the *Iguanodon*. The apex of the tooth soon begins to be worn away, and it would appear by many specimens that the teeth were retained until nearly the whole of the crown had yielded to the daily abrasion. In these teeth however the deep excavation of the remaining fang plainly bespeaks the progress of the successional tooth prepared to supply the place of the worn-out grinder. At the earlier stages of abrasion a sharp edge is maintained at the external part of the tooth by means of the enamel which covers the surface of the crown; the prominent ridges upon that surface give a sinuous contour to the middle of the cutting edge, whilst its sides are jagged by the lateral serrations: the adaptation of this admirable dental instrument to the cropping and comminution of such tough vegetable food as the *Clathrariæ*, and similar plants, which are found buried with the *Iguanodon*, is pointed out by Dr. Buckland with his usual felicity of illustration in his 'Bridgewater Treatise,' vol. i. p. 246. When the crown is worn away beyond the enamel it presents a broad and nearly horizontal grinding surface; and now another dental substance is brought into use to give an inequality to the surface; this is the ossified remnant of the pulp, which being firmer than the surrounding dentine, forms a slight transverse ridge in the middle of the grinding surface. The tooth in this stage has exchanged the functions of an incisor for that of a molar, and is prepared to give the final compression, or comminution, to the coarsely-divided vegetable matters.

"The marginal edge of the incisive condition of the tooth, and the median ridge of the molar stage are more effectually established by the introduction of a modification into the texture of the dentine, by which it is rendered softer than in the existing *Iguanæ* and other reptiles, and more easily worn away; this is effected by an arrest of the calcifying process along certain cylindrical tracts of the pulp, which is thus continued in the form of medullary canals, analogous to those in the soft dentine of the *Megatherium's* grinder from the central cavity, at pretty regular intervals, parallel with the calcigerous tubes, nearly to the surface of the tooth. The medullary canals radiate from the internal and lateral sides of the pulp cavity, and are confined to the dentine forming the corresponding walls of the tooth; their diameter is 1-1250th of an inch; they are separated by pretty regular intervals, equal to from 6 to 8 of their own diameters; they sometimes divide once in their course. Each medullary canal is surrounded by a clear space; its cavity was occupied in the section described by a substance of a deeper yellow colour than the rest of the dentine. The calcigerous tubes present a diameter of 1-25,000th of an inch, with interspaces equal to about 4 of their diameters. At the first part of their course near the pulp cavity, they are bent in strong undulations, but afterwards proceed in slight and regular primary curves, or in nearly straight lines to the periphery of the tooth. When viewed in a longitudinal section of the tooth, the concavity of the primary curvature is turned towards the base of the tooth; the lowest tubes are inclined towards the root, the rest have a general direction at right angles to the axis of the tooth; the few calcigerous tubes which proceed vertically to the apex are soon worn away, and can be seen only in a section of the apical part of the crown of an incompletely developed tooth. The secondary undulations of each tooth are regular and very minute. The branches, both primary and secondary of the calcigerous tubes, are sent off from the concave side of the main inflections; the minute secondary branches are remarkable at certain parts of the tooth for their flexuous ramifications, anastomoses, and dilatations into minute calcigerous cells, which take place along nearly parallel lines for a limited extent of the course of the main tubes. The appearance of interruption in the course of the calcigerous tubes, occasioned by this modification of their secondary branches, is represented by the irregularly dotted tracts in the figure. This modification must contribute with the medullary canals, though in a minor degree, in producing that inequality of texture and density in the dentine, which renders the broad and thick tooth of the *Iguanodon* more efficient as a triturating

Teeth of *Iguanodon*.

a, young tooth; *b*, *c*, teeth further advanced, and worn.

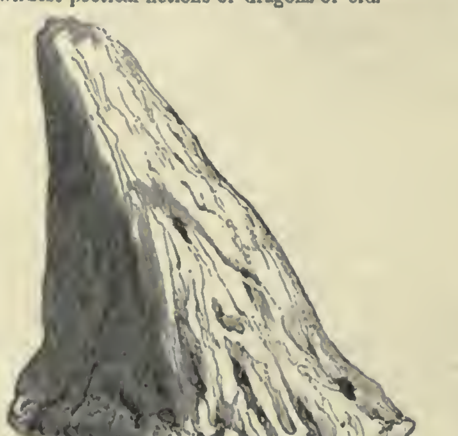
instrument. The enamel which invests the harder dentine, forming the outer side of the tooth, presents the same dirty peculiar brown colour when viewed by transmitted light as in most other teeth; very minute and scarcely perceptible undulating fibres, running vertically to the surface of the tooth, are the only structure I have been able to detect. The remains of the pulp in the contracted cavity of the completely formed tooth are converted into a dense but true osseous substance, characterised by minute radiated cells, whose long axis is parallel with the plane of the concentric lamellæ which surround the few and contracted medullary canals in this substance. The microscopical examination of the structure of the *Iguanodon's* teeth thus contributes additional evidence of the perfection of their adaptation to the offices to which their more obvious characters had indicated them to have been destined.

"To preserve a trenchant edge, a partial coating of enamel is supplied, and that the thick body of the tooth might be worn away in a more regularly oblique plane, the dentine is rendered softer as it recedes from the enamelled edge by the simple contrivance of arresting the calcifying process along certain tracts of the inner wall of the tooth. When attrition has at length exhausted the enamel, and the tooth is limited to its function as a grinder, a third substance has been prepared in the ossified remnant of the pulp to add to the efficiency of the dental instrument in its final capacity."

The size of this giant of the Weald in former ages was enormous. In Dr. Mantell's collection there is a portion of a femur 22 inches in girth in the smallest part. The thigh bone then of the *Iguanodon* exceeded in bulk that of the largest elephant, and its length is on good grounds calculated to have been from 4 to 5 feet. Dr. Mantell carefully compared the bones of the *Iguanodon* with those of the *Iguana*, and by taking an average from eight separate parts of the respective skeletons, he gives the following as the dimensions of the former:—

	Feet.
Length from Snout to the extremity of the Tail . .	70
Length of Tail	52½
Circumference of Body	14½

The thigh bone of the *Iguanodon* is considered by Dr. Mantell to be twenty times the size of that of a modern *Iguana:* but as animals do not increase in length in the same ratio as in bulk, it does not follow that the *Iguanodon* attained the length of 100 feet, although it probably approached 70 feet. (Buckland.) On the snout of this monstrous reptile was a nasal horn, and its appearance must have realised the wildest poetical fictions of dragons of old.



Nasal horn of *Iguanodon*, two-thirds of the natural size.

In the Report above alluded to, Professor Owen gives his reasons for doubting if the *Iguanodon* was so large an animal as is inferred by Dr. Mantell.

"From the comparison," he says, "which the few connected portions of the skeleton of the *Iguanodon* enable us to make between the bones of the extremities and the vertebral column, it is evident that the hind legs at least, and probably also the fore legs, were longer and stronger in proportion to the trunk than in any existing Saurian. One can scarcely suppress a feeling of surprise that this striking characteristic of the *Iguanodon*, in common with other *Dinosauria*, should have been hitherto overlooked; since the required evidence is only an associated vertebra and long bone of the same individual, or a comparison of the largest detached vertebræ with the longest femora or humeri. This characteristic is nevertheless one of the most important towards a restoration of the extinct reptile, since an approximation to a true conception of the size of the entire animal could only be made after the general proportions of the body to the extremities had been ascertained. But it is very obvious that the exaggerated resemblances of the *Iguanodon* to the *Iguana* have misled the palæontologists who have hitherto published the results of their calculations of the size of the *Iguanodon;* and hence the dimensions of 100 feet in length, arrived at by a comparison of the teeth and clavicle of the *Iguanodon* with the *Iguana*, of 75 feet from a similar comparison of their femora, and of 80 feet from that of the claw-bone, which if founded upon the largest specimen from Horsham, instead of the one compared by Dr. Mantell, would yield a result of upwards of 200 feet for the total length of the *Iguanodon*, since the Horsham phalanx exceeds the size of the largest of the recent *Iguana's* phalanges by 40 times. But the same reasons which have been assigned for calculating the bulk of the *Megalosaurus* on the basis of the vertebræ apply with equal force to the *Iguanodon*. Now the largest vertebra of an *Iguanodon* which has yet been obtained does not, as has been before stated, exceed 4½ inches in length; the most common size being 4 inches. The intervertebral substance is shown by the naturally juxtaposed series of dorsal vertebræ in the Maidstone *Iguanodon* to be not more than one-third of an inch in thickness. All the accurately determined vertebræ of the *Iguanodon* manifest the same constancy of their antero-posterior diameter which prevails in Saurians generally; the discovery of the true character of the supposed lacertian vertebræ, 6 inches long, removes the only remaining doubt that could have attached itself to this important element in the present calculation. The cervical vertebræ of the *Iguanodon*, when discovered, if they prove to differ in length from the known dorsal and caudal vertebræ, will be in all probability somewhat shorter, as they are in the Hylæosaur, and in all known Crocodiles and Lizards. It remains therefore to discover the most probable number of the vertebræ and the ribs; and especially the variation in both structure and size which the ribs of the *Iguanodon* already obtained demonstrate to have prevailed in the costal series, renders it much more probable that the number of the costal vertebræ would resemble that of the Crocodiles, than that of the Saurians or other Lizards with unusually numerous dorsal vertebræ, and which possess ribs of a simple and uniform structure, and of nearly equal size. The most probable number of vertebræ of the trunk, from the atlas to the last lumbar inclusive, calculated from Crocodilian analogies, would be 24 vertebræ; which is also the number possessed by the *Iguana*. Twenty-four vertebræ estimated with their invertebral spaces at 5 inches each, give 10 feet; if to this we add the length of the sacrum, namely 17 inches, then that of the trunk of the *Iguanodon* would be 11 feet 5 inches, which exceeds that of the *Megatherium*. If there be any part of the skeleton of the *Iguana* which may with greater probability than the rest be supposed to have the proportions of the corresponding part of the *Iguanodon*, it is the lower jaw, by virtue of the analogy of the teeth and the substances they are adapted to prepare for digestion. Now, the lower jaw gives the length of the head in the *Iguana*, and this equals the length of six dorsal vertebræ, so that as five inches rather exceeds the length of the largest *Iguanodon's* vertebræ yet obtained with the intervertebral space superadded, on this calculation the length of the head of the largest *Iguanodon* must have been 2 feet 6 inches. In the description of the caudal vertebræ it has been shown that the *Iguanodon* could as little have resembled the *Iguana* in the length of its tail as in the anatomical characters of any of the constituent vertebræ of that part; the changes which the series of six caudal vertebræ present in the length and form of the spinous processes, and in the place of origin of the transvers processes, indicate the tail to have been shorter in the *Iguanodon* than in the Crocodile. Assuming however that the number of caudal vertebræ of the *Iguanodon* equalled that in the Crocodile, and allowing to each vertebra with its invertebral space 4½ inches, we obtain the length of 12 feet 6 inches for the tail of the *Iguanodon*.

	Feet.
Length of Head say	3
Length of Trunk with Sacrum	12
Length of Tail	13
Total Length of the *Iguanodon*	28

"The same observations on the general form and proportions of the animal, and its approximation in this respect to the *Mammalia*, especially the great extinct Megatherioid or Pachydermal species, apply as well to the *Iguanodon* as to the *Megalosaurus*."

Since the original discovery of the teeth in Tilgate Forest, several other portions of this remarkable animal have been found. The most interesting of these were discovered by Mr. Bensted, of Maidstone, in a green-sandstone quarry near that town. Other remains have also been obtained from the Wealden of Sussex and the Isle of Wight. On some of these remains Dr. Mantell thus remarks:—

"A recent discovery however supports the idea first suggested by the stupendous size of the bones of the extremities. In a block of calciferous grit, picked up on the sea-shore, I have laid bare a chain of eleven caudal vertebræ, belonging to the middle region of the tail, and the bodies of these bones, instead of being abbreviated, as the shortness of the known anterior caudals led us to infer, are elongated, as in the corresponding part of the skeleton of the recent *Iguana*. The length of four of these vertebræ is equal to that of five dorsals, and their spinous and transverse processes are so well developed as to show that the tail must have been greatly prolonged, probably in the same degree as in the existing Lizards. The length of the femur of this individual is equal to six caudal or eight anterior dorsal vertebræ.

"It is therefore, according to the present state of our knowledge, not at all improbable that the largest *Iguanodons* may have attained a length of from 60 to 70 feet. Although some important points in the osteology of the *Iguanodon* are still unknown, we may safely conclude that this stupendous reptile equalled in bulk the largest herbivorous *Mammalia*, and was as massive in its proportions; for living exclusively on vegetables it must have had the abdominal region greatly developed.

"Its limbs must have been of proportionate size and strength to sustain and move so enormous a carcass; the hinder extremities in all probability resembled the unwieldly contour of the Hippopotamus or Rhinoceros, and were supported by strong short feet, protected by broad ungular phalanges; the fore feet appear to have been less bulky, and adapted for seizing and pulling down the foliage and branches of trees; the jaws and teeth demonstrate its power of mastication, and the character of its food; while the remains of coniferous trees, arborescent ferns, and cycadeous plants, which are found imbedded with its remains, attest the nature of the flora adapted for its sustenance."

Whatever may be the differences of opinion as to the precise size of this creature, all writers agree as to the great interest attaching to its existence in this part of the world during the deposit of the great fresh-water beds that characterise the geology of the British Islands.

The remains of the *Iguanodon* so carefully collected and treasured by Dr. Mantell are now in the British Museum, where they will ever remain a monument of his perseverance and skill, and a means of enabling the student of natural history to come to his own conclusions on the debateable points its structure has raised. To his account of its structure Dr. Mantell adds some physiological inferences as to the structure and economy of the *Iguanodon*, with which this notice may be appropriately closed.

"In instituting a comparison between the maxillary organs of the *Iguanodon* and those of the existing herbivorous Lizards, with the view of obtaining some physiological deductions from their peculiar osteological characters, we are at once struck with their remarkable deviation from all known types in the class *Reptilia*. In the *Amblyrhynchi*, the most exclusively vegetable feeders of the Saurian order, the alveolar process, beset with teeth, is continued round the front of the mouth, the junction of the two rami of the lower jaw at the symphysis presenting no edentulous interval whatever, and the lips not being more produced than in other reptiles; for these creatures chip off and bruise their food, and cannot grind or masticate it: in the Iguanas, as previously shewn, the same character exists. In the carnivorous Saurians the teeth are also continued to the symphysical suture on each side. The extinct colossal Lizards offer no exception to this rule; in the acrodont *Mososaurus* of the Chalk, and in the thecodont *Megalosaurus* of the Oolite and Wealden, the jaws are armed with teeth round the anterior extremity. In short, the edentulous, expanded, scoop-shaped, procumbent, symphysis of the lower jaw of the *Iguanodon*, has no parallel among either existing or fossil reptiles, and we seek in vain for maxillary organs at all analogous, except among the herbivorous *Mammalia*.

"The nearest approach is to be found in certain *Edentata*, as for example in the *Cholœpus didactylus*, or Two-Toed Sloth, in which the anterior part of the lower jaw is edentulous and much prolonged.

"The correspondence is still closer in the gigantic extinct *Mylodon*, in which the symphysis resembles the blade of a spade used by turf-diggers, and has no traces of incisive sockets; and were not this part of the jaw elevated vertically in front, and the two rami confluent, it would present the very counterpart of that of the *Iguanodon*.

"The great size and number of the vascular foramina distributed along the outer side of the dentary bone, and beneath the border of the symphysis, in the *Iguanodon*, and the magnitude of the anterior outlets which gave exit to the vessels and nerves that supplied the front of the mouth, indicate the great development of the integuments and soft parts with which the lower jaw was invested. The sharp ridge bordering the deep groove of the symphysis, in which there are also several foramina, evidently gave attachment to the muscles and integuments of the under lip; while two deep pits for the insertion of the protractor muscles of the tongue, manifest the mobility and power of that organ. There are therefore strong reasons for supposing that the lip was flexible, and, in conjunction with the long fleshy prehensile tongue, constituted the instruments for seizing and cropping the leaves and branches, which, from the construction of the molars, we may infer constituted the chief food of the *Iguanodon*. The mechanism of the maxillary organs, as elucidated by recent discoveries, is thus in perfect harmony with the remarkable characters which rendered the first known teeth so enigmatical; and in the Wealden herbivorous reptile we have a solution of the problem, how the integrity of the type of organisation peculiar to the class of cold-blooded *Vertebrata* was maintained, and yet adapted, by simple modifications, to fulfil the conditions required by the economy of a gigantic terrestrial reptile, destined to obtain support exclusively from vegetable substances, in like manner as the extinct colossal herbivorous *Edentata*, which flourished in South America ages after the country of the *Iguanodon* and its inhabitants had been swept from the face of the earth. Thus in the unlimited production of successional teeth at every period of the animal's existence, in the mode of implantation of the teeth, and in the composite structure of the lower jaw, each ramus consisting of six distinct elements, the Saurian type of organisation is unequivocally manifest; while the intimate structure of the dental organs approaches that of the Sloths, and the sub-alternate arrangement and reversed position of the upper and lower series of teeth correspond with that of the Ruminants; and again, the edentulous and prolonged symphysis, and the great development of the lower lip and the integuments of the jaws, as indicated by the size and number of the vascular foramina, present a striking analogy to the *Edentata*. They who doubt the correctness of this interpretation should remember that it is in this order of *Mammalia* that we find the nearest approach to the *Reptilia;* in the scaly covering of the skin, the imperfections of the dental system, the smallness of the brain, and the long continuance of the muscular fibre after death, which are so many decadences of organisation, so to speak, that indicate a step towards that class of which the *Iguanodon* appears to have been the highest type.

"If the opinion previously advanced be correct that the anterior part of the spinal column consisted of convexo-concave, and the dorsal of plano concave vertebræ, the adult *Iguanodon* must have approached in this part of its skeleton, as well as in its sacrum, in its massive femora, with their large medullary cavities, trochanters, and condyles, and in its short and strong metatarsals and phalangeals, to that of the large herbivorous *Mammalia*. The position of the hinder limbs (the thighs and legs) in relation to the pelvis, cannot be accurately determined from the data at present obtained; but the form of the head and shaft of the femur, and the character of its articulations and processes so closely resemble those of the largest Pachyderms, as to suggest the idea that (unlike the rest of its class) the *Iguanodon* had the body supported as in the *Mammalia*, and the abdomen suspended higher from the ground than in any existing Saurians. In fine, we have in the *Iguanodon* the type of the terrestrial *Herbivora*, which in that remote epoch of the earth's physical history, termed by geologists 'the Age of Reptiles' occupied the same relative station in the scale of being, and fulfilled the same general purposes in the economy of nature as the Mastodons, Mammoths, and Mylodons of the Tertiary period, and the existing Pachyderms."

(Owen, *Report on British Fossil Reptiles;* Mantell, *Petrefactions and their Teachings;* Buckland, *Bridgewater Treatise.*)

ILEUM. [INTESTINES.]

ILEX is a name given to two very different plants. As that of a species, it indicates the Evergreen Oak of the South of Europe, or *Quercus Ilex;* as that of a genus, it belongs to the Common Holly, *Ilex Aquifolium*, the type of the natural order *Aquifoliaceæ*. This latter plant, which constitutes so beautiful a feature in the winter scenery of many parts of England, and whose scarlet or yellow berries render it so universal a decoration of churches (hence the name Holly-Tree, or Holy-Tree) and dwelling-houses at Christmas time, is in Great Britain upon the most northern limits within which it ranges in a wild state. It is however at those limits that it attains its greatest size and beauty; but it occasionally suffers from severe winters. It is common in the middle of Europe, and the southern side of the range of the Caucasus, where it is only a bush, and it probably extends far to the eastward. It is chiefly valued as a shelter in winter, and an ornamental tree, but its fine-grained heavy compact timber is used for a great number of useful purposes, especially by the turner and mathematical instrument maker; the black handles of metal teapots are carved out of its wood. It is also employed medicinally; the leaves and bark possess febrifugal powers of a strongly-marked character: the root and the bark are said to be diuretic and expectorant, but the berries have the discredit of being poisonous, producing purgative and violent emetic effects.

Besides the Common Holly and its numerous varieties, the genus *Ilex* comprehends a large number of species, the most remarkable of which are the *I. Balearica*, or broad-leaved species of Minorca, a very handsome kind, which is hardy in the middle and south of England; the *I. vomitoria*, or Cassena-Tree of the North Americans, whose leaves possess strongly-marked emetic qualities; and the *I. Paraguayensis*, or Maté Plant, of whose leaves a very large consumption takes place in South America, under the name of Tea of Paraguay. [TEA, PARAGUAY.] The leaves are dried, and afterwards used like the tea of the Chinese. (Loudon, *Arboretum Britannicum.*)

ILLÆNUS, Dalman's name for a group of the great genus *Asaphus*, as originally constituted by Brongniart in his work on the *Trilobites*. The caudal plate is one large convex part, nearly corresponding to the anterior shield. From the Transition Strata of Christiania, Ostrogothia, &c. [TRILOBITES.]

ILLECEBRA'CEÆ, *Knotworts*, a small natural order of Exogenous Plants, chiefly consisting of herbaceous weeds, found in the temperate parts of the world: they differ from *Amarantaceæ* in nothing except having stipules and a tendency to produce petals; from *Alsinaceæ* in little more than having stipules; and from *Portulaceæ* in their sepals not being in pairs. This order is one of those which break down the limits between Polypetalous and Apetalous plants, and prove how entirely artificial are such divisions. The species are often conspicuous, especially when dried, for their silvery stipules and shining calyxes, and are sometimes beautiful microscopic objects; but they are too small to be interesting in any other way, and are of no known use. They occur in various parts of the world, especially in the countries bordering on the Mediterranean. The order embraces 24 genera and about 100 species. A few occur at the Cape of Good Hope, and several are found in America. The British representatives are *Corrigiola*, *Herniaria*, and *Illecebrum*. [CORRIGIOLA; ILLECEBRUM.]

Illecebrum verticillatum.

1, a pair of leaves, with the intervening stipules; 2, a flower, seen from above; 3, a flower cut open.

ILLECE'BRUM, a genus of Plants the type of the natural order *Illecebraceæ*. It has 5 sepals slightly cohering at the base and horned at the back. Petals absent or 5, subulate, inserted with the 5 stamens on a perigynous ring; a 1-celled 1-seeded furrowed capsule bursting along the furrows. The only species is a small trailing shrub with opposite leaves having scarious stipules at the base.

I. verticillatum, Whorled Rush-Grass. It has a trailing glabrous stem, roundish leaves, verticillate whorled white minute flowers. It is found in bogs and wet marshy places, chiefly in Cornwall and Devonshire. The seeds of this shrub should be planted in a moist situation, and, if allowed to sow themselves, will spring up regularly every season. It is worth cultivation on account of the delicacy and beauty of its blossoms.

(Babington, *Manual of British Botany;* Don, *Dichlamydeous Plants.*)

ILLICEÆ. [WINTERACEÆ.]

ILLI'CIUM (illicio, I allure), a genus of Plants, so named in consequence of their very agreeable aromatic fragrance; they belong to the Winter's Bark tribe. These are now generally described as a separate family under the name of *Winteraceæ*, and are distinguished by their dotted leaves and aromatic properties from *Magnoliaceæ*, of which they are sometimes made a section. The genus *Illicium* is characterised by having from 3 to 6 petaloid sepals; 27 petals arranged in several rows below the numerous stamens and pistils. The capsules are disposed in a circular manner, and open upwards; each contains a single shining seed. The species are few in number, but widely distributed. Two are indigenous in Florida; and the others in China and the neighbouring islands. *I. Floridanum* is a red-flowered species, of which the leaves are very fragrant, and the capsules smell of anise, though more faintly than the Chinese species. The bark has been proposed as a substitute for cinnamon and sassafras barks. *I. parviflorum* also, a native of North America, has similar properties, especially in its leaves.

The most important species however is *I. anisatum*, or the Aniseed-Tree of China, of which the fruit is exported from Canton, and well known in commerce by the name of Star Anise. In India they are called Badian Khatai, or Chinese Anise. Hence the name Badiane, by which they are chiefly known on the continent of Europe, where they are more employed than in this country; being esteemed, as in the East, for their aromatic and carminative properties. The smell and taste of both the capsule and seed being like that of aniseed, a volatile oil is distilled from them, which may be employed for all the purposes of the oil of aniseed: it is said to give the flavour to Anisette de Bordeaux and to Anisette de Hollande. The Chinese use it in substance both as a condiment and a stimulant medicine, and burn it as incense in their temples. The tree flourishes in China and some of the Philippine Islands, and is found also in Japan, whence Siebold has described a new species. M. Perrotet also mentions that there is an undescribed species at Manilla, which is there called San-ki; that its leaves are mixed with their tea and coffee in the Philippines, and that a liqueur is likewise prepared from its fruit.

ILLUPIE-TREE. [BASSIA.]

ILMENITE. [TITANIUM.]

ILUANTHUS. [ACTINIADÆ.]

ILVAITE, a native Silicate of Iron, identical with *Yenite.* [IRON.]

IMBER. [COLYMBIDÆ.]

IMBRICARIA. [SAPOTACEÆ.]

IMPA'TIENS, a genus of Plants so called from the sudden and elastic force with which they burst their capsules; hence 'Noli me tangere' is the name of one of the species. Another is well known as a highly ornamental annual by the name of Balsam, whence the natural family to which it belongs has been called *Balsaminaceæ.* [BALSAMINACEÆ.] The genus is especially an East Indian one, though single species extend into Europe, Siberia, and North America. Linnæus was only acquainted with 7 or 8 species; but Dr. Wight, in the 'Madras Journal,' vol. ii., states that not less than 100 species are now known, and almost entirely from the mountains of the peninsula of India and the Himalayas; in those from Silhet as far north as the Sutlej, and in 30° N. lat., at as great elevations as 7000 feet. They are absent from the plains of India; some are found on the Malabar coast, little elevated above the sea, but only during the monsoon. Dr. Royle has stated that they are only found in the Himalayas during the rains, and hence inferred that the moisture and moderate temperature, as well as the equability of both during the rainy season, is as favourable to their growth as the heat and moisture of the peninsula; but Dr. Wight has since ascertained that the species are chiefly found at elevations of 4000 and 4500 feet, in a season where there is moisture combined with a moderate but equal temperature. These facts are important as showing the influence of climate on vegetation; and useful as affording hints and principles for the cultivation of these plants at a lower temperature than is necessary for the plants of the plains from the same latitudes, though great success has been attained in the cultivation of Balsams in this country.

IMPERATO'RIA (so named from its supposed imperial virtues in medicine), a genus of Plants belonging to the natural order *Umbelliferæ.* It has no calyx; obovate petals, contracted into an inflexed segment; the fruit flattened at the back, with a dilated flat border. The species are glabrous perennial herbs, with erect hollow terete striated stems. The umbels are large and compound, and the flowers white.

I. Ostruthium has a tuberous fleshy and somewhat creeping root of an aromatic and acrid nature; the lower leaves biternate, the upper ones less compound; the flowers are small, and of a white or pale flesh-coloured hue. It is a native of Europe and Newfoundland in damp meadows and woods. This species is the Masterwort of old English herbalists, and the root has been much celebrated as an antidote against poisons, a diuretic, and sudorific; and Lerango affirms that an infusion of it in wine has cured agues which have resisted quinine. When chewed it excites a copious flow of saliva, and acts as an agreeable stimulant to the gums. It is recommended in cases of rheumatic toothache, and is cultivated in many places for the London market.

I. angustifolia, the Narrow-Leaved Masterwort, has biternate leaves, oblong leaflets, attenuated at the base and deeply serrated. It is a native of the Alps and Piedmont. The blossoms appear in June and July, and are of a white colour. The species of this genus are of easy culture, and may be propagated either by dividing the roots or from seed.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica;* Burnett, *Outlines of Botany.*)

IMPEYAN. [PHASIANIDÆ.]

IMPREGNATION. [REPRODUCTION IN PLANTS; REPRODUCTION IN ANIMALS; STAMEN; PISTIL.]

I'NACHUS, a genus of Brachyurous Crustaceans, placed by M. Milne-Edwards under his tribe Macropodians. [MACROPODIANS.]

INCISORS. [DENTITION; TEETH.]

INCUS. [EAR.]

INDIA-RUBBER, the common name of a vegetable compound which is found in all plants with a milky juice. It is also known by the name of Caoutchouc.

The existence of a milky juice in many plants, which flows from them when their tissues are wounded, is a fact that has been familiarly known from time immemorial. It is however only a matter of recent discovery that this milky juice characterises certain families of plants. Although the great majority of plants which yield this juice in abundance are tropical, yet they are not without their European representatives. The Spurges, Dandelion, and Celandine of our road-sides are instances. The families of plants which furnish this milky juice in the greatest abundance are—*Moraceæ, Euphorbiaceæ, Artocarpaceæ, Apocynaceæ, Cichoraceæ, Papaveraceæ, Campanulaceæ,* and *Lobeliaceæ.*

This juice, which is called by botanists 'the milky juice,' because it has an appearance similar to milk, has also the physical constitution of that fluid. It is an aqueous liquid, charged with soluble matter, in which float globules of a substance insoluble in water, and which are by their tenuity held in suspension in the liquid, but for which they have no affinity, in the same manner as butter is held in suspension by milk. From the difference of the refractive powers of these two substances, each of which taken separately would be colourless or transparent, arise the opacity and white colour of the two: hence the compound is properly called a 'milky juice.'

The analogies which this juice exhibits with the milk of animals and vegetable emulsions are seen in the manner in which it acts when left to itself. Run out into the air, received and preserved in close vessels, it separates itself into two layers, as milk itself would do. The watery part very soon has an insoluble part floating upon it, which collects together and swims at the top as cream swims upon milk, and which forms nearly the half of the entire mass. But with these physical resemblances the analogies cease. That which in milk and in emulsions produced from seeds collects on the surface of the aqueous liquor is, properly speaking, a fatty body, containing oxygen in its composition; while the kind of cream which swims upon the milky juice is a compound of carbon and hydrogen.

This substance has long been known to the natives of both the Old and New World, in Hindustan and South America. It was not however till the expedition of the French academicians to South America in 1735 that its properties and nature were made known in Europe by a memoir upon it by M. de la Coudamine. This notice excited little attention; and subsequently notices of this substance were sent to the French Academy in 1751 by M. Fresnau, and in 1768 by M. Macquer. At the latter end of the last century and the beginning of the present it was brought into this country in small quantities, where, on account of its being used for rubbing out black-lead pencil marks, it acquired the name of India-Rubber.

Although after its application to the water-proofing of garments its consumption gradually increased, the importation into the United Kingdom in 1830 appears not to have been more than 50,000 lbs. In 1842 the import of this article had increased to between 700,000 and 800,000 lbs. Up to the present time the consumption of India-Rubber has prodigiously increased; and one port alone in South America is said now to send to Great Britain nearly 4000 cwts. annually. To the large consumption in the United Kingdom must be added that of America, where the application of Caoutchouc has been much more general and successful than even in our own country.

The particular species of plants which are employed for procuring India-Rubber are very numerous, and it is probable that many yield it which are not yet known to botanists. The tree which supplies most in Continental India is the *Ficus elastica*, a tree belonging to the order *Moraceæ;* it is exceedingly abundant in Asam. All the species of *Ficus* yield Caoutchouc to a greater or less extent in their juices, and even the Common Fig (*Ficus Carica*) of Europe contains it. Species of *Ficus* produce the Caoutchouc brought from Java; and *F. radula, F. elliptica,* and *F. prinoides* are amongst those mentioned as affording a portion of that brought from America. Next to the *Moraceæ* the order *Euphorbiaceæ* yields the largest quantity of Caoutchouc. The *Siphonia elastica*, a plant found in Guyana, Brazil, and extending over a large district of Central America, yields the best kinds of India-Rubber that are brought into the markets of Europe and America. To another order, *Apocynaceæ*, we are indebted for the Caoutchouc which is brought from the islands of the Indian Archipelago. The plant which is the source of this substance in those districts is the *Urceola elastica*, a climbing plant of very rapid growth and gigantic dimensions. A single tree is said to yield, by tapping, from 50 to 60 lbs. annually. Many other plants of this order yield Caoutchouc, and of those given on good authority we may mention—*Collophora utilis* and *Cameraria latifolia*, plants of South America; *Vahea gummifera*, in Madagascar; and *Willughbeia edulis*, in the East Indies. To this order belongs the Cow-Tree, or Hya-Hya (*Tabernæmontana utilis*), of Tropical America, which yields a milky juice that is drunk by the natives of the district in which it grows.

The Caoutchouc, whilst it is in the tissues of the plant, is evidently in a fluid condition; but after its separation from the other fluid parts its consistence becomes changed, and it forms a solid mass similar in its external characters to vegetable albumen. In this state it is dense and hard, but may be separated and rolled out so as to form a sheet resembling leather. It has many interesting and peculiar properties. Insoluble in water and in alcohol, it dissolves in ether, in the sulphuret of carbon, the fat oils, and the liquid carburets of hydrogen.

It is soft and elastic at the ordinary temperature, but at the temperature of 2° above the freezing point it acquires the hardness of wood. A temperature of 100° softens it without altering its form. It then unites with itself with the greatest facility, and two pieces recently cut apart re-unite so as to render it impossible to discover where the junction has taken place. But a higher temperature, approaching 150°, changes it into an adhesive substance, which on cooling does not recover the primitive properties of Caoutchouc.

In the state of recent coagulation, and while still in a pulpy condition, Caoutchouc possesses a degree of plasticity which admits of its receiving, by means of moulds, the most varied forms.

The greater part of the Caoutchouc of commerce is obtained by the natives of the countries in which it is produced in the form of shapeless masses, collected at the foot of the tree which has been incised or cut for the purpose of extracting the juice from it, or solidified in a trench made in the earth, and coagulated in this rude mould in voluminous masses, which often resemble the trunk of a large tree. A part of it however possesses other forms which the rude art of the natives attempts to communicate to it. They model with plastic clay figures of animals, imitations of the human foot, and pear-shaped bodies; and then dipping these moulds in the thickened Caoutchouc, and renewing the connection when the first coat is solidified by exposure to the air, they obtain, by breaking the mould and getting it out in fragments through an opening properly arranged, hollow flasks, figures of animals, rough slippers, &c. They thus make Caoutchouc serve for the manufacture of objects for which we ourselves employ animal membranes and leather.

India-Rubber is obtained from both the Old and New World. The East Indies supplied the original specimens seen in Europe, and have ever since been a source of supply to the British markets. It comes principally from Java, and is often glutinous, and is less esteemed in commerce than that furnished by the equatorial regions of America. Great quantities of Caoutchouc are imported into Europe from Mexico, from South America, and especially from the province of Para in Brazil. That which comes in the shape of bottles is generally preferred; and when it is pure, and the different coats which comprise it are well united, it may be employed immediately for many purposes. But it often happens that the coats which form the pear-shaped masses are badly united. It then becomes necessary, in order to make use of them, to work it up by a process of kneading, so as to obtain it in a coherent or homogeneous mass. This operation becomes especially indispensable when, as most commonly happens, the Caoutchouc is in large impure masses, and mixed with sand and the débris of vegetable matter. These impurities do not entirely proceed from the moulds made in the earth into which the juice has been allowed to exude, and in which it has been left to thicken and solidify; but their quantity and their presence between the coats of the pyriform masses show that the impurity is mainly to be attributed to fraud. The Caoutchouc thus obtained is not applicable to any use until it has undergone a previous purification.

The purification of the Caoutchouc is accomplished by submitting the impure Caoutchouc to the action of cylinders furnished with teeth turning in opposite directions and with unequal velocities, which cause it to undergo a kind of mastication. By this treatment the Caoutchouc becomes softened without being liquified, and a homogeneous mass is formed which is cut in the form of rectangular blocks, which being again cut, constitute those small parallelopipedons used by draughtsmen to rub out the marks of black-lead pencils. This use was in England for a long time the only one to which this substance was applied, but this limited use was far from indicating the extent to which Caoutchouc has been employed in the last thirty years, or the multiplicity of services it has been called upon to perform for sanitary and industrial purposes. To rub out pencil-marks, to form the rude slippers which seemed well adapted to the Indian toilet, but to which a form acceptable in Europe had not been imparted, were in fact the only uses to which Caoutchouc was applied up to 1820. [CAOUTCHOUC, MANUFACTURE OF, in ARTS AND SC. DIV.]

The relations of Caoutchouc to the functions of the plants in which it is found are not understood. Many fallacious views have been offered on this subject. Schulze of Berlin, who has written most extensively on this subject, regarded it as a principle in the juices of plants analogous to the fibrine of the blood, but his views with regard to the milky juice of plants and the laticiferous tissue are now generally allowed to be erroneous. It is not improbable that Caoutchouc is formed as the result of the deoxidation of cellulose, or some other ternary constituent. The chemical composition of Caoutchouc is Hydrogen and Carbon. In what proportion they exist is not known. When distilled, Caoutchouc yields oils which have a composition similar to oil of turpentine—$C_{10} H_8$ or $C_{20} H_{16}$.

(*Reports of the Great Exhibition of* 1851, Class XXVIII., by Dr. Lankester; Schleiden, *Principles of Scientific Botany*; Gregory, *Handbook of Organic Chemistry*.)

INDIAN CORN. [ZEA.]

INDIAN CRESSES. [TROPÆOLACEÆ.]

INDIAN OX. [BOVIDÆ.]

INDIAN SHOT. [MARANTACEÆ.]

INDIANITE. This Mineral occurs in granular masses. It has a hardness 5·0 to 5·5. It scratches glass. The colour is white or grayish; lustre shining; translucent; specific gravity 2·74. It is infusible by the blow-pipe, and gelatinises in acids. It occurs associated with *Garnet*, *Felspar*, *Fibrolite*, and *Hornblende*.

INDICATOR. [CUCULIDÆ.]

INDICOLITE. [TOURMALINE.]

INDIGO. [INDIGOFERA.]

INDIGOFERA, a genus of Plants belonging to the natural family *Leguminosæ*, indigenous in the equinoctial parts of Asia, Africa, and America, and celebrated for some of the species yielding Indigo. The species are about 150 in number; all are small herbaceous or shrubby plants. The leaves are usually pinnate; the flowers small and papilionaceous, in axillary clusters of a purple, blue, or white colour. The calyx is 5-cleft; segments acute; vexillum roundish, emarginate; keel furnished with a subulate spur on both sides. Stamens diadelphous (9 and 1). Legume continuous, one or more seeded. Seeds usually truncated, separated by cellular spurious partitions. There is some difficulty in ascertaining all the cultivated species, as the subject is usually neglected both by naturalists and cultivators.

I. tinctoria is the species generally cultivated in India, whence it has been introduced both into Africa and America. It is suffruticose, erect, branched; leaves pinnate: leaflets 5 or 6 pairs, long-obovate, scarcely pubescent; racemes of flowers axillary, shorter than the leaves. Legumes approximated towards the base of the rachis, nearly cylindrical, slightly torulose, deflexed, and more or less curved upwards; sutures thickened; seeds about 10, cylindrical, truncated at both ends. This species is sometimes called Indigo Franc and French Indigo in the West Indies. It is said to be found wild along the sands of Senegal. ('Flore de Senegambie,' vol. i. p. 178.)

I. Anil. From the name it might be inferred that this was an Asiatic plant; but it is said by De Candolle to grow wild in America, and to be cultivated in both Indies, as also along the Gambia in Africa. The name Anil, which has passed into the Spanish, has evidently the same origin as the Arabic Neel, or Nil. The Spaniards and Portuguese, who had found the way to India by two opposite courses, must there have become acquainted with Indigo, and adopted its Indian name: they were the first to manufacture it in America—the Portuguese in Brazil, and the Spaniards in Mexico. This species is characterised by an erect suffruticose stem; leaves pinnate in 3 to 8 pairs; leaflets oval-oblong, scarcely pubescent on the under surface; racemes axillary, shorter than the leaves; legumes compressed, not torulose, deflexed, curved, with both sutures thickened and prominent, 10- to 12-seeded. Messrs. Wight and Arnot state, "We have not sufficient materials to enable us to determine if *I. Anil* be a distinct species. We know of no distinguishing character, unless it is to be found in the fruit, and the descriptions given of that part in the two species differ in different authors." But the authors of the 'Flore de Senegambie' consider them distinct, as do most botanists.

I. cærulea (Roxb.). This is a new species described by Dr. Roxburgh, and called Karneeli in Telinga by the natives of the peninsula of India. He states that from the leaves of this plant he had often extracted a most beautiful light Indigo, more so than he ever could from the Common Indigo Plant, or even from *Nerium tinctorium*, and in a large proportion. He says it is an erect shrubby species, growing in dry barren uncultivated ground, to the height of 3 feet, and higher in good garden soil. It flowers during the wet and cold seasons. The leaves are pinnate; leaflets 4-paired, obovate, emarginate; racemes rather shorter than the leaves; legumes reflexed, curved, contracted between the seeds, hairy; from 3- to 4-seeded. De Candolle inquires whether this be sufficiently distinct from *I. tinctoria*. Dr. Roxburgh states that it comes near to *I. argentea*, Linn. The process he adopted for extracting Indigo from this plant was similar to that practised with the leaves of *Nerium tinctorium*, or the scalding process.

I. argentea is a species usually stated to be a native of India, and the authority of Dr. Roxburgh might be cited for the fact; but Messrs. Wight and Arnott state that *I. argentea* of Linnæus is not found in India. It is the species cultivated in Egypt and Barbary for the sake of its Indigo, and, according to Humboldt, also in America. The Indian species which has been confounded with it is *I. paucifolia* of Delille, which has alternate leaflets, and linear, slightly compressed, torulose legumes. *I. argentea* is shrubby, with round branches, which appear of a silky whiteness from appressed pubescence; leaves pinnate, 1- to 2-paired; leaflets opposite, obovate, silky-pubescent; racemes shorter than the leaf; legumes pendulous, much compressed, torulose, canescent; 2- to 4-seeded.

I. disperma. This, according to Humboldt, is also one of the species cultivated in America, and seen among the most ancient hieroglyphical paintings of the Mexicans. Dr. Bancroft considers it as the species called Guatemala Indigo, which yields fine pulp, but is less productive than other species. The stem is herbaceous, weak; the branches round; leaves pinnate, 4- to 6-paired; leaflets elliptico-olbong, smooth; racemes slender, larger than the leaf; legumes round, subtorulose, mucronate; 2-seeded.

Plants of other genera are also employed for obtaining Indigo—as *Wrightia* (*Nerium*, Roxb.) *tinctoria*, *Marsdenia tinctoria*, *Galega tinctoria*, but especially the first two. Dr. Bancroft (vol. i. p. 190) also adduces *Spilanthes tinctoria*, *Scabiosa succisa*, *Cheiranthus fenestralis*; also a species of *Bignonia* and a *Tabernæmontana*, on the African coast, with *Amorpha fruticosa* and *Sophora tinctoria*, as all yielding a blue dye, or coarse sorts of indigo. [INDIGO, in ARTS AND SC. DIV.]

INDU. [LEMURIDÆ.]

INFEROBRANCHIA'TA, the third order of Gasteropodous *Mollusca*, in the system of Cuvier, who describes them as having nearly the form and organisation of *Doris* and *Tritonia*, but remarks that their branchiæ, instead of being placed on the back, are arranged in the form of two long suites of leaflets on the two sides of the body under the advanced border of the mantle. He records two genera, *Phyllidia* and *Diphyllidia*.

Phyllidia.—Mantle naked, and most frequently coriaceous; no shell. Mouth a small proboscis, with a tentacle on each side; two other tentacles come forth above two small cavities of the mantle. Organs of generation under the right side forward. Heart towards the middle of the back. Stomach simple, membranous; intestine short. (Cuvier.)

M. De Blainville describes the body of the genus *Phyllidia* as oblong and rather convex; the head and the foot hidden by the border of the mantle; four tentacles, the two upper ones retractile in a cavity which is at their base, the two lower buccal; mouth without an upper tooth; a lingual denticulated mass; branchial laminæ all round the lower border of the mantle, except in front; vent at the posterior and mesial part of the back; orifices of the organs of generation in a common tubercle at the anterior fourth of the right side.

P. pustulosa is a native of the Indian seas, where the other species have also been found.

Phyllidia pustulosa.

Diphyllidia (*Linguella* ? Leach).—Branchiæ nearly the same as in *Phyllidia*, but the mantle is more pointed behind; the head, which is demicircular (la tête, en demi-cercle), has on each side a pointed tentacle and a slight tubercle; vent on the right side. (Cuvier.)

M. De Blainville thus describes *Linguella*, which both Cuvier and himself seem to consider as identical with *Diphyllidia*.

Body oval, very much depressed, the mantle projecting beyond the foot on all sides, except in front; head uncovered. Branchial lamellæ oblique, and only occupying the two posterior thirds of the inferior border of the mantle; vent inferior, situated at the posterior third of the right side; orifices of the organs of generation in the same tubercle, at the anterior third of the same side.

Linguella Elfortii, De Blainv. (*Diphyllidia Brugmansii* ? Cuv.). M. De Blainville says that the locality of this animal is unknown. Cuvier says that *Linguella Elfortii* appears to him not to be different from his *Diphyllidia Brugmansii*.

M. De Blainville further says that it is probable that the genus established by M. Rafinesque under the name of *Arminia* does not differ much from *Linguella*. In his 'Additions and Corrections' to his 'Manuel' he says that M. Otto has discovered a species of *Linguella* in the sea of Naples.

Linguella Elfortii. De Blainville.

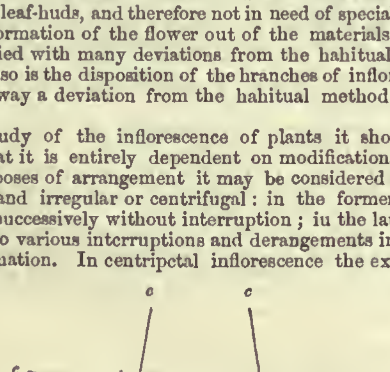
M. Rang observes that *Diphyllidia, Languella*, and *Arminia* being identical, Cuvier's name should be preserved: the two subsequent names should consequently be omitted.

Messrs. Forbes and Hanley, in the Appendix to the 'History of British Mollusca,' give an account of the taking of specimens of *Diphyllidia lineata* in the Shetland Isles and at Whitburn in Durham.

M. Rang included the fresh-water *Aucylus* in this group. It has however pulmonic sacs, and belongs to the *Limneadæ*.

INFLORESCENCE, in Plants, is the manner in which their flowers are arranged. A flower being a body analogous to a leaf-bud, with a similar origin, and capable, under particular circumstances, of reverting absolutely to that condition, it follows that the branching of that part of a plant which bears flowers should be of the same nature as that which bears leaf-buds, and therefore not in need of special explanation. But as the formation of the flower out of the materials of a leaf-bud is accompanied with many deviations from the habitual development of its parts, so is the disposition of the branches of inflorescence often in a similar way a deviation from the habitual method of arranging those parts.

In the study of the inflorescence of plants it should never be forgotten that it is entirely dependent on modifications of the axis. For the purposes of arrangement it may be considered as regular or centripetal, and irregular or centrifugal: in the former all the parts are formed successively without interruption; in the latter the parts are subject to various interruptions and derangements in the progress of their formation. In centripetal inflorescence the external flowers



of a disc, or the lowermost of a cone, are first developed, and consequently first expanded; and hence the course of unfolding proceeds from the circumference to the centre, or, which is the same thing, from the base to the apex. In centrifugal inflorescence the axis of growth is arrested in its progress by the formation of a flower-bud, as at *a*, in the accompanying diagram; two lateral points then develop from below *a*, and lengthen to *b*, where a new flower-bud appears, and stops the growth; two other lateral points are produced from below *b* and lengthen to *c*, where a new flower-bud again arrests the progress of development; and so on. In this case it is clear that *a* in the centre, being first formed, will expand before *b b* and *c c c c*; that *b b* will in like manner open before *c c c c*, and in the same way all the others: hence the order of expansion of the flowers is from the centre to the circumference. To this kind of inflorescence the word Cyme is usually applied. It occurs in the Common Elder, the Laurustinus, &c.

The centripetal inflorescence, in its simplest state, is merely a branch bearing flowers instead of leaf-buds, as in the Hyacinth and the *Ornithogalum*. If the flowers are sessile, it is then called a Spike; if stalked, a Raceme. If the branch of the spike or its axis is so much contracted as to become a broad disc, as in the Dandelion, or Daisy, or common Artichoke, the inflorescence is called a Head or Capitulum; if the same thing happens to a raceme, the Umbel of Astrantia, Fennel, Parsley, &c., is the result. Let the flower-stalks of the raceme be branched or racemose, and the Panicle is produced.

The following is a survey of the kinds of inflorescence and their names, from Professor Schleiden's 'Principles of Scientific Botany.'

A. The Solitary Flower, as terminal or axillary flower (Flos Solitarius, terminalis vel axillaris). The latter may be situated in whorls, and then form a Verticil (Verticillus).

B. Simple Inflorescence.

α. Inflorescentia Centripeta.

1. The Capitulum. The undeveloped axis is here usually enlarged upward, with a fleshy or spongy substance, and the more so if the number of flowers is very great. It may be more minutely designated as simple, discoid, cupulate, lageniform, conical, and cylindrical, as it approaches nearer to one or another. The last form then passes gradually into the spadix. Special varieties are:—

* The Calathium (Anthodium, Ehrh.; Flos Compositus, Linn.), a many-flowered capitulum, whose single flowers stand in the axils of more or fewer stunted bracts, and are surrounded with one or more circles of sterile bracts, as in the family of the *Compositæ*.

** The Cœnanthinum, Nees (Hypanthodium, Link.). Exactly like the preceding inflorescence in some *Urticaceæ*. The cup-shape of the peduncle in *Ficus* is no distinction, since it is wanting in *Dorstenia*; and it exists in some *Compositæ*; the same may be said with regard to the sterile bracts, which are as much stunted in *Dorstenia* as they are clearly present in *Ficus*.

2. The Spike (Spica) in very various forms. The kinds are:—

* The Catkin (Amentum), distinguished by the fact that it falls off entire, or by its imperfect flowers. The male inflorescence of *Cupuliferæ, Salicaceæ, Betulaceæ*, and some few other plants.

** The Spadix, a closely crowded spike, or partially a cylindrical capitulum with fleshy peduncle; in *Araceæ*, Maize, and some other Grasses, and in Palms, in the last of which it is often compound (Spadix Ramosus).

*** The Cone (Strobilus or Conus), a cylindrical capitulum or solid spike, on which the individual foliar organs become woody scales; as in the *Coniferæ*, the *Casuarinaceæ*, the *Betulaceæ*, and some others.

**** The Spikelet (Spicula), the simple inflorescence of the Grasses and *Cyperaceæ*; namely, a few-flowered spike, whose flowers have no bracts, surrounded at the basis by one or two sterile bracts (Glumæ).

3. The Umbel (Umbella) in the *Umbelliferæ*; when compound termed Umbellule (Umbellula).

4. The Raceme (Racemus) occurs in very different forms; it is usual to distinguish in it—

The Corymb (Corymbus), a pyramidal raceme.

β. Inflorescentia Centrifuga.

5. The Cyme or False Umbel (Cyma), is a corymb with Inflorescentia Centrifuga.

That only singular cases are distinguished in these is a proof of the totally unscientific patching together of our terminology. The compound raceme, the compound umbel, and capitulum, with inflorescentia centrifuga are all called a Cyme (Cyma), which is contrary to the commonest scientific laws. De Candolle has further applied the term Cyme to the inflorescence of the *Boraginaceæ*, which, on account of the peculiar manner in which it unrolls itself, he terms Cyma Scorpioides; and he adds the fiction, that the undermost first-blooming flower is really the terminal blossom, and the second, the terminal blossom of side axis, is developed in a disproportionate degree, &c. From the rolling up there is just as little to be deduced as from the same phenomenon in the leaves of *Ficus* and *Cycadaceæ*. The position of the bracts, as seen in *Cerinthe*, contradicts this fiction; and the history of the development, which can alone determine the point, appears to prove that here a one-sided raceme or spike is present, whose unrolling is only a peculiar situation of the buds.

C. Once-Compound Inflorescence.

α. Pure or Homomorphous.

* Inflorescentia Centripeta.

6. The Spike of the Grasses (Spica), several spikes united in a spicate arrangement, as in the Grasses; the component spikes are termed Spikelets (Spiculæ).

7. The Umbel (Umbella). Umbels united in umbels; the components are termed Umbellules (Umbellulæ).

Sound terminology would have long ago rejected these words, and exchanged them for Spica and Umbella Composita.

8. The Panicle (Panicula); see No. 11.

None of the remaining combinations deserve special names, and may probably be classed among those mentioned under 9 and 11.

** Inflorescentia Centrifuga.

9. The Cyme or False Umbel (Cyma); see No. 5 and No. 14.

10. The Anthela; see No. 16.

β. Mixed or Heteromorphous.

* Inflorescentia Centrifuga.

See No. 14.

** Inflorescentia Centripeta.

See No. 11.

D. Many-Times-Compound Inflorescence.

* Inflorescentia Centripeta.

11. The Panicle (Panicula), every many-branched inflorescence; in Grasses universally, and otherwise only in developed pedicels.

12. The Thyrse (Thyrsus), a panicle, with very short pedicels; with the exception of Grasses, found almost universally.

Both terms are applied also to once-compound inflorescences. De Candolle uses the term Thyrsus for those in which Inflorescence Centrifuga and Centripeta are mingled; others differently; all arbitrarily.

13. The Anthurus, an inflorescence that has the kind of aspect of that of the *Amaranthus caudatus* or the *Chenopodiaceæ*.

** Inflorescentia Centrifuga.

14. The Cyme (Cyma), also in manifold combinations, in which however we not consider whether the side ramifications follow the Inflorescence Centripeta or Centrifuga in longer pedicels.

15. The Bunch (Fasciculus), a manifold compound cyme, with short pedicels, and rather crowded.

16. The Anthela, all kinds of inflorescences in the *Juncaceæ* and *Cyperaceæ*.

17. The Glomerule (Glomerulus), many inflorescences that appear almost like a capitulum, and consist only of ill-formed, imperfect flowers, as in some *Chenopodiaceæ*, *Urticaceæ*, and *Juncaceæ*.

We subjoin Professor Schleiden's closing remarks:—

"I leave every one with thinking faculties to draw for himself the sad conclusions which the preceding survey affords; and I think that I have not to defend myself to any one who is acquainted with our literature against the charge that the foregoing is a frivolous vagary of my humour. Röper first attempted a scientific development of the inflorescence. No one that I know of has followed him, except Lindley. Physiologists seem not to have accounted it of sufficient importance. Systematists have too much to do with their herbaria, and it is much easier to coin a new word than to study minutely the progressive development through a large series of plants. For the sake of those unacquainted with these matters I will insert the following examples:—In *Lotus corniculatus*, Koch ('Syn. Fl. Germ.') has a Capitulum, Kunth ('Fl. Berol.'), an Umbella, Reichenbach ('Fl. Excurs.'), actually a Fasciculus. To *Eriophorum vaginatum* Kunth gives a Spica; Koch, a Spicula. For *Cladium Mariscus* Kunth has Umbellæ Axillares et Terminales; Koch, Anthelæ Axillares et Terminales; Reichenbach, Cymæ Axillares et Terminales; in *Isolepis supina* Koch has Spiculis in Fasciculum aggregatis; Kunth, Spicis Conglomeratis. I have here omitted the French and English botanists, or the matter would have been still more glaring."

INFUSORIA. This term has been applied to the numerous minute animals found in water, which are commonly called Animalcules.

The invention of the microscope by Hooke revealed the existence of myriads of living creatures whose presence was before unknown; and this instrument has shown that a drop of water, though it may appear to the naked eye to be perfectly clear, is perhaps swarming with living beings. Ehrenberg (whose labours have principally contributed to the knowledge of the true nature and structure of the infusory animalcules) has described species which are not larger than from 1·1000th to 1·2000th of a line in diameter, and which are separated from one another by intervals not greater than their own size. A cubic inch of water may thus contain more than 800,000 millions of these beings, estimating them only to occupy one-fourth of its space; and a single drop (measuring not more than a line in diameter) placed under the microscope will be seen to hold 500 millions, an amount perhaps nearly equal to the whole number of human beings on the surface of our globe.

If a single drop of water thus swarms with life, what incalculable numbers of animalcules must be contained in every stagnant pond or lake, and in the sea.

When Linnæus arranged all the organised beings known to him in the 'Systema Naturæ,' the structure of these minute animals was not sufficiently understood to enable him to distribute them according to their relations in his several classes; he therefore placed them at the end of his last class, *Vermes*, in a genus which he denominated *Chaos*. Otto Frederick Müller first separated them as a distinct order; and as the greater number of animalcules had been detected in liquids, in which vegetable or animal matters had been dissolved by infusion, he gave them the name *Infusoria*. Müller described many species, and acquired a considerable knowledge of the structure and organisation of these minute beings; but he did not base his arrangement of the different genera on their varieties of structure, but only on the differences of their external form. Gmelin, in the 13th edition of the 'Systema Naturæ,' adopted Müller's arrangement, as also did Lamarck and Cuvier, who only altered the divisions and subdivisions of the class without changing the mode of arrangement or adding any new facts respecting the structure of these animals. Bory de St. Vincent formed a new classification; but he also based his system on their external forms, which later investigations have shown to possess little importance as distinctive characters, for two species very unlike in external form may be almost identical in internal structure.

No new facts of importance respecting the organisation of the *Infusoria* were discovered after the publication of the work of Müller in 1773-74, till Professor Ehrenberg of Berlin directed his attention to the subject. He made numerous observations on the internal structure of these animals by means of feeding them with particles of colouring matter, which he diffused in the water which contained them. The substance which he found to answer this purpose in the most satisfactory manner was pure indigo. It was necessary to use colours not chemically combining with water, but only diffusible through the fluid in a state of minute subdivision, so that the coloured particles might be seen passing through the body of the animal.

The result of Ehrenberg's labours was given to the world in his great work entitled 'Die Infusionsthierchen,' in which he described upwards of 500 species of these minute beings. When first published this work seemed so complete and so exhaustive of the subject, that it was some years before any one doubted either the correctness of the observations or the soundness of the conclusions of its author. The improvement however of the microscope, and the extended use of this instrument, have recently brought a large number of observers into the field, and many modifications of the views of Ehrenberg have been introduced. We present here a summary of the conclusions arrived at by Ehrenberg, as a fit starting-point for a history of the more recent views of naturalists and comparative anatomists on the subject of the *Infusoria*:—

1. All the *Infusoria* are organised, and the greater part of them (probably all) are highly organised bodies.

2. The *Infusoria* constitute two very natural classes of animals, according to their structure, which classes admit of subdivision upon the same principle.

3. The existence of the *Infusoria* in the four quarters of the globe, and the sea, is proved; as also that of individuals of the same species in the most opposite ends of the world.

4. The geographical distribution of the *Infusoria* upon the earth follows the laws observed regulating that of other natural bodies.

5. Most of the *Infusoria* are visible to the naked eye; many are visible as moving points; and the size of the body does not exceed in any case 1·12th of an inch.

6. The minute invisible *Infusoria*, in consequence of their immense and swarming numbers, colour large tracts of water with very remarkable hues.

7. They give rise to one kind of phosphorescence of the sea, though in themselves invisible.

8. They compose (though singly invisible) a sort of mould, through living in dense and crowded masses.

9. In a cubic inch of this mould more than 41,000 millions of single animals exist, and constitute most likely the chief proportion of living bodies upon the face of the earth.

10. The *Infusoria* are the most reproductive of organised bodies.

11. From one of the known propagative modes of the *Infusoria*—that is, self-division—a continual destruction beyond all idea of the individual, and a similar interminable preservation and extension of it, in air and water, ensue, which poetically border upon eternal life and growth.

12. The copulation of *Gemmæ*, which perhaps includes the hitherto-unsolved polyembryonate riddle of the seeds of all plants and vegetable formations, is solved in the family *Closteria*. [DESMIDEÆ.]

13. The *Infusoria*, in consequence of their silicious shells, form indestructible earths, stones, and rocky masses. [DIATOMACEÆ.]

14. With lime and soda we can prepare glass, and swimming bricks, out of invisible animalcules; use them as flints; probably prepare iron from them; and use the 'mountain meal' composed of them as food in hunger. [BERGMEHL.]

15. The invisible *Infusoria* are sometimes hurtful by causing the death of fish in ponds, deterioration of clear water, and boggy smells; but not, as has been supposed, in giving rise to malaria, plague, and other maladies.

16. The *Infusoria* appear to be (as far as is yet known) sleepless.

17. The *Infusoria* partly disappear by the deposition of ova, and thereby undergo, passively, various changes of form.

18. The *Infusoria* form invisible intestinal worms in many animals, and in man, even if the *Spermatozoa* are excluded from amongst them.

19. The microscopic *Infusoria* have also themselves internal and external parasites.

20. The *Infusoria* possess a comparatively long life.

21. As the pollen of the pine falls yearly from the clouds, in the form of sulphur rain, so do the much smaller animalcules appear (from being passively elevated with the watery vapour) floating in a live state in the atmosphere, and sometimes perhaps mixed with dust.

22. In general the *Infusoria* maintain themselves pretty uniformly against all external influences, as do larger organised bodies. It is true that they sometimes consume strong poisons without immediate injury, but not without an after-effect.

23. The weight of the invisible *Infusoria*, light as it is, is yet calculable, and the most gentle current of air or draught can play with their bodies as with the vapour of water.

24. The evident and great quickness of the motion of *Infusoria* is reducible as follows:—*Hydatina senta* moves 1-12th of an inch in 4 seconds, *Monas punctum* the same in 48 seconds, while *Navicula gracilis* takes 26 minutes and 24 seconds to progress the same distance.

25. Linnæus said 'omnis calx è vermibus:' either to maintain or deny 'omnis silex, omne ferrum ve, vermibus,' would be at the present moment unjust.

26. The direct observations as yet known, upon the theory of 'generatio primitiva,' are wanting in necessary strictness. Those observers who profess to have seen the sudden origin of the minutest *Infusoria* from elementary substances, have quite overlooked the compound structure of these organic bodies.

27. The frequent wonderful changes of form of many *Infusoria* are yet to have their limits, and the laws governing them defined.

28. The power of infusorial organisation is instinctively shown by the strong chewing apparatus, with teeth, which they possess, and their exhibition, likewise of a complete mental activity.

29. The study of *Infusoria* has led to a more distinct and conclusive notion of animal organisation generally, and the limits which circumscribe the animal form, from which all plants and minerals, that want the animal organic system, are distinctly separated.

30. Finally, it results from these inquiries, that experience shows an unfathomableness of organic creations, when attention is directed to the smallest space, as it does of stars, when reverting to the most immense.

Under the class *Infusoria* Ehrenberg embraced two very different forms of animal life. This he did not fail to apprehend, and he divided them into *Polygastrica* and *Rotifera*. The latter division included the animals known by the name of Wheel Animalcules. The *Polygastrica*, so-called from the supposition that the typical forms possessed a number of stomachs, included all the remaining species of *Infusoria*.

Subsequently to the first publication of his views, Ehrenberg separated from what he calls the true *Infusoria* several families of animalcules which were formerly included in the same class. The principal genera thus separated are *Spermatozoa*, *Cercaria*, and *Vibrio*, which are now considered by some as part of the class *Entozoa*, and are divided into two families, named *Cercariadæ* and *Vibrionidæ*.

The *Cercariæ* found in vegetable infusions have an ovoid or cylindrical body, furnished with a tail, which is not so long as in the Zoosperms; and in some of the species a mouth, and eye-like specks of a dull red colour have been observed on the anterior part of the body. The family of the *Vibrionidæ*, so-named from their darting or quivering motion, includes the eel-like microscopic animalcules which abound in stale paste, vinegar, &c., together with others which are parasitic on living vegetables, where they have excited particular attention, from the damage which they occasion to ears of corn, as the *Vibrio Tritici*, which infests the grains of wheat, and occasions the destructive disease called ear-cockle, or purples. The *Vibrionidæ*, as well as the *Cercariadæ*, are said to differ from the true *Infusoria* not only in the absence of internal stomachs, but also of external cilia, which prevents them from exciting any currents when placed in coloured water.

On account of the difference in the perfection of structure between the two principal groups of infusory animals, they have been separated and placed in distinct divisions of the animal kingdom by some naturalists. Professor Owen makes the *Polygastrica* the lowest class of the sub-kingdom *Acrita*, and places the *Rotifera* in the division *Nematoneura*. Dr. Grant separates them in the same manner, placing the *Polygastrica* in his lowest group *Cycloneura*, and the *Rotifera* among the *Diploneura*. Ehrenberg, who retains both forms of *Infusoria* in one class, subdivides the sections *Polygastrica* and *Rotifera* into many minor groups, which are founded upon the modifications of different organs: first as to the form of the intestine, whether it is straight or curved, complete or imperfect; secondly, he considers the varieties of the organs of mastication or dental apparatus; thirdly, many of the *Infusoria* have the integuments naked; others are furnished with a crustaceous or horny covering; but both among the *Rotifera* and *Polygastrica* the naked and coated species are intimately connected together, and very often entirely agree with one another in internal and external structure, with the single exception of the consistency of their covering. These characters however, though not separating the animals into distinct divisions, are used as subordinate means of classification: and Ehrenberg has formed two parallel series, named *Nuda* and *Loricata*; which correspond to certain of the *Gymnodes* and *Crustodes* of Bory de St. Vincent. The number of loricated *Polygastrica* is very small, but among the *Rotifera* they bear a nearer proportion to the naked species.

An account of the *Rotifera* will be found under the article ROTIFERA. We here proceed to give Ehrenberg's classification of the *Polygastrica*.

Class *Phytozoaria polygastrica*.

Swimming animals, without vertebræ, apodal, having sometimes a tail, and very often scattered vibratory or rotatory ciliæ: having no heart, but vessels extremely delicate (ténus), reticulated, transparent, and deprived of proper movement; often rudimentary eyes, with red pigmentum, indicating a nervous system, which however is not apparent; mouth nude or surrounded by vibratory ciliæ, and communicating with several ventricules; the phalanx apparent, and generally unarmed; no branchiæ; organs of generation filiform, reticulated, and granular; no distinct male organ; gifted with power of reproduction by spontaneous division.

Legion 1. *Anentera.*

Mouth communicating with several stomachal vesicules; no anus, no intestinal tube.

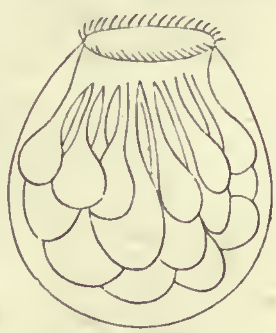
Order 1. *Nuda.*
Body without envelope.

Order 2. *Loricata.*
Body enveloped.

Section 1.—*Gymnica.*

Body not ciliated; mouth with or without ciliæ; no pseudo-pediform prolongations.

§ 1. *Gymnica nuda.*
Fam. 1.—*Monadina.*
Form of the body constant, reproduction by simple transverse division.
A. Without tail.
a. No eyes.
* Mouth truncate, terminal and turned forwards in swimming.
† Individuals solitary.
Genus *Monas.*
†† Individuals solitary when young, afterwards aggregated and again liberated.



Monas atomos.

Genus *Uvella.*
††† Individuals solitary when young, dividing crucially.
Genus *Polytoma.*
** Mouth direct, truncate, and turned different ways in the animal's movements.
Genus *Doxococcus.*
*** Mouth oblique, without edges, and bilobate.
Genus *Chilomonas.*
aa. One red eye.
Genus *Microglena.*
B. With a tail.
b. Body cylindrical.
Genus *Bodo.*
bb. Body angular.
Genus *Urocentrum.*

Fam. 2.—*Vibrionina.*
Body elongate, constant in shape, dividing into many parts, mouth terminal (?)
A. Body filiform, cylindrical, bending itself in undulations.
Genus *Vibrio.*
B. Body filiform, rigid, and rolling itself in spiral.

§ 1. *Gymnica loricata.*
Fam. 1.—*Cryptomonadina.*
Envelope membranous, sub-globular, and oval.
A. Simple.
a. No eyes.
* Mouth ciliated.
Genus *Cryptomonas.*
** Mouth nude.
Genus *Gyges.*
aa. With a red eye.
Genus *Lagenula.*
B. Compound, or reproducing by internal division.
Genus *Pandorina.*

Fam. 2.—*Closterina.*
Envelope round, when rigid, separating spontaneously into two or four parts by transverse divisions, and open at each end.
Genus *Closterium.*
[DESMIDEÆ.]

b. The spiral plane.
Genus *Spirodiscus*.
bb. The spiral helical.
Genus *Spirillum*.
C. Body oblong, fusiform, or filiform, neither undulated nor turned spirally.
Genus *Bacterium*.

Fam. 3.—*Astasiæa*.

Body elongated, becoming polymorphic by contraction, often cylindrical or fusiform, and spontaneously dividing itself in longitudinal or oblique direction.

A. No vestiges of eyes.
Genus *Astasia*.
B. Distinct rudimentary eyes.
b. One eye.
* A tail.
Genus *Euglena*.
** No tail.
Genus *Amblyophis*.
bb. Two eyes.
Genus *Distigma*.

Section 2.—*Epitricha*.

Body ciliated; mouth ciliated or nude; no pseudo-pediform prolongations.

Epitricha nuda.
Family 4.—*Cycladina*.

A. Body with vibratory ciliæ.
a. Ciliæ in simple rows, longitudinal or circular.
Genus *Cyclidium*.
aa. Ciliæ scattered.
Genus *Pantotrichum*.
B. Body deprived of ciliæ, but furnished with hairs not vibratile.
Genus *Chætomonas*.

Epitricha loricata.
Family 3.—*Peridina*.

A. Simple.
Genus *Peridinium*.
B. Compound, reproduced by interior division and rupture of the envelope.
b. No eyes.
* Envelope compressed.
Genus *Gonium*.
** Envelope globular.
† Ciliated.
Genus *Volvox*.
†† Tentaculated.
Genus *Sphærosira*.
bb. With eyes.
Genus *Eudorina*.

Section 3.—*Pseudopodia*.

Body furnished with variable pseudo-pediform prolongations.

Pseudopodia nuda.
Family 5.—*Amæbæ*.
Genus *Amœba*.

Pseudopodia loricata.
Family 4.—*Bacillaria*. [DIATOMACEÆ.]

The envelope dividing with the animal.

A. Free, never fixed.
a. Solitary or agglomerated.
* Envelope oblong.
Genus *Navicula*.
** Envelope wider than long.
Genus *Euastrum*.
aa. United in form of ribands, polymorphous; the individuals of the group have some freedom of movement without becoming detached; cuirass equally thick throughout, and prismatic.
Genus *Bacillaria*.
aaa. United in bundles, and not polymorphous, afterwards disunited.
Genus *Fragillaria*.
aaaa. United in a fan shape, without foot; cuirass thicker in front.
Genus *Exilaria*.
B. Fixed when young, afterwards free.
b. Sessile.
Genus *Synedra*.
bb. Pedicellated, often dichotomous by ramification; body reduced below, cuneiform.
Genus *Gomphonema*.
bbb. Pedicellated, often dichotomous; body contracted towards each extremity, subfusiform.
Genus *Cocconema*.
bbbb. Pedicellated, united in a fan shape, and often dichotomous.
Genus *Echinella*.

Family 5.—*Arcellina*.
Envelope undivided.

A. Envelope urceolate.
Genus *Difflugia*.
B. Envelope scutelliform.
Genus *Arcella*.

1. *Diatoma vulgaris*; *a*, natural size; *b*, *c*, magnified. 2. *Diatoma Swartzii*, magnified; *a*, end view. 3. *Fragillaria unipunctata*, magnified.

Legion 2.—*Enterodela*.

Mouth and anus distinct, opening into an intestine, round which are grouped the stomachal vesiculi.

Section 4.—*Anopisthia*.

Mouth and anus contiguous.

Anopisthia nuda.
Family 6.—*Vorticellina*.

A. Body pedicellated, fixed, afterwards detached, becoming often dichotomous.
a. Pedicle simple or branched, contracting into a spiral.
* Pedicle solid, the interior muscle indistinct.
Genus *Vorticella*.
** Pedicle tubular, the interior muscle often distinct, becoming arborescent by the spontaneous divisions of the animal.
† Animalcula of the same group similar.
Genus *Carchesium*.
†† Animalcula dissimilar in the same group.
Genus *Zoocladium*.
aa. Pedicle not contracting in spiral, rigid, with no interior tube.
Genus *Epistylis*.
B. Body not pedicellated and free.
b. Ciliæ in a single crown.
Genus *Trichodina*.
bb. Ciliæ in a spiral row conducting to the mouth.
Genus *Stentor*.

Anopisthia loricata.
Family 6.—*Ophrydina*.

A. Body surrounded by gelatine and not pedicellated.
Genus *Ophrydium*.
B. Body inclosed in a membranous sheath.
b. Pedicellated.
* Sheath sessile.
Genus *Tintinnus*.
** Sheath pedicellated.
Genus *Cothurnia*.
bb. Not pedicellated.
Genus *Vaginicola*.

Section 5.—*Enantiotreta.*

Mouth and anus terminal and opposite, reproduction effected by transverse division.

Enantiotreta nuda.
Family 7.—*Enchelia.*

A. Mouth terminal, direct, obtuse, generally ciliated; division of the body transverse.
a. Body not ciliated, nor with hairs.
* Simple.
Genus *Enchelys.*
** Double.
Genus *Disoma.*
aa. Body with vibratory ciliæ.
Genus *Holophrya.*
aaa. Body with ciliæ not vibratory.
* Subglobular.
Genus *Actinophrys.*
** Disciform.
Genus *Trichodiscus.*
B. Mouth terminal, oblique, often ciliated.
b. Body without cilia.
* No prolongation of the anterior part.
Genus *Trichoda.*
** Anterior part prolonged into the form of head and neck.
Genus *Lachrymaria.*
bb. Body ciliated.
Genus *Leucophrys.*

Enantiotreta loricata.
Family 7.—*Colepina.*
Envelope oval or cylindrical.
Genus *Coleps.*

Leucophrys patula, with some of the gastric cavities full of food.


Intestinal system of *Leucophrys patula.*

Section 6.—*Allotreta.*

Mouth and anus terminal and opposite, reproduction effected by longitudinal and transverse divisions.

Allotreta nuda.
Family 8.—*Trachelina.*
Mouth inferior, anus terminal.
A. Mouth unarmed.
a. No circle of ciliæ in front.
* Upper lip or front elongate, cylindrical or depressed, prolonged into a narrow trumpet form.
Genus *Trachelius.*
** Upper lip short, depressed, and dilated obliquely.
Genus *Loxodes.*
*** Upper lip compressed, subcarinate, or tumid.
Genus *Bursaria.*
aa. Front with a ring of ciliæ.
Genus *Phialina.*
B. Mouth armed with hooks.
Genus *Glaucoma.*
Family 9. *Ophryocercina.*
Anus inferior, mouth terminal.
Genus *Ophryocercus.*

Allotreta loricata.
Family 8.—*Aspidiscina.*
Genus *Aspidiscia.*

Section 7.—*Katotreta.*

Mouth and anus not terminal, reproduction as in the preceding section.

Katotreta nuda.
Family 10.—*Kolpoda.*
Body smooth or ciliated, unarmed.
A. No eyes.
a. A short retractile proboscis.
* Body partially ciliated.
Genus *Kolpoda.*
** Body ciliated obliquely all over.
Genus *Paramæcium.*
aa. No proboscis.
* Front and tail contracted.
Genus *Amphileptus.*
** Front oblong, tail contracted.
Genus *Uroleptus.*
B. With eyes.
Genus *Ophryoglena.*
Family 11.—*Oxytrichina.*
Body ciliated and hairy, or armed with styles or straight spiculæ and hooks.
A. Body hairy, no styles or hooks.
Genus *Oxytricha.*
B. Body with hooks and no styles.
Genus *Kerona.*
C. Body with styles and no hooks.
Genus *Urostyla.*
B. Body with styles and hooks.
Genus *Stylonichia.*

Katotreta loricata.
Family 9.—*Euplota.*
Body armed with hooks.
A. Head indistinct.
Genus *Euplotes.*
B. Head separated from the body by a contraction.
Genus *Discocephalus.*

At the time this classification was drawn up, the distinctions that limit the vegetable and animal kingdoms were less perfectly understood than at present. One of the first members of this group of organised beings that was withdrawn from the animal kingdom, was the *Desmideæ*, which are now generally recognised as plants. [DESMIDEÆ.] The group of *Pseudopodia loricata* must also be placed amongst doubtful creations, although many physiologists do not hesitate to group them amongst plants [DIATOMACEÆ], whilst the groups *Monadina* and *Volvocina* have recently undergone the most searching investigation, with the result that many of these forms are more decidedly vegetable than animal in their character. [VOLVOX.] Some have even gone further than this, and Agassiz in the 'American Journal of Science,' for 1852, thus writes to Mr. Dana :—"You may remember a paper I read at the meeting at Cambridge, United States, in August 1849, in which I showed that the embryo which is hatched from the egg of a *Planaria* is a genuine polygastric animalcule of the genus *Paramecium*, as now characterised by Ehrenberg. In Steenstrup's work on the 'Alternations of Generation' [GENERATIONS, ALTERNATION OF], you find that in the extraordinary succession of alternate generations, ending with the production of *Cercaria* and its metamorphosis into *Distoma*, a link was wanting—the knowledge of the young hatched from the egg of *Distoma*. The deficiency I can now fill. It is another *Infusorium*, a genuine *Opalina*. With such facts before us there is no longer any doubt left respecting the character of all these *Polygastrica*—they are the earliest larval condition of worms. And since I have ascertained that the *Vorticellæ* are true *Bryozoa*, and botanists claim the *Anentera* as *Algæ*, there is not a single type of these microscopic beings left which hereafter can be considered as a class by itself in the animal kingdom." Few naturalists would perhaps indorse this statement of Professor Agassiz. The *Vorticellæ* are not yet admitted as members of the family *Bryozoa* [POLYZOA]; nor are all the *Anentera* of Ehrenberg regarded indiscriminately as *Algæ*. The passage however indicates the direction in which inquiry is gradually breaking up the great polygastric family of Ehrenberg. It is nevertheless very certain that many of the species enumerated by Ehrenberg are only transitionary forms in which the same being exists. To no one has this department of science been more indebted than to Dr. F. Stein, who in his recent work, entitled 'Die Infusionsthiere auf ihre Entwickelungs-Geschichte untersucht' (Leipsic 1854), has given the result of a long series of investigations on this subject. The following is a summary of Dr. Stein's researches, as recorded in this volume. (It ought however to be premised that Föcke, Dujardin, and Siebold had previously pointed out that the great mass of the Polygastric *Infusoria* were much simpler than Ehrenberg had supposed, and that the internal organs he had described were referrible to the general conditions of unicellular organisms, whether animal or vegetable.)

"In a glass in which were contained a great variety of ciliated *Infusoria*, and among them also numerous individuals of *Euglena viridis*, *Eacus*, and *Edeses*, Dr. Stein remarked, after the lapse of some days, the formation of a thin film on the surface of the water, composed of an interlacement of confervoid filaments and *Oscillatoriæ*. This film swarmed with *Euglenæ*, many of which had lost their beaks, and crawled about with a worm-like movement among the *Confervæ* and *Oscillatoriæ* filaments. Besides these he discovered, to his great joy, a great many transparent gelatinous or quite soft cysts, which sometimes contained only a single *Euglena* contracted into a globular form; sometimes two of a hemispherical form appressed together. The encysted *Euglenæ* proved to be still living, inasmuch as they moved about in the cysts, and if the cysts were ruptured the previously globular individuals reassumed their pristine elongated figure, and crawled about in the same manner as the other beakless individuals among the *Confervæ*.

"For what purpose was this encysting? The cyst was evidently intended for something more than a coffin. Farther observations soon showed that the encysting process of the *Euglenæ* had really reference to their multiplication. The process however appeared to be different in *Euglena* from that in *Gregarinæ*, inasmuch as in the latter case two individuals are conjoined before the cyst is developed, whilst in the *Euglenæ* the case is formed usually around but one; for where two individuals were found inclosed in a cyst, it was at once apparent that they had proceeded from the division of an originally single individual. Whilst thus investigating the *Euglenæ* his notice was also directed to other forms of *Infusoria* contained in the same water, such as *Paramecium aurelia*, *Prorodon niveus*, and *Holophrya discolor*, the latter two of which species he frequently observed inclosed in well-defined gelatinous cysts; and as these *Infusoria* belonged to quite another principal division of the class, he began to hope that the process of becoming encysted would probably turn out to be of general occurrence in the infusory world.

"This proved to be the case, and the work then proceeds to describe the way in which Dr. Stein was led to detect the connection between *Epistylis plicatilis* with a species of Ehrenberg's genus *Acineta*, an observation which pointed the way in his future researches. One of his earliest additional observations was that of the heterogeneous generation of *Epistylis digitalis*. In this species he traced first the metamorphosis of the *Epistylis* into an *Acineta*; and, secondly, observed in the latter the extraordinary fact of the development and evolution of a *Tricodina*, a discovery which Ehrenberg has attempted to explain by the supposition that the *Tricodina* had been previously swallowed by the *Acineta*. Dr. Stein's important researches are continued through the family of the *Vorticellinæ*, and his observations given upon *Actinophrys*, *Podophrya*, the genus *Tricodina*, and on the nature of the *Opalinæ*, the propagation of the *Chlorogonium euchlorum* and *Vorticella microstoma*, and particularly upon the quiescent condition of the latter *Infusoria*; upon *Spirochona gemmipara* and *S. Scheutenii*, and upon the *Acineta* state of *Dendrocometes paradoxus*, *Zoothamnium affine*," &c. &c. ('Quarterly Journal of Microscopical Science,' July, 1854.)

At the present time it would undoubtedly be premature to state that no organisms ought to be referred to Ehrenberg's class *Polygastrica*. It would however be probably better to substitute the term *Protozoa*, to receive organisms having an animal character, and yet presenting the same simple conditions that we find amongst the *Nostochineæ*, and other groups of lowly-developed plants. We may state generally that Ehrenberg's *Polygastrica* embrace the following groups of beings:—

1. True plants, as in the *Desmideæ* (*Closterina*), *Volvocina* (*Cryptomonadina*). and some others. [DESMIDEÆ.]

2. Organisms which the weight of evidence at present assigns to the vegetable kingdom, as *Diatomaceæ* (*Bacillaria*, *Fragillaria*, &c.), and a large number of the *Monadina* and *Vibrionina*.

3. The ova of *Entozoa*, as *Cercaria* and others, and probably even of higher animals.

4. Minute forms of animals referrible to previously-established groups: this seems to be the case with the whole of the *Vorticellina*, which may with more propriety probably be referred to Hydroid than to any other form of polypiferous animals.

5. Dujardin has pointed out the identity between the structure of organisms like *Amœba* with such forms as *Difflugia* and *Arcella*. In all these creatures there is no trace of mouth or digestive cavity, and the entire body is a single cell or an aggregation of cells, which derives it nutriment by absorption from without. Professor Kolliker has recently described the method by which one of these creatures, the *Actinophrys*, takes its food:—

"As regards the vegetable functions," says the Professor, "the mode in which the *Actinophrys* is nourished is one of the highest and most special interest. Although the creature has neither mouth nor stomach, yet it takes in solid nutriment and rejects what is indigestible. This miracle, for so it may almost be called, is thus effected with minute Crustaceans (*Rotifera*, minute species of *Lynceus*, the young of *Cyclops*, &c.) and the lower *Algæ* (*Diatomaceæ*, spores of *Vaucheria*, *Closterium*, &c.). When in its progress through the water it approaches one of these little plants, or when an *Infusorium* has come into proximity with it, both plant and animal, as soon as they touch one of the tentacular filaments, usually adhere to it. Now, as the filament with its prey slowly shortens itself, and the latter approaches the surface of the body, all the surrounding filaments apply themselves upon it, bending their points together so that the captive becomes gradually inclosed on all sides. According to all appearance, these filaments also become more or less shortened. In this way the morsel is gradually brought to the surface of the body, the filament by which it was seized being finally so much shortened as to disappear altogether, and having, as not unfrequently happens, relinquished its hold upon the prey, after the latter has become encompassed by the surrounding filaments. These gradually apply themselves more and more closely together around it, forcing it towards the surface of the body.

"The following proceeding now takes place:—The spot of the surface upon which the captured animalcule is lying slowly retracts, and forms at first a shallow depression gradually becoming deeper and deeper, in which the prey, apparently adherent to the surface and following it in its retraction, is finally lodged. The depression by the continued retraction of the substance now becomes deeper; the imprisoned animalcule, which up to this time had projected from the surface of the *Actinophrys*, disappears entirely within it; and at the same time the tentacles, which had remained with their extremities applied to each other, again erect themselves and stretch out as before. Finally, the depression acquires a flask-like form by the drawing in of its margin, the edges of which coalesce, and thus a cavity closed on all sides is formed in which the prey is lodged. In this situation it remains for a longer or shorter time, gradually however approaching the central or nuclear portion, and at last passing entirely into it, in order to await its final destination. In the meanwhile the external portion of the *Actinophrys* regains in all respects its pristine condition. The engulphed morsel is gradually digested and dissolved, as is readily seen by its change of appearance from time to time. If entirely soluble, as for instance an *Infusorium*, the space in which it is contained contracts as the dissolution of its contents goes on, and finally disappears altogether. Should there be however an indigestible residue (a membrane composed of cellulose, a portion of chitine, a shell of a *Lynceus*, or case of a rotifer, &c.), a passage for its exit is formed, and it is expelled by renewed contractions of the homogeneous substance, and in the same direction, or nearly so, as that which the morsel followed in its introduction. The passage and the opening through which the expulsion was effected disappear again without leaving any trace."

In the *Actinophrys* we have an animal closely resembling the creature which inhabits the shell of the large family known now as *Foraminifera* [FORAMINIFERA], and Dujardin suggests that the loricated forms of *Difflugia* and *Arcella* are transitions to the more decided forms of *Foraminifera*. Hence he proposes to include several forms of Ehrenberg's *Infusoria*, with the *Foraminifera* or *Polythalamia*, under the term *Rhizopoda*. Little therefore is left us to say of what may be regarded as true *Polygastrica*. They all appear to have a distinct mouth or entrance to the cavity of the body, and this is usually surrounded by vibratile cilia, as seen in the cuts of *Monas atomos* and *Leucophrys patula*. These cilia apparently bring the food to the mouth of the animal. An anal orifice is described by Ehrenberg in the majority of species. When finely divided soluble colouring-matter as carmine or indigo (a writer in the 'Microscopical Journal' recommends the red pigment which lines the cornea of the common house-fly) is introduced into the water in which they are contained, the transparent body of the animalcule is speedily seen to be studded with coloured globules, consisting of an aggregation of the particles of colouring matter. Ehrenberg regarded these globules as distinct sacs, which he supposed were given off from a central intestinal canal, as seen in *Leucophrys patula*. Regarding these sacs as so many stomachs, he gave them the name of *Polygastrica* (many-stomached). It is however still a question as to whether in any case these masses are contained in a distinct sac. The whole body of the animalcule is often covered with vibratile cilia (see cut of *Leucophrys*), and it is to the constant action of these organs that the varied movements of these animalcules are due. [CILIA.] The movements thus effected are perfectly automatic, and in no way connected with any intelligent consciousness. All the movements of these animals are not due to cilia, as the whole of the tissue of the animal is observed to contract in *Amœba*, *Amphileptus*, and the stalk of the *Vorticellina*.

Although Ehrenberg has described a complicated apparatus for reproduction, no instances of conjugation are recorded amongst the true *Polygastrica*. Their modes of multiplication are by fission and gemmation. In a large number of cases a simple division of the unicellular organism into two equal parts takes place. This process goes on so rapidly that, according to Ehrenberg, a single *Paramecium* could produce 268,000,000 of cells in a single month. From analogy we must suppose this process would not go on continually, and, as in plants, we must regard the separate cells thus produced as belonging to the same individual. Further observation is probably only needed to demonstrate the existence of a union of two cells—a sperm cell and a germ cell—as is now known to be almost universal in the vegetable kingdom. In the account above given of Stein's researches it will be seen, that it is not improbable that one of the modes by which these beings are enabled to spring suddenly into existence, is the production of winter-eggs, or reproductive bodies of a kind that will resist the influence of an absence of moisture from the spots in which they ordinarily abound.

The true *Polygastrica* seem universally diffused. Wherever organic matter exists in a decomposing state, there they abound. They exist in incredible numbers in the waters of the ocean, in rivers, lakes, ponds, pools, and ditches. They are found in the secretions of the higher animals, and even in man. Wherever the organic elements, carbon, hydrogen, nitrogen, and oxygen, are capable of uniting to form water, carbonic acid, and ammonia, there they may be expected to be found. The composition of the liquids in which they are found seems to determine the forms they assume. One set of forms inhabits salt-water, another fresh. Every mineral spring has its peculiar inhabitan. The sulphureous springs of the Pyrenees, the chalybeate waters of the Rhine, the siliceous, calcareous, and aluminous waters of Europe, all contain them. They are found with the red snow of the Alps and the poles, and with the *Conferva thermalis* of the hot springs of Aix and Baden. They are always accompanied with plants. Perhaps it would be wrong to call any beings animals that are not found feeding on plants, as it seems to be a law of organic existence that plants should subsist on mineral matters, and animals on organised matters.

What are the uses of these beings? To this question Professor Owen gives the following reply:—"Consider their incredible numbers, their universal distribution, their insatiable voracity, and that it is the particles of decaying vegetable and animal bodies which they are appointed to devour and assimilate. Surely we must in some degree be indebted to those ever-active invisible scavengers for the salubrity of our atmosphere. Nor is this all: they perform a still more important office in preventing the gradual diminution of the present amount of organised matter upon the earth; for when this matter is dissolved or suspended in water, in that state of comminution and decay which immediately precedes its final decomposition into the elementary gases, and its consequent return from the organic to the inorganic world, these wakeful members of nature's invisible police are everywhere ready to arrest the fugitive organised particles and turn them back into the ascending stream of animal life. Having converted the dead and decomposing particles into their own living tissues, they themselves become the food of large *Infusoria*, as the *Rotifera*, and of numerous other small animals, which in their turn are devoured by larger animals, as fishes; and thus a pabulum, fit for the nourishment of the highest organised beings, is brought back by a short route from the extremity of the realms of organic matter.

"There is no elementary and self subsistent organic matter, as Buffon taught; the inorganic elements into which the particles of organic matter pass by their final decomposition, are organically recomposed and fitted for the sustenance of animals through the operations of the vegetable kingdom. No animal can subsist on inorganic matter. The vegetable kingdom thus stands, as it were, between animal matter and its ultimate destruction; but in this great office plants must derive most important assistance from the Polygastric *Infusoria*. These invisible animacules may be compared, in the great organic world, to the minute capillaries in the microcosm of the animal body, receiving organic matter in its state of minutest subdivision, and, when in full career to escape from the organic system, turning it back by a new route towards the central and highest point of that system."

Fossil Infusoria.

Many of the species of the *Polygastrica* of Ehrenberg, are covered with a siliceous shield or shell, which is quite impenetrable. These forms are those which are now recognised as belonging to the *Diatomaceæ*. [DIATOMACEÆ.] The forms of *Infusoria* which are found fossil belong chiefly to this section. They are frequent in all the varieties of water which have been exposed to air and light, and in all the conditions of this element between the extremities of terrestrial temperatures, not absent even from snow, ice-covered streams, or the ejections of volcanoes, they have been recognised in all the regions of the globe. Lakes, rivers, and the sea are in places richly replenished by them, and their siliceous integuments falling through the water accumulate into extensive deposits. In regard to such accumulations in the sea, we have the evidence of soundings by Captain Sir J. Ross in the course of the antarctic voyage ('Annals of Nat. History,' Oct. 1845) and Ehrenberg's examination of the deposits at Cuxhaven; and their abundance in fresh waters is matter of universal occurrence. These deposits consist of the siliceous integuments of the *Infusoria*, and as only a small proportion of the families are protected with siliceous coverings, and as the waters which nourished them contain but little silica, while the deposits are very extensive, we naturally associate with these facts the idea of long-elapsed time.

On turning to the marine and fresh-water deposits of earlier date, this impression of the long duration of natural agencies becomes much heightened. When, conducted by Ehrenberg, we find beneath the Bohemian Mountains, and in the plains of North Germany, pleiocene deposits many feet in thickness, composed of little else than the thin flinty loricæ of *Microzoaria*, and following Professor Rogers and Mr. Bailey, who dug up myriads of other forms from the meiocene strata of Virginia, while Mantell and Reade exhibit to us *Infusora* from the chalk and the Kimmeridge clay of England, we must add to the historic time during which it can be proved these organisms have lived the large indefinite geological periods of Cainozoic and Mesozoic formations.

The source of the siliceous matter which enters the organisation of these beings is not difficult of discovery. Most of our fresh-waters contain silica, though not in abundance, derived, it is probable, from the decomposition of felspar and other mineral silicates. Silicate of soda and silicate of potash, thus occasioned, may by intermediate vegetative processes yield the silica in a state suitable for being organically solidified. In the hot waters of volcanic foci, silica is dissolved abundantly, and it is necessary to keep this fact in view while considering the extensive flint beds in chalk, the thick Polierschiefer beds of Bilin, and other siliceous masses, the result of organisation. The distinction of marine and fresh-water races, which runs through all the larger animals and plants with such regularity as to be termed a law of nature, obtains also, but less absolutely, in the *Infusoria*. Some species live both in fresh and salt water, and many at the junction of rivers with the sea. By comparing the living oceanic and lacustrine races on a large scale, enough of difference appears in their siliceous shields to authorise conclusions more or less positive as to the marine or fresh-water origin of infusorial deposits which contain identical or analogous forms belonging to earlier periods. Thus the rich deposits of Richmond in Virginia appear to have been formed beneath the sea; the famous deposits of Bohemia, Berlin, and Santa Fiora contain admixtures of marine and fresh-water tribes; while those of the Bann, in the county of Down, and Gainsborough and Bridlington, contain a more considerable proportion of fresh-water species.

Infusoria of marine or æstuary origin have been found in a fossil state very extensively in Europe, Asia, Africa, and America. Ehrenberg has described many species from Greece (Zante and Egina), Italy (Caltasinetta and Cattolica), and Africa (Oran), which occur in calcareous marls, referred by Ehrenberg to the age of the true chalk deposits. These deposits are very extensive in Africa, occupying the whole coast of Oran and large tracts in Egypt and Arabia. (Portions of this tract have however been described by M. Rozet as tertiary.) In the undoubted white chalk of Denmark (Rügen), of France (Meudon), of England (Gravesend and Brighton), *Infusoria* also occur, but less abundantly. North America has yielded a great variety of marine or partly marine *Infusoria*, especially at Richmond and Petersburg in Virginia, at West Point in Connecticut, Rhode Island, Massachusetts, and Maine. Brazil has also yielded similar deposits.

Infusoria partly of marine and partly of fresh-water origin have become familiar to us in the Polierschiefer (polishing slate) of Bilin and Planitz in Bohemia, and of the Habichtwald near Cassel, the Bergmehl of Santa Fiora in Tuscany, the white marls in the peat of Franzenbad near Egra in Bohemia, the peat deposits of Gainsborough in Lincolnshire, and at the base of the Mourne Mountains in Ireland. We find them to occur also in considerable plenty, but in limited distribution, in the lacustrine deposits of the east coast of Yorkshire. The Mauritius is added to these localities by Ehrenberg, and New Zealand by Mantell, all the occurrences belonging to supra-tertiary eras.

Infusorial remains are very unequally congregated. The siliceous marl (Kieselguhr) of Franzenbad consists mainly of *Navicula viridis* (*fig.* 6), now recent; that of the Mauritius, of *Bacillaria vulgaris* (*fig.* 7); that of San Fiora, of *Synedra capitata* (*fig.* 9); while that of Bilin is composed of *Gaillonella distans* (*fig.* 8) almost exclusively. (Ehrenberg.)

Infusoria are mentioned in the moya (volcanic mud) of Mexico, and in the edible clay of the river Amazonas, by Ehrenberg; in the rock-salt and the marl which accompany it at Cardona in Spain, by Marcel de Serres; they are assumed by Ehrenberg to enter largely into the composition of flint, which indeed readily shows *Xanthidia* and *Pyxidiculæ*. The bog-iron ore (Raseneisenstein) common near Berlin is composed chiefly of *Gaillonella ferruginea*. A kind of semiopal lying in nodules in the Polierschiefer of Bilin is composed of the same siliceous reliquiæ (*Gaillonellæ*) as the true polishing slate, but they are cemented together and filled by infiltrated siliceous paste. With the *Gaillonellæ* Ehrenberg finds spiculæ of sponges. The Precious Porphyry Opal of Kaschau, and the Serpentine Opal of Kosernitz in Silesia, has appeared to Ehrenberg of analogous composition. The following tabular view given by Ehrenberg of some of these facts will be useful:—

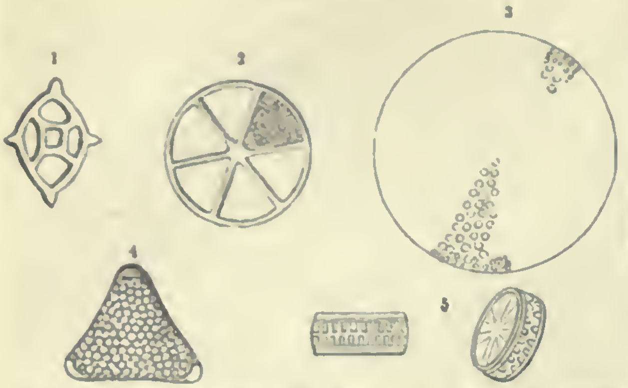
1. Bergmehl	Newest Formation.
2. Kieselguhr	
3. Polierschiefer	Tertiary Formation.
4. Saugschiefer	
5. Semiopal of Polierschiefer	

The above consist entirely or partly of the shells of *Diatomaceæ*.

6. Semiopal of the Dolerite	Pyrogenous Rock.
7. Precious Opal of the Porphyry	
8. Flint of the Chalk	Secondary Strata.
9. Gelherde (yellow earth)	Newest Formation.
10. Raseneisenstein	
11. Certain kinds of Steinmark, investing the Opal of Kaschau	

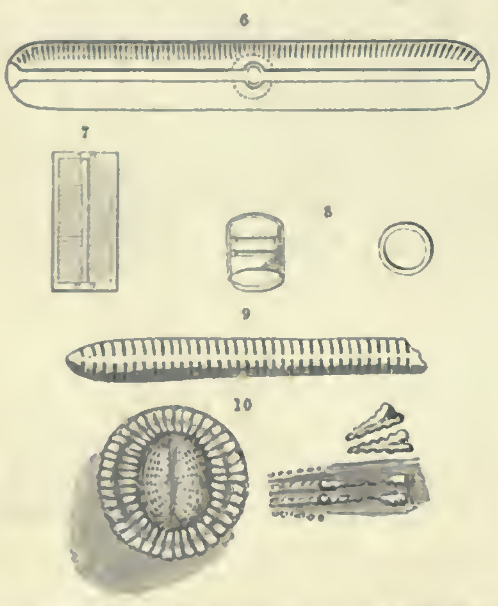
The above are probably of the same nature.

As examples of undoubted marine Infusorial Fossils, the following figures of some of the forms most frequent in a white deposit from Richmond may be taken:—



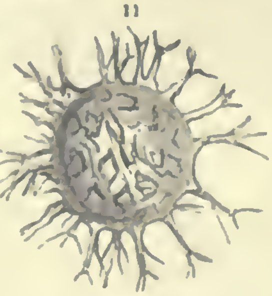
1. *Dictyocha fibula*. 2. *Actinocyclus senarius*. 3. *Coscinodiscus radiatus*. 4. *Triceratium favus*. 5. *Gaillonella sulcata*.

And for comparison the following outlines of mixed marine and fresh-water species common in the Polierschiefer of Bilin and the Peat and Kieselguhr of Franzenbad, Egra, San Fiora, &c.



6. *Navicula viridis*. 7. *Bacillaria vulgaris*. 8. *Gaillonella distans*. 9. *Synedra capitata*. 10. *Campylodiscus clypeatus*.

These are tertiary forms, and below is a specimen of a group referred to the recent genus *Xanthidium*, and frequent in the flint nodules which occur in chalk.



11. *Xanthidium ramosum*.

List of species of *Infusoria* from the Kieselguhr of Franzenbad:—*Navicula viridis* (plentiful), *N. gibba*, *N. fulva*, *N. librile*, *Gomphonema paradoxum*, *G. clavatum* (fresh-water species now living near Berlin), *N. viridula*, *N. striatula* (now living in the sea, the second also lives in the Carlsbad water), *Gaillonella varians* (?).

Species of *Infusoria* in the Peat-Bog of Franzenbad:—*Eunotia granulata* (plentiful), *Navicula viridis* (rare), *Bacillaria vulgaris*, *Cocconeis undulata*, *Gomphonema paradoxum*.

Species which occur in the Kieselguhr of Mauritius:—*Bacillaria vulgaris* ? (plentiful), *B. major*, *Navicula fulva* (?), *N. gibba*, *N. bifrons* (living near Berlin).

In the Bergmehl of Santa Fiora:—*Synedra capitata* (plentiful); with this are *S. ulna* (living both in fresh-water and the sea), *Navicula inæqualis*, *N. capitata*, *N. viridis*, *N. gibba* (fresh-water species); *N. viridula* (living in the Baltic), *Eunotia granulata*, *Navicula follis* (extinct), *Cocconeis undulata* (marine), *Gomphonema paradoxum*, *G. clavatum*, *G. acuminatum* (living near Berlin), *Cocconema cymbiforme* (fresh-water), *Gaillonella italica*, Spicula of *Spongiæ*, or *Spongillæ*.

In the Polierschiefer of Bilin:—*Podosphenia nana* (plentiful), *Gaillonella distans*, *Navicula scalprum*, *Bacillaria vulgaris* ? (probably all marine!)

In the Leaf Tripoli:—*Gaillonella distans* (plentiful), *Podosphenia nana*, *Bacillaria vulgaris* ? (probably marine.)

At Bann, in the county of Down, Captain Portlock found under Peat *Naviculæ*, *Bacillariæ*, *Eunotiæ*, with fragments of *Achnanthes* and *Conferræ*. ('Microscopical Jonrnal,' 1841.) At Gainsborough Mr. Binney found under Peat abundance of *Gaillonella*. At Bridlington, in white and brown Marls, *Eunotia serra* (?), *Bacillaria vulgaris*, *Navicula inæqualis*, *N. viridis*, *N. phœnicenteron*, *Cocconema lanceolata*, *Campilodiscus zonalis*, &c.

The North American localities have yielded to Bailey and Ehrenberg a large catalogue of Diatomaceous *Infusoria*. Ehrenberg enumerates—

Amphiphora—one species.
Cocconema—two species.
Eunotia—seven species.
Fragillaria—three species.
Gomphonema—four species.
Himantidium—one species.
Navicula—eighteen species.
Staurosira—two species.
Tabellaria—three species.

With these are three forms of Spongoid Spicula and two species of *Thylacium*.

These are mostly derived from beds lying under Peat—

The Richmond earth (of miocene date) yields—

Coscinodiscus radiatus and other species (*fig.* 3)	Mr. Quckett has found several of these recent in the North Sea. Mr. Lee has discovered *Coscinodisci* and *Dictyochæ* in the Barnacle and Scallop.
Actinocyclus senarius and others (*fig.* 2)	
Naviculæ, several species . .	
Gaillonellæ	
Dictyocha fibula (*fig.* 1) . .	

In the chalky marls of Oran, Sicily, Greece, &c., occur many living forms, as—

Actinocylus—ten species.
Amphitetra—two species.
Biddulphia—one species.
Cocconema—one species.
Coscinodiscus—seven species.
Dictyocha—four species.
Eunotia—two species.
Gaillonella—one species.
Grammatophora—four species.
Haliomma—one species.
Navicula—six species.
Striatella—one species.
Synedra—one species.
Tessella catena—one species.
Triceratium—one species.

In the white chalk and flint of Europe, and also living—

Fragillaria rhabdosoma. Gravesend.
F. striolata. Gravesend.
Gaillonella aurichalcea. Rügen.
Peridinium pyrophorum. Gravesend.
Xanthidium furcatum. Gravesend.
X. hirsutum. Gravesend.

Dr. Mantell has been unable to discover *Fragillaria* in the chalk of Gravesend, but *Xanthidia* occur in the chalk of Dover. ('Ann. Nat. Hist.,' Aug., 1845.) *Gaillonella aurichalcea* has been regarded as an *Oscillatoria*; and it appears doubtful whether the so-called *Xanthidia* of the flints and chalk are really to be referred to that fresh-water genus.

From the preceding notices we may gather as general facts the occurrence of the remains of siliceous *Infusoria* in the following stratifications:—

Cainozoic period	Recent Fluviatile and other sediments.
	Lacustrine deposits of the Elk period.
	Deposits of the 'Lehm' period.
	Miocene Tertiaries.
	Eocene Tertiaries.
Mesozoic period	Chalk deposits.
	Oolitic deposits.

The relative abundance of the *Infusoria* in these several deposits is inversely as their antiquity; they are rare in the oolitic and cretaceous rocks, and abundant in the upper tertiaries. It is true that Ehrenberg, by assigning to the cretaceous era the calcareous marls of Oran, Sicily, and Greece, gives a large catalogue of Mesozoic *Infusoria*, and that in favour of such reference of those marls are the *Rotaliæ*, *Textilinæ*, &c., which occur both in the true chalk and in such marls. But on the other hand, remembering the long scale of geological time through which these genera of *Polythalamiæ* extend, and taking into consideration the fact that some species which occur in the chalk of Europe are quoted by Ehrenberg from unquestionably miocene strata in America, we shall hesitate to admit those richly infusorial marls as truly coeval with the white chalk, in which comparatively very few remains of the group occur, and these not of the same species as those which abound in the other deposits.

Another point on which the authority of Ehrenberg has not been received without hesitation, is the absolute specific identity of a large proportion of the fossil and recent *Infusoria*. The previous discoveries of geology had prepared an easy admission for the opinion that many of the tertiary forms of *Infusoria* were undistinguishable from living races; such is the fact in regard to all the invertebral races; but with very few and those not always allowed exceptions, the secondary strata had been found to contain only extinct forms of life, till Ehrenberg examined the minute *Polythalamiæ*, and found many of them similar to living types, and confirmed this inference by independent researches among the *Infusoria*. Supposing these opinions of the Prussian microscopist to be confirmed by future inquirers, we shall find that they involve no infraction of the relations of zoological forms to geological time, which have been established from examinations of the other classes of the animal kingdom. The systems of life in each successive system of strata are not separate and distinct creations, but successive terms of a creative series; each of these terms is compound, and (to speak exactly) its constituent quantities (the several classes, orders, families, genera, or species) have their own coefficients and exponents; that is to say, have their own times of duration, their own periods of abundance, their own peculiar relations to earlier and later organisations.

A rule drawn from Fishes cannot be applied to *Mollusca;* a law based on *Crustacea* cannot be received for *Microzoaria*, without scrupulous examination; and palæontology is full of examples of the unequal periods of duration which belong to the different organisations, and the unequal degree of development and unequal geographical diffusion which characterise these organisations at the same epochs and during the same periods.

Admitting the authority of Ehrenberg's determination of species, we find another curious and unexpected result—the frequent, if not general, admixture of marine and fresh-water tribes in the comparatively level regions of Europe. In the plains of North Germany, round the Bohemian and Harz Mountains, in Tuscany, and Yorkshire, we find this admixture of supposed marine and supposed fresh-water races in the supra-tertiary deposits. Is this to be explained by supposing those deposits to have happened while the relative level of land and sea was different from what it is at present, and the sea was near to the place of deposition, so that by some of the many natural modes of diffusion which are effective in this class of life the organisms of the sea might be carried into lakes, as well as mixed in æstuaries, and along the course of languid rivers? Probably so. The deposits of *Infusoria* which now happen so abundantly at the mouth of the Elbe are mostly derived from the sea; and it has been found in the river Hudson that species once imagined to be truly marine live in juxtaposition with the species of fresh waters. There may probably be, in a class of beings associated with silicated waters, a greater independence of the saline qualities of water than in other races which have little need of silica, and which require the extrication of lime from a state of solution in the waters which they inhabit. In confirmation of this view we find the *Spongiæ* of the sea matched by the *Spongillæ* of fresh water, each extracting silica from the liquid, but the calciferous Polypean races of the ocean are almost unrepresented in our inland lakes and streams.

(Ehrenberg, *Die Infusionsthierchen; Memoirs of the Berlin Academy*, and Translations in Taylor's *Scientific Memoirs;* Reade, Quekett, Roper, Brightwell, Gregory, and others, in the *Microscopic Journal*, and *Quarterly Journal of Microscopical Science;* Mantell, *Medals of Creation and Annals of Natural History;* Pritchard, *Infusorial Animalcules;* Owen, *Lectures on Comparative Anatomy;* Carpenter, *Principles of Physiology;* Dujardin, *Histoire des Zoophytes Infusoires;* Stein, *Die Infusionsthiere*, &c.)

INGA, a genus of Plants belonging to the natural order *Leguminosæ*, which, though it has been separated from *Mimosa*, yet contains upwards of 100 species. These are found in the tropical parts of Asia, Africa, and America. They are distinguished by their legumes being broadly linear, compressed, and 1-celled. The seeds are usually covered with pulp, more rarely with farinaceous matter or a pellicle. The species form shrubs or trees, and are commonly unarmed. The flowers are in spikes, or are capitate, and of a red or white colour. From the number of species in this genus, as well as in *Acacia* and *Mimosa*, and from their having been removed from one to the other, there is some confusion in the synonyms. A few of the useful species have been further separated into the genus *Parkia;* but many still remain which are important in the countries where they are indigenous, either for astringent properties, like many Mimosas and Acacias, or for the edible nature of the fecula or pulp which surrounds their seeds. Thus *I. cochliocarpus* has bitter and astringent bark, which is used in tanning and also in medicine. It is taken to Portugal, where it is called the Brazilian Bark, and used even as a substitute for that of the *Cinchona*. Martius distinguishes from this species, which he calls *I. Jurema*, another which he has named *I. astringens*, and of which the bark has similar properties. The bark of these trees is considered by some authors to be the Cortex Astringens Brasiliensis of old pharmacopœias. *I. salutaris* is another astringent species, a native of New Granada, of which the bark is much used in the form of decoction for various complaints in which astringents are indicated, and for the same purposes as Ratany Root. Some of the species, as before mentioned, are esteemed for the sweetish edible pulp with which their seeds are surrounded, as *I. dulcis* in India and *I. insignis* in the province of Quito, where it is called Guabo, or Guabas, but Pacaes in Peru. So *I. Camatchili*, according to Perrotet, is similarly esteemed in Manilla, and *I. Faroba* in Western Africa, in the neighbourhood of the Senegal. *I. vera* contains tannic acid, and is one of the numerous leguminous plants used for obtaining Catechu. The pulp of the fruit of this species also is purgative. *I. fæculifera* yields in its pods a laxative pulp called Pois-Doux in St. Domingo. It has a sweet taste. The pulp also of the pods of *I. tetraphylla* is sweet and mucilaginous. (Lindley, *Vegetable Kingdom.*)

INIA. [CETACEA.]

INOCERAMUS (Sowerby; Goldfuss), a remarkable genus of Fossil *Conchifera monomyaria*, allied to *Crenatula*, *Gervillia*, &c., originally named by Mr. J. Sowerby in the 'Linn. Trans.' The name *Catillus* was given to the larger species by M. Brongniart. The two valves approach to equality; both are convex; the hinge-line straight, often extended into a wing, and thickened with many transverse grooves to receive a divided ligament; shell fibrous; beaks recurved. *Inoceramus dubius* occurs in the Lias; *I. concentricus* in the Gault; *I. Cuvieri* and many other species in the Chalk.

INSECTA, one of the classes of Invertebrate Animals. The Latin term Insecta, like the Greek Entoma, which has been applied to these animals, has reference to the insected or divided appearance of the body; hence the English name Insect, the French Insecte, and the German Insect. Invertebrate Animals are divided by Lamarck into two groups, which he calls Animaux Apathiques, and Animaux Sensibles. The latter, or the Sensitive Animals, contain six classes, of which Insects are the first. According to Latreille's arrangement in the 'Règne Animal,' the class *Insecta* forms the third great division of articulated animals—articulated referring to the innumerable joints of which this class of animals is composed.

True Insects may be thus defined:—Articulated animals possessing six legs, two antennæ, two compound eyes; a small brain at the anterior extremity of a double medullary chord. Circulation effected by a pulsating dorsal vessel provided with numerous valves. Respiration by tracheæ, which form two lateral trunks, and ramify through the body; generation oviparous; two distinct sexes; adult state attained through a series of metamorphoses.

Insects generally possess two pairs of wings; the trunk in the adult animal is usually composed of three chief parts, the Head (Caput), Thorax, and Abdomen; or the trunk of an insect may be described as consisting of thirteen segments, of which one constitutes the head, three form the thorax, and the remaining nine compose the abdomen. The head includes the organs of sensation and manducation, and its principal parts have received the following names:—the Clypeus, Vertex, Occiput, Genæ, Canthus, Gula, Oculi, Stemmata, Antennæ, and the Trophi.

Fig. 1.

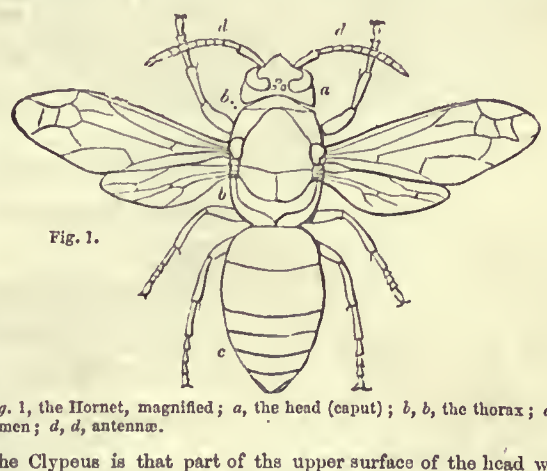


Fig. 1, the Hornet, magnified; *a*, the head (caput); *b*, *b*, the thorax; *c*, the abdomen; *d*, *d*, antennæ.

The Clypeus is that part of the upper surface of the head which joins the labrum. It is called by Kirby nasus, and in the *Lamellicornes* it is usually the foremost part of the head when viewed from above.

The Vertex is the summit of the head.

The Occiput is the hinder portion of the head, or that adjoining the thorax.

Genæ (the cheeks). "Those parts which lie on the outer side of the anterior half of the eyes, and intervene also between them and the mandibula." (Kirby).

Canthus, a name applied by Kirby to a process of the head which encroaches upon the eyes.

The eye in certain insects is encroached upon by a narrow process of the head in such a manner as to render it kidney-shaped, instead of its ordinary round form, and in some instances this organ is divided by the canthus into two parts.

Gula, the hindermost portion of the head beneath.

Fig. 3.

Fig. 2.

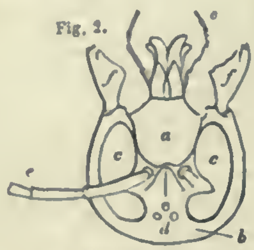


Fig. 2, Head of Hornet, magnified; *a*, the clypeus; *b*, the vertex; *c*, *c*, the eyes (oculi); *d*, the eyelets (stemmata); *e*, the antenna; *f*, *f*, mandibula. *Fig.* 3, the same, viewed from beneath; *g*, the occiput; *h*, the gula.

Oculi (the eyes). These are almost invariably two in number, placed one on each side of the head, and composed of hexagonal lenses.

Stemmata (the eyelets), minute simple eyes. They may be seen in the orders *Hymenoptera*, *Orthoptera*, and *Hemiptera*, and are generally placed vertically on the head. The larvæ of Coleopterous Insects generally possess them, and they are usually placed on each side of the head close to the antennæ.

Antennæ, jointed organs, two in number, most commonly springing from the upper surface, or side of the head near the eyes. These organs vary much in every way, not only in the various species of insects, but in the sexes of the same species they often differ.

There is much difference of opinion as regards the use of these organs. Some have come to the conclusion, from anatomical researches, that they are organs of hearing, whilst others maintain they are organs of touch or smell. When however we see so much difference in the structure of the antennæ in insects, and perceive that some use them in touching surrounding objects, as is the case in many of the *Hymenoptera* (particularly the *Ichneumonidæ*, and Bees and Ants), whilst others carefully avoid so doing, we are naturally led to the conclusion that they are used for different purposes. It is certain that insects possess the sense of smell, but in those insects which possess it apparently in the highest degree we can trace no similarity in the structure of the antennæ. A *Silpha*, a *Staphylinus*, and a common fly, appear to be equally attracted by the scent of a piece of putrid flesh, and yet their antennæ bear no resemblance. The same remark will apply to the antennæ of those insects which emit sound; the Grasshopper, the *Sphinx Atropos*, many of the *Cerambycidæ*, and numerous other insects might be enumerated which emit voluntary sound, but their antennæ do not differ from those of the species to which they are most closely allied, and which emit no sound that we can perceive. As regards touch, there can be no doubt that the antennæ of many insects are used as organs of touch, and it appears highly probable that, through the means of the antennæ, some insects can perceive the state of the atmosphere. The delicately plumed antennæ of the gnat, and of the nocturnal Lepidopterous Insects, seem to be well fitted for receiving impressions of this nature. The arguments in favour of their being organs of hearing are also at least worthy of attention. [ANTENNÆ.]

An Antenna may be divided into the following parts:—

Torulus, the cavity or socket in which the base of the antenna is planted.

Scapus, the first and in many cases the most conspicuous joint of the antenna.

Pedicellus, the second joint of the antenna.

Clavola, the remaining joints taken together.

In describing the species of the *Curculionidæ*, the term Funiculus is often used to designate that portion of the antenna between the long basal joint, or Scapus, and the Club (called Capitulum or Clava), which in these insects usually terminates the antenna.

The principal modifications in the form of antennæ are figured and described in the article COLEOPTERA.

The Trophi, or parts of the mouth (called by Fabricius Instrumenta Cibaria), consist of six principal portions:—The Labrum, Labium, Mandibulæ, and Maxillæ.

The Labrum, or upper-lip, is a corneous plate, which terminates the head anteriorly, and covers the mouth above; its posterior margin is united by a membranous hinge to the clypeus.

The most common form of the labrum is represented in *fig.* 8; it

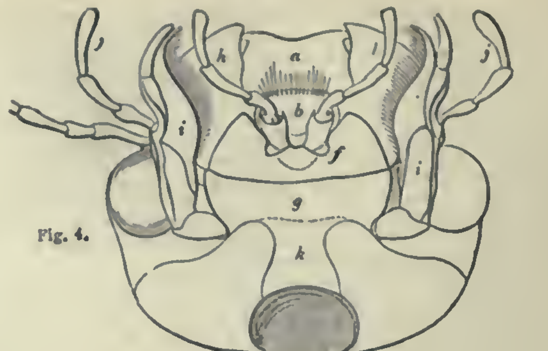
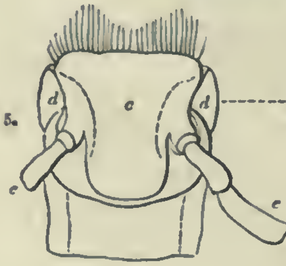


Fig. 4.

Fig. 5.



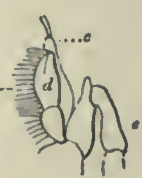


Fig. 6.

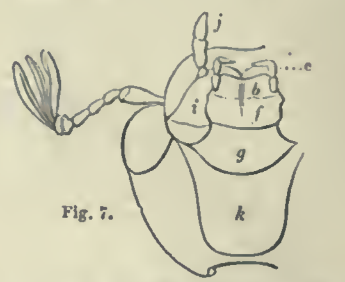


Fig. 7.

Fig. 4, parts of the mouth of a Water-Beetle (*Dytiscus marginalis*); *a*, labrum; *b*, *f*, and *g*, labium—*b*, palpiger; *f*, mentum; *g*, stipes; *h*, *h*, mandibula; *i*, *i*, maxillæ; *j*, *j*, maxillary palpi; *k*, jugulum. *Figs.* 5 and 6, the palpiger, highly magnified (5, front view; 6, side view); *c*, lingua; *d*, *d*, paraglossæ; *e*, palpi-labiales. *Fig.* 7, parts of the Mouth of *Amphimalla solstitialis*. Corresponding letters refer to the same parts as in *figs.* 4, 5, and 6.

is however very variable in shape, and in the *Lamellicornes* a tribe of Beetles which feed upon vegetable substances, instead of being of the ordinary horny texture, it is soft and membranous, and hidden beneath the clypeus (*fig.* 9, *a*). In some of the *Cicindelidæ* (predaceous insects) it is more or less elongated and notched at the sides and apex (*fig.* 10). In the genus *Cicindela* a small projecting tubercle may be observed on the anterior margin of the labrum. In the Hornet (*Vespa Crabro*) the labrum is produced in front into an elongated pointed process (*fig.* 11). In the *Lepidoptera* it is extremely minute, and the *Hemiptera* possess a long, slender, and pointed labrum.

Fig. 9.

Fig. 11.

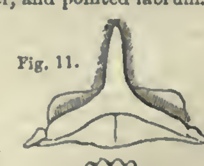
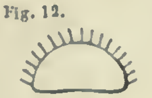


Fig. 12.



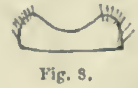
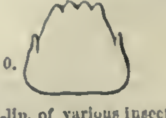


Fig. 8.

Fig. 10.



Figs. 8, 9, 10, 11, and 12, labrum, or upper-lip, of various insects.

The Labium, or under-lip, is opposed to the labrum, and generally serves to close the mouth beneath.

The labium is a very complicated organ, consisting of several parts which are variously developed in the different tribes of insects, &c. There is much confusion in the nomenclature of these parts, especially as regards the portion which is to be considered the true labium; for although the whole apparatus is often called the labium, yet when treated of in detail most authors agree in applying this term to some particular portion, but differ as to which particular portion the term shall be applied, and consequently the neighbouring parts are differently named. The confusion has arisen from the circumstance of entomologists having applied the name labium to the whole apparatus, and likewise to a particular part of it. We shall therefore use the term labium to express the whole apparatus, and describe the several parts under the three heads Palpiger, Mentum, and Stipes.

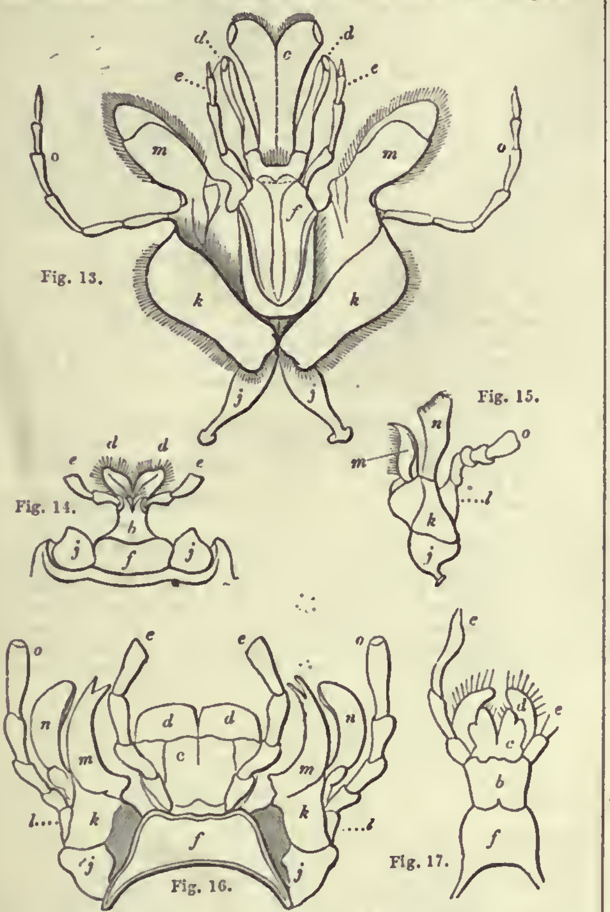


Fig. 13. Fig. 14. Fig. 15. Fig. 16. Fig. 17.

Fig. 13, Labium and maxillæ of the Hornet. *Fig.* 14, Labium of *Cerambyx moschatus*. *Fig.* 15, Maxilla of the same insect. *Fig.* 16, Labium and maxillæ of a Locust. *Fig.* 17, Labium of another species of Locust. In all these figures the letters refer—*b* to the palpiger; *c*, lingua; *d*, paraglossæ; *e*, palpi-labiales; *f*, mentum; *j*, cardo of maxilla; *k*, stipes of ditto; *l*, palpifer; *m*, lacinia; *n*, galea; *o*, palpi-maxillares.

Palpiger, or palpi-bearer. This name was first applied by Mr. Newman ('Entomological Magazine,' vol. ii.) to a portion of the part called lingua by Kirby, and labium by M'Leay and others. It will be used in this article as the name of the whole apparatus to which the labial-palpi are attached, including the lingua, paraglossæ, and palpi-labiales.

The several parts of the labium therefore will be thus divided :—

Labium.
- Palpiger (*b*).
  - Lingua (*c*).
  - Paraglossæ (*d*).
  - Palpi-labiales (*e*).
- Mentum (*f*).
- Stipes (*g*).

If we examine the underside of the head of any insect in which the various parts of the mouth are well developed, the palpiger will be readily distinguished from the other two portions of the labium by its bearing a pair of palpi, the palpi-labiales. In *Dytiscus marginalis*, a common water-beetle, the palpiger is of a square form, or nearly so. The broad piece furnished with bristly hairs along its anterior extremity is the lingua. On each side of this piece there is a small plate (apparently divided), which has its posterior margin recurved, so as to lie close to the underside of the lingua, and furnished with a fringe of hairs. These small pieces we conceive to be the analogue of the parts called by Kirby paraglossæ, and which are distinct in the bees, wasps, &c. They also appear to represent the two leaf-like appendages at the apex of the palpiger in *Cerambyx*, the lingua here being nearly obliterated, and consisting only of an extremely minute divided process furnished with hairs.

The palpiger is not very distinct in the *Hymenoptera;* its appendages however are often greatly developed. In the hornet the lingua is very large, broad, and divided at the extremity; the paraglossæ are also large. The labial palpi are long, and composed of four joints. The lingua in many bees is of great length, and the paraglossæ are often long. The labial-palpi in the typical bees are flattened, and have the basal joint long.

Orthopterous Insects have a well-developed palpiger: the lingua, paraglossæ, and palpi are distinct.

Mentum, or chin, by which we mean the part so called by M'Leay, Westwood, and indeed most modern authors, but which is the labium of Kirby and Newman. The mentum is the piece below the palpiger, and generally articulated to the stipes by a membranous hinge. This part is very variable in shape, and is consequently often referred to in descriptions of insects, or rather in definitions of the genera. It is generally distinct in mandibulate insects.

In *Dytiscus marginalis* it is of a transverse form, and emarginated on the fore part. In the hornet, as well as in the bees, the mentum is long, and nearly cylindrical.

Stipes. This name is applied by M'Leay to that piece which is below the mentum. It is the mentum of Kirby, the 'pièce prebasilaire' of Straus-Durckheim, and the insertio of Mr. Newman.

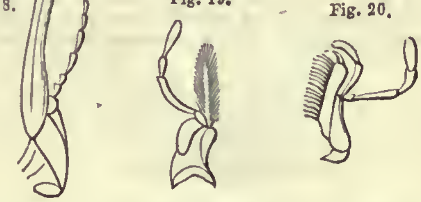
The stipes is generally soldered to the jugulum, so that its boundaries cannot be detected. Such is the case in the water-beetle, the head of which is selected to illustrate this article. Its lower boundary is indicated in the figure by a dotted line. In the common Cockchafer (*Melolontha vulgaris*) however it forms a well-defined piece. In *Amphimalla solstitialis* (*fig.* 7), an allied insect, it is also distinct. In the *Hymenoptera* the stipes is small, and generally of a triangular shape.

The Mandibles (Mandibulæ) come next under consideration. These, the representatives of jaws, are situated immediately below the labrum. They are two in number, and have a vertical motion.

In the *Mandibulata* the mandibles are almost invariably of a hard horny nature, often of a triangular form, or nearly so, and furnished with pointed processes (which have been compared to teeth) on their inner side.

In Carnivorous Insects the mandibles are usually of moderate length, sharply pointed, and armed internally with acute processes. Wood-boring insects, such as the *Cerambycidæ*, have short stout mandibles; and in those insects which feed upon vegetable substances (the *Phyllophagi*, &c.) the mandibles often present a broad grinding surface on their inner side near the base.

Fig. 18. Fig. 19. Fig. 20.



Figs. 18, 19, and 20, Maxillæ of various insects.

The Maxillæ, or feeler-jaws, like the mandibles, under which they are placed, are opposed to each other horizontally. They are joined at their base to the labium, and distinguished by their giving attachment to the maxillary palpi, on which account Mr. Newman has applied to them the name of feeler-jaws. The maxillæ are variable in form, and hence the characters of genera and larger groups are not unfrequently derived from them. A perfect maxilla presents five distinct portions—the Cardo, Stipes, Palpifer, Lacinia, Galea, and Palpi-Maxillares.

Cardo (the hinge) is a small piece, often of a triangular form, upon which the maxilla sits. It is the Insertio of Newman.*

Stipes (the stalk). Kirby applies this name to the "corneous base of the maxilla, below the palpus," and in his detailed account of this part refers both to the palpifer and another portion which is generally situated within the palpifer. We shall confine the name stipes to that part of the maxilla which is joined to the cardo, and is either within or below the palpifer. It is the Maxilla, or Disc, of Mr. Newman.†

Palpifer. This part, to the summit of which the maxillary palpi are always attached, is usually a narrow piece running parallel with and joined to the outer side of the maxilla at the base.

Lacinia (the blade). This is the chief part of the maxilla. It is situated above the stipes, is usually of an elongated pointed form, and furnished with bristly hairs along its inner margin, and generally has one or more pointed claws at the extremity: these claws are called the Ungues. The name Lacinia is applied to this part by Mr. M'Leay, and according to Kirby it is the Lobus Inferior.

Galea (the helmet), or the Lobus Superior of Kirby, is a lobe which is attached to the palpifer, and lies between the galea and the maxillary-palpi. It is jointed in the predaceous beetles, and resembles a palpus.

* Mr. Newman has applied a new name to this part without sufficient reason, since it is well defined by Kirby. The name insertio is also objectionable, since it might create confusion, the same name having been also applied by Mr. Newman to a part of the labium.

† By the same rule that we do not apply the name labium both to the whole labial apparatus and at the same time to a part, we reject the name maxilla as applied to a part of the maxillary apparatus.

Palpi-Maxillares (the maxillary-palpi), joined organs, two in number, one to each maxilla, situated on the outer side of the maxillæ and springing from the palpifer.

In the order *Diptera* the maxillæ are long, slender, and pointed. In the *Hemiptera* they are still more slender, resembling bristles. The long slender proboscis of the *Lepidoptera* consists of the maxillæ. In the order *Hymenoptera* the maxillæ are usually large, and when closed form a sheath which covers the various parts of the labium.

The oral apparatus, or Trophi, of the various Haustellate orders of insects have each received names from Mr. Kirby. In the order *Hemiptera* the oral instrument is termed the promuscis. The same part is termed the Proboscis in the *Diptera*, Antlia in the *Lepidoptera*, and Rostulum in the *Aphaniptera*. The several parts representing the mandibles, maxillæ, labium, &c., have also received additional names in each of these orders, but we have already sufficient.

The term Thorax is applied to all that part of an insect which lies between the head and the abdomen, and to which the legs and wings are attached.

Fig. 21.

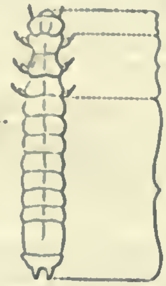


Fig. 21, Larva, showing the three segments of the thorax and the nine segments of the abdomen; *a*, the thorax; *b*, the abdomen.

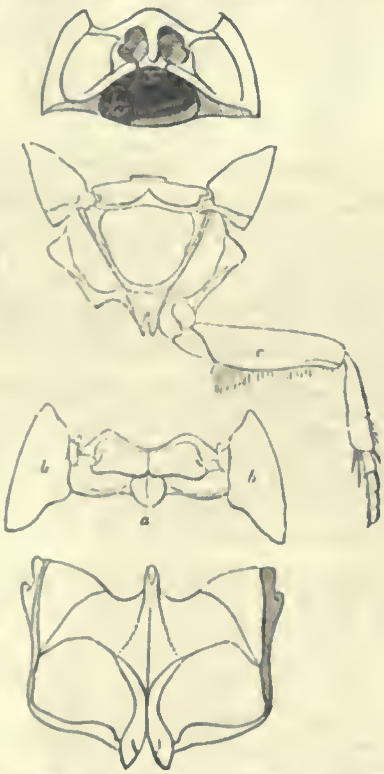
We have before said that the thorax is composed of three segments; these are generally distinct in those larvæ which do not resemble the perfect insect and which possess legs—such as the larvæ of the *Lepidoptera*, *Coleoptera*, and certain *Hymenoptera* (*Tenthredinidæ*): here each of the segments in question possesses a pair of legs.

Fig. 22.

Fig. 24.

Fig. 23.

Fig. 25.



Parts of thorax of a Water-Beetle (*Dytiscus marginalis*).
Fig. 22, the under side of the prothorax, called prosternum. *Fig.* 23, the upper side of the mesothorax, called mesonotum: *a*, the scutellum; *b*, *b*, basal portions of the elytra. *Fig.* 24, posterior view of the same: *c*, one of the middle pair of legs. *Fig.* 25, under side of the metathorax, called metasternum.

The term Prothorax is applied to the foremost of the thoracic segments, Mesothorax to the next, and Metathorax to the hinder one, or that which joins the abdomen. In the perfect insect we find the three simple thoracic rings of the larvæ replaced by the same number of segments, but each divided into several distinct parts; these three segments however are never uniformly developed, but generally two of them are more or less perfected, and exert an inverse influence on the third, and sometimes one of the segments is greatly developed at the expense of the remaining portions.

The Prothorax bears the anterior pair of legs and is articulated to the head. It is large in the *Coleoptera*, and is the part called thorax in descriptions of insects of this tribe; it is likewise well developed in the *Orthoptera* and *Hemiptera*. In the *Lepidoptera* it forms a narrow ring, which is easily distinguished by the scales with which it is covered being erect, those on the next segment being adpressed. In the *Hymenoptera* the prothorax sometimes forms a distinct neck, but generally it is a narrow plate, and extends back on each side to the base of the anterior wings.

The upper surface of this segment is termed by Burmeister the Pronotum, and by Audouin and M'Leay the Tergum of the prothorax. The latter authors state that the tergum, when perfect, is composed of four parts, to which M. Audouin gives the names Præscutum, Scutum, Scutellum, and Postscutellum, so named according to their succession, commencing at that nearest the head of the insect. These parts however are seldom to be seen, unless it be in certain Orthopterous Insects.

The underside of the prothorax is called by Burmeister and Kirby the Prosternum, and by Audouin the Pectus of the prothorax. To the prosternum the legs are attached, and hence this part is always tolerably well developed.

Besides the above parts there is an internal piece called the Antefurca.

The Mesothorax, or middle segment of the thorax, is more complicated than the prothorax, owing to its giving attachment to the anterior pair of wings in addition to a pair of legs. The mesothorax is well developed in nearly all insects, and in the order *Diptera* attains its largest size, and indeed forms the principal part of the thorax. Its upper surface is termed by Burmeister the Mesonotum (Tergum of Audouin), and the under part the Mesosternum (Pectus, Audouin).

Fig. 26.

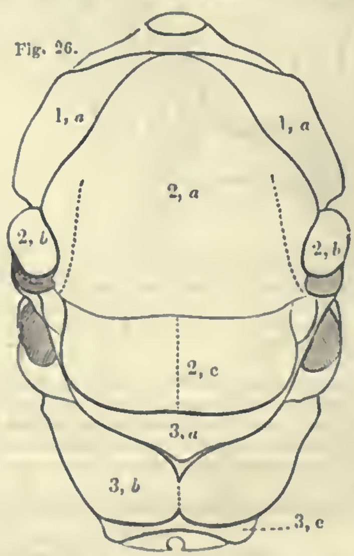


Fig. 26, upper view of thorax of *Vespa Crabro*. 1, prothorax; 2, mesothorax; 3, metathorax. 1, *a*, scutellum; 2, *a*, scutum; 2, *b*, squamula; 2, *c*, scutellum; 3, *a*, præscutum; 3, *b*, scutellum; 3, *c*, postscutellum.

Fig. 27.

Fig. 27, side view of thorax of *Vespa Crabro*. The figures and letters refer to the same parts as in *fig.* 26, to which may be added—1, *b*, præscutum and scutum; 1, *c*, situation of the anterior pair of legs; 2, *d*, sternum; 2, *e*, situation of the middle pair of legs; 2, *f*, situation of the anterior pair of wings; 3, *d*, metasternum; 3, *e*, situation of the posterior pair of wings; 3, *f*, insertion of posterior pair of legs; 4, abdomen.

At its maximum of development it consists of four pieces above and eight below, to which Audouin applies the names Præscutum, Scutum, Scutellum, and Postscutellum, to the upper pieces, or tergum; and Paraptera, Sternum, Episterna, Epimera, and Medifurca, to the mesosternum. The metathorax, as it bears the posterior wings, is well developed in those insects which possess them, but where they are wanting, as in the order *Diptera*, it is of small size. Its upper surface is called Metanotum, and the under surface Metasternum. When perfect it contains the same number of parts as the mesothorax. To this segment are attached the posterior pair of legs.

The various parts of the thorax will perhaps be better understood by their being placed in a tabular form, thus—

Thorax.	Prothorax.	Tergum, or Pronotum.	Præscutum.
			Scutum.
			Scutellum.
			Postscutellum.
		Pectus, or Prosternum.	Sternum.
			Episterna.
			Epimera.
		Furca, called Antefurca.	
	Mesothorax.	Tergum, or Mesonotum.	Præscutum.
			Scutum.
			Scutellum.
			Postscutellum.
		Pectus, or Mesosternum.	Paraptera.
			Sternum.
			Episterna.
			Epimera.
		Furca, called Medifurca.	
	Metathorax.	Tergum, or Metanotum.	Præscutum.
			Scutum.
			Scutellum.
			Postscutellum.
		Pectus, or Metasternum.	Paraptera.
			Sternum.
			Episterna.
			Epimera.
		Furca, called Postfurca.	

From the thorax we are naturally led to the wings and legs of insects.

The greater portion of the insect tribe possess four wings; some however only possess two, and others are quite destitute. These organs consist of two membranes applied closely together, and inclosing numerous nervures or hollow tubes which contain tracheæ.

The various descriptions of wings may be described under the following heads—Elytra, Tegmina, Hemelytra, and Halteres. The term elytra is applied to the anterior wings. "When they are without nervures and uniformly of a thicker and harder substance than membrane," they are peculiar to the *Coleoptera*. [COLEOPTERA.]

Tegmina is the name applied to the upper organs of flight when of a uniform coriaceous texture, and furnished with nervures as in the *Orthoptera*. [ORTHOPTERA.]

Hemelytra, the upper organs of flight when they are coriaceous at the base and membranous at the apex, as in the *Hemiptera*. [HEMIPTERA.]

The Halteres are two minute organs situated behind the wings of Dipterous Insects, and supposed to represent the posterior wings; they consist of a slender stalk with a round or oval knob at the extremity. [DIPTERA.]

The Legs in true insects are invariably six in number, but in certain butterflies the anterior pair are minute. Each leg consists of a Coxa, Trochanter, Femur, Tibia, and Tarsus, all of which parts are figured and described in the article COLEOPTERA.

The Abdomen. Although the nine segments which compose the abdomen are generally distinct in larvæ, we seldom find more than seven or eight visible joints in the perfect insect, the remaining one or two being generally hidden, and in fact converted into parts of the organs of generation. The number of segments to the abdomen sometimes differs in the males and females of the same insect, as in the Aculeate *Hymenoptera*. As these segments in the perfect insect bear no organs of locomotion, they are of a more simple structure than those of the thorax, consisting chiefly of an upper plate called the Dorsum, and an under plate called the Venter.

The substance of the abdominal segments is almost invariably less hard and more flexible than that of the head and thorax.

In the *Coleoptera* and *Hemiptera*, where the upper parts are protected by elytra, or hemelytra, they are softer than on the under surface which is exposed. In certain species however where the elytra do not cover the abdomen they are of the same substance throughout, as for instance in the *Staphylinidæ* and several minor groups of Coleopterous Insects. The articulation of the abdomen to the thorax offers some curious modifications, some of which are constant throughout whole groups, and hence afford distinguishing characters. When the abdomen is closely applied to the thorax it is termed sessile; and when the first segment, or more, is narrow and elongated, and forms a kind of stalk, it is termed petiolate.

The abdomen is often furnished with appendages at its extremity; thus in the Earwig (in which Mr. Westwood discovered one more than the usual number of segments) there is a pair of forceps which serve as weapons of defence, and in the male sex of *Panorpa*, where the apex of the abdomen is considerably elongated, there is also a pair of forceps. In the Dragon-Flies there are small flattened appendages, and likewise in the *Staphylinidæ*, which are called Stylets. Indeed the various kinds of appendages are too numerous to be here described, but are noticed in the accounts of the various groups of insects contained in this work. The modifications of the ovipositor are likewise noticed where they occur in the different groups. When it is of a long and compressed form it is termed ensate; and when it consists of several tubes retractile within each other, like the pieces of a telescope, it is called telescopiform. The term aculeiform is applied to this organ in the Hymenopterous Insects.

We now come to the internal anatomy of insects.

The Digestive System of insects is well developed, and consists of an intestinal canal, in which a crop, gizzard, stomach, and small intestine are generally distinct; but, as in the higher orders of animals, these parts vary according to the nature of the food.

Fig. 28.

Fig. 28, Intestinal canal of *Cicindela campestris*: *a*, œsophagus; *b*, crop; *c*, gizzard; *d*, stomach; *e*, *e*, hepatic vessels; *f*, small intestine.

In a predaceous beetle (*Cicindela*) the intestinal canal passes nearly straight through the body, the œsophagus dilates into a wide crop, which is succeeded by a minute gizzard, and then by the stomach, which, as well as the crop, is covered by numerous minute follicles; at the pyloric extremity of the stomach the biliary ducts pour their secretion into the cavity through four orifices, which are situated two on each side. The small intestine is short, and opens into a wide colon which terminates the canal.

In a vegetable-feeding insect the stomach is very voluminous and much convoluted, and the biliary ducts are proportionately long. In the common cockchafer these ducts have the secreting surface increased by innumerable minute secæ.

The salivary glands are distinct in many insects.

The circulation of the blood in insects is carried on in part by means of distinct vessels, and in part by channels excavated in the tissues. Its central organ is the dorsal vessel, which is segmentally divided; the compartments are separated by valves, which do not allow the blood to pass in any other direction than from behind forward. This segmental division however in the perfect insect does not extend into the thorax, the dorsal vessel in that region being converted into an aortic trunk, which carries the blood onwards, that it may be distributed to the head and thoracic appendages. From these it returns backwards along the limbs and body to re-enter the dorsal vessel, either by veins which open into its several chambers, or by larger vessels that collect the whole to convey it into the posterior chamber. In its course however it is brought into very close relation with the air that is conveyed through the whole interior of the body by the complex tracheal apparatus; for it appears from recent observations that the blood not only bathes the exterior of the air tubes, but moves through that space between the outer and inner membranes in which a spiral filament winds (as in the spiral vessels of plants) to keep them from being closed by lateral pressure.

These air-tubes form a complex system, which is distributed with the most elaborate minuteness throughout the body, commencing from lateral Stigmata, or breathing pores, of which each segment normally contains a pair, though some of them are frequently closed up, so that the number is greatly reduced. Between all the parts of the system there is the freest communication; and in some parts of it, especially in insects of rapid flight, we find the air-tubes dilated into large air-sacs, which both serve as reservoirs of air and contribute to diminish the specific gravity of the body. By this extraordinary development of the respiratory system the apparent imperfection of the circulating apparatus is compensated, since the chief demand for a very rapid movement of the blood in animals, which (like birds) put forth a vast amount of muscular energy and activity, arises not so much out of the demand for nutrition as from the necessity for a constant supply of oxygen to the tissues, which is here provided for by the penetration of the air itself into their substance.

Fig. 29.

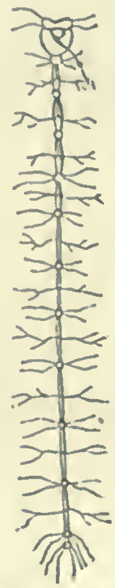


Fig. 30.

Fig. 29. Nervous System of the Common Cockchafer (*Melolontha vulgaris*). *Fig.* 30. Nervous System of a Caterpillar, or Larva.

The nervous system in insects consists of a double nervous chord, which is situated in the ventral portion of the body (being the reverse in this respect to the vertebrate animals). This double chord is joined at intervals by ganglia, which in larvæ correspond in number to the joints of the body, namely, thirteen. As the larva is about to assume the pupa state the abdominal ganglia gradually approach the thorax, and consequently are nearer to each other, a circumstance owing to the longitudinal contraction of the segments at this time, at least such is the case in Lepidopterous larvæ. In the pupa state the ganglia are still more approximated, and the nervous chords are curved and distorted: the same number of ganglia however are generally to be found; but in the Imago state of Coleopterous Insects several of the ganglia have become confluent, so that the number is considerably reduced. In the Common Cockchafer (*Melolontha vulgaris*), which may be taken as an illustration of the general character of the nervous system in insects, there is one large transverse ganglion in the head, consisting of two chief portions joined laterally, and which are expanded on their outer side to form the optic lobe. From this large transverse ganglion the two nervous chords extend downwards and backwards, and form a ring which encircles the œsophagus, beneath which they are united by the second ganglion. These two ganglia together send off the nerves which supply the various parts of the head and its appendages, the trophi, antennæ, &c. From the lower part of the second ganglion the nervous chords are continued to the thorax, where we find three large ganglionic masses, from which all the nerves which supply the thorax and abdomen have their origin.

The development of the organs of sense, and especially of the visual apparatus, attains a high degree of development. The eyes are here aggregated into large compound masses, usually of nearly hemispherical form, which are so large as to occupy a considerable part of the sides of the head. The structure of each individual eye (which is nearly of cylindrical form) seems most perfectly adapted to bring to a focus the rays which impinge upon it in the direction of its own axis, and by the mode in which the single eyes of each hemispherical mass are disposed, the range of vision is extended in every direction, although the eyes themselves are perfectly motionless. This multiplication of cylindrical eyes precisely similar to each other to gain an end, which is answered in vertebrated animals by a single globular eye, endowed with the power of motion on either side, is in remarkable accordance with the general plan of structure, characteristic of the *Articulata*, and is sometimes carried to a most wonderful extent; the number of single eyes in a common House-Fly being 4000, in the Cabbage-Butterfly 17,000, in the Dragon-Fly 24,000, and in the Mordella-Beetle 25,000. Besides the great compound eyes most insects have a few simple eyes disposed on the top of their head, in the narrow space between the aggregate masses, which appear to be of considerable use in directing their upward flight. There can be no doubt that insects are possessed of the sense of hearing, for though the precise organ which is subservient to it has not been determined, there is ample evidence that they are guided and influenced by sounds, one of the most striking instances of which is that the male of some insects (such as *Cicadæ*, Crickets, &c.), emit peculiar sounds, which attract the females to them. These sounds are produced entirely by mechanical means, and cannot be regarded as vocal. It would seem probable, as has been hinted above, that some part of the base of the antennæ is the auditory organ. There is similar evidence that insects possess the sense of smell; thus the Flesh-Fly deposits its eggs in the thick fleshy petals of the *Stapelia* (Carrion-Flower), deceived by its odour, which resembles tainted meat. The sense of touch is very delicate in some insects; such is the principal purpose of the antennæ, and the feet in some cases are furnished with peculiar organs, such as a soft cushion or a delicate expanded sucker, that is adapted to receive tactile impressions from the substances to which it is applied.

The muscular system of insects is highly developed, being entirely made up of the striated muscular fibre in its most perfect form, and consisting not only of muscles for the contraction and elongation of the trunk by the approximation or separation of its segments, but also of numerous muscles which give motion to the legs and wings. In insects of rapid and powerful flight these latter are so highly developed as almost to fill the cavity of the thorax. The joints are for the most part constructed so as to admit of but two kinds of movement, namely, flexion and extension; and the muscular apparatus has consequently not that variety of action which is seen where the ball and socket joint, which permits movements of circumduction, takes the place of the simple hinge joint. Nevertheless there are no animals which surpass insects in command over the organs of flight. "Even the swallow cannot match the dragon-fly, which often eludes its feathered pursuer as it can fly backwards and forwards, right or left without turning. When we compare the space traversed by an insect in a given time, with the dimensions of its body, we find it vastly exceeds the similar ratio in the bird, and thus we perceive that the locomotive powers of insects are far higher than those of any animal whatever.

"This power is most remarkably developed in the orders *Neuroptera* (Dragon-Flies, Termites, &c.), and *Hymenoptera* (Bees, Ants, &c.), and it is remarkable that these are the very orders in which we find the most extraordinary manifestation of those instinctive tendencies, the high development of which, with an almost complete absence of intelligence, is a striking characteristic of the articulated series in general, and of the class of insects in particular.

"These tendencies may be considered as dependent upon an association between sensory impressions and muscular movements, which arises from the original constitution of the nervous systems of these animals; and they may thus be regarded as necessities of their nature, not in the least indicative of intelligence, design, or voluntary choice on their own parts, but rather indicating the wise adaptation, by which they have been constructed to work out plans of most admirable elaborateness with the most wonderful perfection. Now these and all other instinctive actions have for their object the maintenance of animal life, as distinguished on the one hand from the mere organic life of plants, and on the other from the mental or psychical life of higher beings. And thus, if we consider the animal kingdom as holding an intermediate position between the vegetable world on the one side, and the domain of mind on the other, we should be led to regard the class of insects, and especially the orders *Neuroptera* and *Hymenoptera*, as its type." (Carpenter).

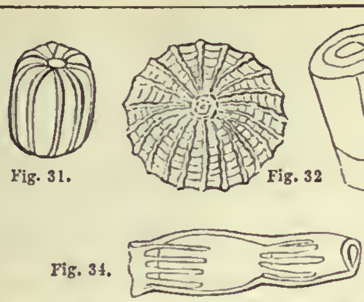
Insects are endowed with great powers of multiplication; this is accomplished with only one exception, by means of the sexual process of generation. The exception referred to is that of the *Aphis* [APHIS], which is capable of propagation by a process that appears to be analogous to that of gemmation amongst the lower animals.

The eggs of insects are extremely variable in shape: the more common form is oval; they are however often round, sometimes cylindrical. Those of the common white butterfly are conical. In many moths they are lenticular. The eggs of *Hemerobius* and several other insects are placed upon footstalks.

The surface of the eggs is generally smooth or nearly so, but it not unfrequently happens that they are uneven, and display a great variety of sculpture.

White, yellow, and green are the predominant colours of the eggs of insects: they are deposited in various situations, but always where the young larvæ may find appropriate food when hatched. Thus we often find them attached to the leaves or stems of plants. The *Ichneumonidæ* deposit their eggs in or on the bodies of caterpillars, and their larvæ when hatched feed upon these animals.

No insects come forth from the egg in their perfect condition, and their state in many cases at the time of their being hatched is quite



Figs. 31, 32, 33, and 34, Eggs of various insects.

embryonic, so that it is usually not until a series of very considerable changes have taken place in external configuration and internal structure, together constituting what is known as the Metamorphosis that the complete development of the specific type is attained. The amount of this metamorphosis, and the mode in which it is accomplished, vary considerably in the different orders of insects; but these stages are usually marked out more or less distinctly in the life of each individual. The term 'Larva,' in the ordinary language of Entomology, is applied to the insect from the date of its escape from the egg, up to the time when the wings begin to appear; the term 'Pupa' is in like manner employed to mark the period during which it is acquiring wings; and from the time when these and other organs characteristic of its perfect state are complete, it is spoken of as the 'Imago.' The grade of development however at which the insect comes forth from the egg is very different in the several orders and families. In all cases the embryonic mass within the egg is first converted into a footless worm, resembling the higher *Entozoa* or the inferior *Annelida* in its general organisation, but possessing the number of segments, thirteen, which is typical of the class of Insects. Such, in the *Diptera* and *Hymenoptera*, and in some of the *Coleoptera*, is the condition of the larva at the time of its escape from the egg; and it is remarkable that many of the larvæ of the first of these groups resemble *Entozoa* in their parasitic habits. The head in larvæ of this kind, which are known as maggots, differs but little from the segments of the body, the eyes in many cases not being developed, and the mouth being furnished with a mere suctorial disc. In the *Lepidoptera* and most of the *Coleoptera* however, the larva at the time of its escape possesses the rudiments of the three pairs of thoracic legs, although they are little else than simple claws, save in the carnivorous beetles; whilst in addition to these, several of the abdominal segments are furnished with fleshy tubercles or prolegs, generally to the number of four or five pairs, which are peculiar to the larva state. In such larvæ, which are commonly designated as 'Caterpillars,' we observe a remarkable equality in the different segments both as to size, form, and plan of construction, which reminds us of the *Annelida*. The alimentary canal occupies nearly the whole of the cavity of the body, and passes without flexure from one end of it to the other. The compartments of the dorsal vessel, the respiratory organs, the nervous centres, and the muscular bands, are repeated with great regularity, and there is as yet no distinction between the thoracic and abdominal portions of the trunk. The head however is usually protected by a horny covering, and is provided with simple or clustered eyes like those of the higher *Annelida* and *Myriapoda*, and the mouth is furnished with powerful cutting jaws for the division of the food, which is

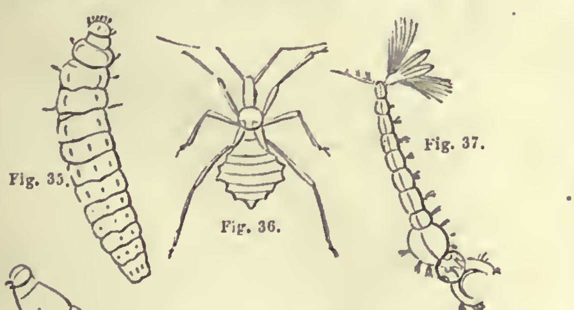


Fig. 35, a Coleopterous Larva (*Telephorus*). *Fig.* 36, Larva of an Hemipterous Insect (*Zelus*). *Fig.* 37, Larva of a Dipterous Insect (*Culex*). *Fig.* 38, Larva of a Lepidopterous Insect (*Sphinx*).

usually vegetable in its nature. In the Orthopterous and Hemipterous orders however, these stages of development are passed through within the egg, and as the young insect does not emerge thence until it has attained a higher grade, in which it presents a close resemblance to its parents in almost every particular save the want of wings, it cannot be regarded as having the characteristics of a real larva. This is the case too with some of the *Coleoptera*, in which we find a considerable variety as regards the stage of development at which the embryo quits the ovum. In the true larva condition, the whole energy seems concentrated upon the nutritive functions; the quantity of food consumed is enormous, and the increase in the bulk of the body is very rapid. During this rapid growth the caterpillar throws off and renews its epidermis several times, but the larvæ of the *Hymenoptera* and *Diptera* do not undergo this exuviation until they pass into the pupa state, their integument being soft enough to yield to the distension from within.

The principal variations in the larvæ of insects have been arranged in the following tabular form by Messrs. Kirby and Spence ('Introduction to Entomology,' vol. iii.):—

I. Larvæ without legs.
- i. With a corneous head of determinate shape.
  Coleopterous and Hymenopterous Apods—*Culicidæ*. Some *Tipulariæ*, &c., among the *Diptera*.
- ii. With a membranous head of determinate shape.
  (*Muscidæ*, *Syrphidæ*, and other *Diptera*.)

II. Larvæ with legs.
- i. With legs only and without an anal proleg.
  (*Neuroptera* and many *Coleoptera*.)
  1. Joints short and conical. (*Elater*, *Cerambycidæ*.)
  2. Joints long and subfiliform. (*Staphylinus*, *Coccinella*, *Cicindela*, &c.)
- ii. Prolegs only. (Many *Tipulariæ*, and some subcutaneous Lepidopterous larvæ, &c.)
- iii. Both legs and prolegs. (*Lepidoptera*, *Serrifera*, and some *Coleoptera*.)
  1. Without claws. (*Serrifera*, &c.)
  2. With claws. (*Lepidoptera*, &c.)

In the Pupa state insects exhibit two principal modifications: those which in general form resemble their larvæ, and those which are wholly unlike their larvæ.

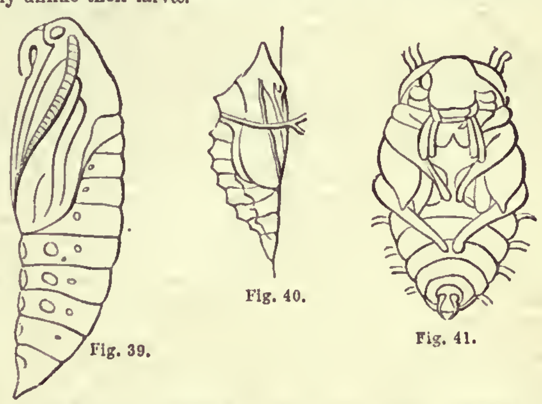


Fig. 39, Pupa of a Lepidopterous Insect (*Sphinx*). *Fig.* 40, Pupa of a Butterfly. *Fig.* 41, Pupa of a Beetle.

The former of these divisions Burmeister subdivides into incomplete pupæ and sub-incomplete. Incomplete pupæ are those without alary appendages: to these belong the Lice and Bugs (*Pediculus* and *Cimex lectularius*). Sub-incomplete pupæ are those which possess rudiments of wings. These comprise all the pupæ of the winged genera of the orders *Hemiptera* and *Orthoptera*.

In the second division, comprising those insects in which there is a complete metamorphosis, the pupa, with very few exceptions, is inactive, and does not take the least nourishment. They are divided into Pupa Coarctata, or those which are covered with a case in which no traces of the future insect can be perceived, as in *Musca* and many other Dipterous Insects; Pupa Obtecta, where the thorax and abdomen are distinct and inclosed in a horny case, as in the *Lepidoptera;* and Pupa Incompleta, where the parts are covered by a membrane, but distinct, as in the order *Hymenoptera* and some Dipterous Insects.

In the *Coleoptera*, *Lepidoptera*, *Hymenoptera*, *Diptera*, and some *Neuroptera*, the pupa state is one of complete inactivity as regards all manifestations of animal life; although the formative processes are carried on with extraordinary energy. The imperfect larvæ of these orders are truly embryonic in their condition; and the processes of development which were commenced in the egg, and which were then only carried far enough to enable the larvæ to come forth and obtain their own nutriment, are now continued at the expense of the food which they have collected and stored up within their bodies; so that the passage into the pupa state in such cases may be fairly likened to a re-entrance into the egg. The pupa is inclosed in the last skin exuviated by the larva, which, instead of being thrown off, dries up, and remains to encase the proper skin of the pupa that is formed beneath it; and in addition to this, it is frequently protected by a silken cocoon, the construction of which was the last act of larval life. The duration of the pupa condition, and the rate at which the developmental changes take place, vary considerably in different cases—some insects remaining in this state for years, while others pass through it in a few days or hours; in both cases however we perceive that an important influence is exerted by external temperature. As the state of the pupa is one of rapid transition it cannot be said to have any characteristic organisation. The assumption of the imago, or perfect type of insect life, is always marked by an exuviation of the integument which covered the pupa; and with this are cast off all the vestiges of the organs peculiar to the larva state, while the wings, the true legs, the compound eyes, the antennæ, the complete masticating or suctorial apparatus, and many other organs are now revealed for the first time in all those whose pupa condition was inactive. The wings however are seldom ready for use at the time of the insect's emersion from the pupa-case, being usually soft and moist, hanging loosely at the sides of the body, and having none of that rigidity which is requisite to give them power of serving as organs of impulsion in the air. It is not until the insect has forcibly injected the trachea with air—by taking several full inspirations, and then making an expiratory effort whilst the spiracles are closed—that the wings are expanded; they then soon become dried up by exposure to the air, and by the cessation of the circulation which previously took place within them, and from that time they are the chief instruments of locomotion in all insects in which they are fully developed. The nutritive apparatus of the Imago is far less developed relatively to the muscular, nervous, and sexual organs than it is in the preceding conditions; and its subordination to the offices of these is shown by the fact that many insects take no food whatever after their last change, the sole purpose of their existence in their perfect state being the propagation of the race by the generative process. In many instances the duration of the imago state is very brief, even when that of the preparatory periods has been very long, as in the case of the *Ephemera* (Day-Fly), which usually dies in a few hours after its last change; although the term of its previous life as a larva and an active pupa has not been less than two or three years: and even when the length of the life of the perfect insect is much greater, as in bees, wasps, &c., it seems to have a special relation to the nurture of the offspring, which are tended and supplied with food during the whole of the larva state. In the Ant tribe the neuters do not acquire wings; and some of them, which are two or three times the size of the rest, and are somewhat differently formed, are characterised as 'soldiers,' their special office being the defence of the nest rather than the nurture of the young. Among the *Termites* (White Ants) however the soldiers appear to be pupæ arrested in their development, whilst the 'workers' have the characters of permanent larvæ. In the Apterous orders of insects we find some tribes undergoing a regular metamorphosis, which is complete in every respect save the non-development of the wings. Thus, the larvæ of the *Pulex* (Flea) are footless worms, which afterwards pass into the pupa state, spinning for themselves a silken cocoon; in this they remain inactive for about twelve days, after which the imago comes forth, having the rudiments of wings attached to the second and third segments of the body, though without any proper distinction of thorax and abdomen. The *Pediculus* (Louse), *Podura* (Spring-Tail), and some other *Aptera* however undergo no metamorphosis, coming forth from the egg in the condition in which they remain all their lives, and this being far from the type of the perfect insect. (Carpenter, 'Principles of Physiology.')

We now come to speak of the classification of Insects. As the various orders of insects are noticed under their respective headings, at present we shall confine ourselves to the arrangement of these orders.

The orders of insects have been so variously arranged by different authors, that to give an outline of the views even of the more celebrated would occupy much space; we will therefore select the most distinguished of these systems:—Firstly, that of Linnæus, whose subdivisions are founded upon the substance and position of the wings; next, that of Fabricius, where the parts of the mouth have been selected in the division of this class into orders; then that of Burmeister, where no particular part or character has been chosen, but where the orders are established upon an aggregate of characters; and lastly, that of Mr. Westwood.

The orders of insects are thus characterised by Linnæus:—

Superior wings crustaceous, with a straight suture	*Coleoptera.*
Superior wings semicrustaceous, incumbent .	*Hemiptera.*
All the wings with scales	*Lepidoptera.*
All the wings membranous, tail unarmed .	*Neuroptera.*
All the wings membranous, tail aculeate .	*Hymenoptera.*
Two poisers in the place of the posterior pair of wings	*Diptera.*
Without either wings or elytra . . .	*Aptera.*

Insects are divided by Fabricius into—

I.—Insects with Biting Mouths.

1. *Eleutherata.* — Maxilla free, uncovered, and palpigerous. (*Coleoptera.*)

2. *Ulonata.* — Maxilla covered by an obtuse galea or lobe. (*Orthoptera.*)

3. *Synistata.*—Maxilla geniculate at the base, and connate with the labium. (*Neuroptera*, &c.)

4. *Piezata.* — Maxilla corneous, compressed, often elongate. (*Hymenoptera.*)

5. *Odonata.*—Maxilla corneous, toothed; two palpi. (*Libellulæ.*)

6. *Mitosata.* — Maxilla corneous, vaulted, not palpigerous. (*Myriopoda.*)

7. *Unogata.*—Maxillæ resembling scissors. (*Arachnida*, part.)

8. *Polygonata.*—Palpi mostly six; many maxillæ within the labium. (*Isopoda.*)

9. *Kleistognatha.*—Many maxillæ without the labium, closing the mouth. (Brachyurous Decapod *Crustacea.*)

10. *Exochnata.*—Maxillæ many without the labium, covered by palpi. (Macrurous Decapod *Crustacea.*)

II.—Insects with Suctorial Mouths.

11. *Glossata.*—Mouth with a spiral tongue between reflexed palpi. (*Lepidoptera.*)

12. *Ryngota.*—Mouth with a rostrum having a jointed sheath. (*Hemiptera*, Latr.)

13. *Antliata.*—Mouth with a haustellum without joints. (*Diptera*, *Anoplura*, and Tracheau *Arachnida*, Latr.)

Burmeister's System.

I.—*Insecta Ametabola.*

The larva resembles the perfect insect, yet it wants wings, if the perfect insect be winged; the pupa in this case has its rudiments. It runs about and eats.

a. With sucking mouths, which consist of four fine setæ lying in a sheath; palpi are wanting; four biliary vessels, and generally a free prothorax.

Order 1.—*Hemiptera.*

b. With mandibulate mouths; mandibles and maxillæ distinct, the latter having palpi, and generally distinct large superior lip.

a. Four unequal wings; the anterior pair leathery, or like parchment, the posterior pair folded longitudinally, and also once transversely; prothorax always free; many biliary vessels.

Order 2.—*Orthoptera.*

β. Four generally equal and rarely unequal wings, never folded, or sometimes none at all. In the first the nervures are usually reticulated, and there are generally many biliary vessels; in the latter case there are four biliary vessels attached to the intestine; prothorax sometimes free, sometimes not.

Order 3.—*Dictyoptera.*

II.—*Insecta Metabola.*

The larva consists of thirteen segments, either with or without legs; the pupa is inactive, or, if it moves, it takes no food.

a. Four equally large or equally long wings with reticulated nervures; mandibulate mouths; few biliary vessels, rarely more than eight; prothorax always free.

Order 4.—*Neuroptera.*

b. Wings always unequal, the posterior pair sometimes wanting, rarely all.

a. Mouths adapted to sucking.

a a. Instead of posterior wings there are pediculated knobs; yet the wings are sometimes wholly wanting; four biliary vessels; larva without feet; a soft proboscis with several setæ and a pair of palpi; prothorax not free.

Order 5.—*Diptera.*

b b. Four wings generally covered with scales; six biliary vessels; larva with feet and a distinct head; maxillæ forming a spiral tongue; prothorax not free but small, and closely connected with the mesothorax.

Order 6.—*Lepidoptera.*

β. Mouths with distinct biting mandibles.

a a. Four naked wings traversed by ramose nervures; larvæ generally without head and feet, but sometimes with both; many biliary vessels; prothorax not free.

Order 7.—*Hymenoptera.*

b b. Anterior wings in the form of horny elytra; larvæ with head, with or without feet; four or six biliary vessels; prothorax always free.

Order 8.—*Coleoptera.*

The first and second of the above classifications are by no means natural, nor were they intended to be so by their respective authors.

The former was established when entomology was, comparatively speaking, in its infancy; and although Fabricius possessed a more intimate acquaintance with insects, yet he contended that an artificial classification should he adopted till further discoveries had cleared the way for their satisfactory development. We cannot feel surprised therefore that these systems should have been superseded by others more modern.

The system of Burmeister is founded upon philosophical principles; we are not however prepared to agree with him in all instances. We allude more particularly to his order *Dictyoptera*, the species of which ought, we think, to be incorporated with the *Orthoptera*.

The following arrangement is that given by Mr. Westwood in his 'Introduction to the Modern Classification of Insects:'—

Class of Hexapod Metamorphic Insects.

Sub-class, Mouth with Jaws.	Sub-class, Mouth with a Sucker.
(*Dacnostomata*, W.)	(*Antliostomata*, W.)
Order *Hymenoptera*.	Order, *Diptera*.
? Osculant order *Strepsiptera*.	? Osculant order, *Homaloptera*.
Order *Coleoptera*.	
Osculant order *Euplexoptera*.	? Osculant order, *Aphaniptera*.
Order, *Orthoptera*.	Order, *Heteroptera* (including the Water-Bugs).
? (*Thrips*?)	
Order, *Neuroptera*.	Order, *Homoptera*.
Order, *Trichoptera* (*Phryganea* alone).	Order *Lepidoptera*.

The mutual affinities and likewise the grade of perfection of the various orders, may be expressed by arranging them in the following succession:—

1. *Hymenoptera*.	5. *Hemiptera*.
2. *Coleoptera*.	6. *Homoptera*.
3. *Orthoptera*.	7. *Lepidoptera*.
4. *Neuroptera*.	8. *Diptera*.

The number of species of Insects is much greater than that of any other class, and they are probably as numerous as all other forms of animals put together. Although possessed of extraordinary locomotive powers, they are each and all distributed within as certain bounds as the most stationary animals or plants. Independent, then, of its great interest as a part of philosophical zoology, the study of the range and specific centres of the forms of insect life becomes of great importance as an aid in the definition of tribes, genera, and species.

Climate and the extension or form of land are the chief influences regulating the distribution of insect life. The constitution of the soil affects it also, but in a secondary manner, through its influence on the vegetation, on which many insects feed. When from the intervention of tracts of water, of mountain barriers, or other causes depending on ancient geological events anterior to the origin of the existing Fauna of the earth, tracts of land presenting exactly similar conditions of climate and soil are placed far apart, we then have, not a repetition of the same forms among their insect population, but a representation by similar forms. This we see also in the Fauna of the several zones of climate belting mountains at different heights. Man's agency and the transporting power of currents of wind modify the distribution of many species of insects. In the following brief glance at the distribution of the principal genera of insects, examples of all these influences will be met with.

Coleoptera.—From the facility with which insects of this division may be preserved and trasported from place to place, we have more detailed accounts of their distribution than of any of the species of other orders. The *Cincindelidæ* are dispersed over most parts of the globe, the typical genus being cosmopolitan, whilst other groups are more limited. Among the *Carabidæ* are many genera peculiar to Europe. *Chlænius*, *Agonum*, and *Amara*, are common to both hemispheres. *Harpalus* and *Brachinus* are cosmopolitan. *Cnemacanthus* occurs in Africa and Chili. The *Carabidæ* of Western Asia agree remarkably with those of Europe. Erichson has remarked that *Carabi* are very constant to certain soils: the vertical distribution of the species is also very constant. The water-beetles allied to *Dytiscus*, itself universal in the Old World, are mostly European: several of the species live in salt or brackish waters. *Gyrinus* ranges from Northern Europe to Australia. The *Brachelytra* have their chief centre in Europe. The typical genus *Staphylinus* appears however to be represented everywhere: many species occur in South America. A species of *Aleochara* is found in Van Diemen's Land. *Elater* and *Buprestis*, types of families, are both cosmopolitan: the species are often local, and their distribution depends, in many cases, on that of certain plants on which the larvæ prey. Among the Fire-Flies (*Lampyridæ*) the genus *Lampyris*, which is European, is represented in the tropics by *Photinus*, and in the New World by *Aspisoma*. The *Malachii* are found everywhere, except in South America. *Ptinus*, a genus chiefly European, has a single representative in Australasia. Of the *Necrophagi*, the genera *Cryptophagus*, *Strongylus*, and *Silpha* are found everywhere, ranging from Britain to China, and from Brazil to Lapland. *Hister*, the type of a family, is also a cosmopolitan genus. *Byrrhus* belongs to the northern hemisphere, and has its chief centre in Europe. Among the Coprophagous *Lamellicornes*, the genus *Aphodius*, though represented in most countries, is chiefly developed in temperate regions; whilst *Ateuchus*, on the other hand, is mainly tropical. *Geotrupes* is cosmopolitan. *Copris* ranges to Australia, where however it is confined to the north coast. *Scarabæus* is subtropical. *Pelidnota* is American. The beautiful *Cetoniæ* appear to be of universal distribution. The strange forms of *Goliathus* are South African. Of the cockchafers, *Melolontha* is cosmopolitan; *Macrotops* and *Anoplognathus*, confined to Australia; *Hoplia*, with one exception, European; *Amphicoma* is Mediterranean; *Anisoplea* and *Serica* are natives of the warm and temperate regions of both hemispheres, whilst *Euchlorus*, occupying the same range, extends beyond in a northern direction. Of the *Melasomæ*, *Blaps* and *Pimelia*, both extensive genera, have their chief development in the warmer regions of the Old World. Of the *Stenilytra*, *Helops* is cosmopolitan, *Œdenura* European. Of the *Anthicidæ* the numerous species of *Anthicus* are chiefly inhabitants of temperate regions. The Blistering Beetles of the genus *Melöe* are very generally distributed.

Of the ten thousand species of Weevils the great genera *Centorhynchus*, *Cryptorhynchus*, *Calandra*, *Otiorhynchus*, and *Clionus* are all cosmopolitan. *Platysomis* and *Cyphus* are South American; *Brachycerus*, South African and Mediterranean. *Brentus*, mainly confined to the tropical regions of both hemispheres; *Apion* and *Rhynchites*, chiefly European. The distribution of the species of weevils depends in a great measure on that of plants.

The most beautiful and vividly coloured forms of Longicorn Beetles are mostly tropical. The presence of forests determines that of many of the genera. Of the seventy genera of *Cerambycidæ*, the typical one, *Cerambyx*, is cosmopolitan. Others have defined centres, as *Clytus* in Europe, *Trachyderes*, in South America.

Of the *Chrysomelinæ*, the typical genus *Chrysomela* is cosmopolitan. The presence of certain plants determines the distribution of the species. From this cause, species of limited distribution are sometimes multiplied far from their aboriginal centres. Thus *Galeruca calmariensis*, introduced from Europe into America, multiplied so at Baltimore in the years 1838 and 1839, that the elm-trees of the district were eaten bare by their larvæ, and probably they will henceforth become a constant annoyance in the New World. *Lema* and *Donacia* are instances of cosmopolitan genera having distinct centres in temperate climates. *Cassida*, on the other hand, has its centre in the tropics.

Of the *Trimera*, *Coccinellæ* are found everywhere. *Eumorphus* is Indian and Polynesian.

Orthoptera.—Though by no means an extensive order either as to genus or species, the *Orthoptera* are of very general distribution. Representatives of the genera *Gryllus* and *Acheta*, the grasshoppers and crickets, are found in most countries. The Locusts are mostly exotic. The strange *Phasmæ* are mostly tropical, as are also the greater number of *Mantidæ*, known popularly as 'walking leaves.' The Cockroaches, *Blattæ*, are very general, and have been greatly diffused from their original centres by unintentional human agency. The Earwig tribes, *Forficulidæ*, including more than fifty species, are in great part European, but range even to Van Diemen's Land.

Erichson notices the curious fact respecting the *Orthoptera* of Van Diemen's Land, that only one fourth of the species are completely winged and capable of flying.

Neuroptera.—The number of known species in this order is short of one thousand. The section of *Plicipennes* is almost entirely European; the genus *Macronoma*, including species from Madagascar and Brazil, is an exception. The *Planipennes*, a great part of the genera of which division are now considered by many naturalists Orthopterous, have a much more varied distribution. Thus the *Myrmelionidæ* are cosmopolitan, the *Perlæ* and *Nemouræ* chiefly European, the *Panorpæ* characteristic of the temperate regions of both the Old and and New World, the *Termites* of the tropics. In the section of *Subulicornes*, the *Ephemeridæ* are European; the *Æshnidæ*, cosmopolitan; as also the true Dragon-Flies, *Libellulæ*, of which near two hundred species are known. Other allied genera are more limited.

Hymenoptera.—Among the sting-bearing species, the true bees are characteristic of the ancient continent, those now dispersed in America having been transported from Europe. The genera *Centris* and *Euglossa* are exclusively American. *Nomia* is Asiatic. *Allodape* is south African. *Andrena*, *Xylocopa*, and several other extensive genera, are cosmopolitan. A great many genera of wasps are peculiar to South America. The ants are most developed in Europe. *Bembex* is a tropical genus. The terebrating *Hymenoptera* are both very numerous and widely distributed, especially the great genus *Ichneumon*. Certain genera forming the family *Oxyuræ* are exclusively European, as are also a great part of the numerous family of *Chalcididæ*. *Cynips* is European, and the greater number of *Tenthredinidæ*.

The distribution of the *Strepsiptera* depends on that of the insects on which they are parasitic.

Lepidoptera.—When the distribution of the butterflies shall have been worked out, it will doubtless prove very interesting. At present our knowledge of this subject is imperfect. The *Papilionidæ* are very numerous specifically, and for the most part tropical. Some of them possess great ranges. Thus certain species of *Pieris* are found over all Europe, and great part of Asia and Africa. Other forms are constant to mountainous regions. Of the *Nymphalidæ* the greater number and more gorgeous forms are tropical. In this family there are some remarkable instances of extensive distribution of species. Thus *Vanessa Cardui* (a common British butterfly) is found in every part of the world, and *Vanessa Atalanta* ranges over all Europe, part of Asia and Africa, and to North America. In the remaining tribes the typical genera are almost always cosmopolitan, whilst others have more limited areas.

The *Sphingidæ* and *Zygænidæ* are in great part European; the *Castnidæ* mostly tropical.

Among the Moths, the *Phalenidæ* are chiefly European, and the species are usually widely distributed. This appears to be the case also with the other families of Nocturnal *Lepidoptera*, probably rather in consequence of our imperfect knowledge of exotic forms, than because it is really so, for we find types and species in distant regions wherever they have been even casually explored, as in the instance of Asiatic Russia, where the researches of Eversmann among these insects have brought many new forms to light.

Diptera.—One half of the described species of two-winged flies (about eight thousand) belong to Europe. This disproportion arises from our comparative ignorance of the exotic forms. The small group of *Ornithomyzidæ*, parasites on quadrupeds and birds, has representatives of all its genera in Europe, the few remaining species being natives of eastern Asia, Western Africa, Australia, or Brazil. The flies forming the family of *Muscidæ* include a great number of genera, both European and exotic, the former being most prolific in species, some of which have wide ranges. The *Syrphidæ* are in the same category. The genus *Chrysops*, equally developed in Europe and America, and represented in a less degree in Africa and Asia, does not appear in Australia nor in the islands of the Pacific. *Tabanus* is more widely distributed. *Ommatius*, a genus of *Asilidæ*, has its members in all parts of the world. A great many genera are peculiar to South America, and several to Africa, hot, woody, and moist regions favouring their diffusion. *Tipula*, presenting numerous and varied forms in most parts of the world, is excluded from Australia and the Pacific, which region seems to be the least prolific in *Diptera*. The species of Gnats, *Culex*, are very generally distributed.

Hemiptera.—Of the two great divisions of this order, the *Homoptera* and the *Heteroptera*, the first is the smallest and also the most tropical. The distribution of the insects comprising them depends mainly on the Fauna and Flora of the countries they inhabit. Thus each species of *Coccus aphis* has a range correspondent to that of the plant upon which it feeds; and of the *Coræidæ* and *Lygæidæ* with the presence of their favourite animal food. Among the most interesting of the families of *Hemiptera* are the *Cicadeidæ*, of which the genus *Tettigonia* includes 200 species, centred in America, but having members also in the Old World; the *Fulgoridæ*, or Lantern-Flies, very generally distributed through warm climates; *Scutelleridæ*, remarkable for brilliancy, are mostly equatorial; and *Cimex*, of which the only true species is the common bed-bug, a pest spread over all Europe. Of the Aquatic *Hemiptera*, *Gerris* and *Nepa* are cosmopolitan; *Pelogonus* and the *Notonectidæ*, mostly European; *Galgulus* and *Mononyx*, American; and *Halobates*, equatorial.

Thysanura.—As yet the distribution of these minute insects has been scarcely attended to. The species of *Lepisma* range from Europe to China. *Podura* and *Smynthura* are European; a single species of the last-named genus occurs in North America.

Anoplura.—These disagreeable parasites have lately been honoured by the attention of some excellent naturalists, especially Denny and Gwilt. Their distribution corresponds with that of the animals upon which they are found. Of the equally annoying order *Aphaniptera* three-fourths of the known species are European. The Common Flea is a cosmopolite, and the *Chigo* is confined to South America.

Fossil Insects.

Until within a few years the occurrence of insects in a fossil state could only be substantiated by reference to a small number of localities, situated (as at Aix in Provence) among lacustrine tertiary strata, or (as at Stonesfield in Oxfordshire, and Solenhofen in Franconia) among marine Oolitic beds; but Mr. Prestwich has added traces of *Coleoptera* from the Coal Formation of Coalbrook Dale, and Mr. Strickland parts of *Neuroptera* from the Lias of Warwickshire; Dr. Buckland obtains *Neuroptera* from the Oolite of Stonesfield, and Mr. Brodie portions of insects belonging to various natural orders from the Lias of Somersetshire, Gloucestershire, and in the Wealden deposits of the Vale of Wardour in Wilts, and the Vale of Aylesbury.

Still the number of fossil insects, whether we estimate individuals or species, is very small compared to the probable number of anciently existing races; a circumstance quite explicable by reference to the phenomena which are now taking place in nature; for of upwards of 12,000 British species of insects there is reason to believe that but a very minute proportion is buried and preserved in lacustrine, estuary, or marine deposits now in progress. Only one elytron of a small beetle was observed in a deposit of the Elephantoidal era in Yorkshire, and one seed of some umbellate plant, along with hundreds of shells which inhabited the lake.

No doubt vast numbers of insects, wandering by caprice or drifted by winds, pass from the shore and fall into the sea—as we learn from the first voyage of Cook, who sailed through myriads of insects, some on the wing and others in the water, even thirty leagues from land off the coast of South America,—but few of these escape the watchful finny races, or ever reach the bottom of the sea.

In like manner we find land insects heaped in profusion by winds on certain tracts of fresh water, and borne down the course of rivers by inundations; and these cases, by the aid of particular suppositions, such as evaporation or slow draining off of the water, may offer the nearest analogy to the facts actually observed in the greater number of insect deposits.

The occurrence of fossil insects, especially in marine strata, is therefore to be regarded as an exceptional case, and this makes the circumstances brought to light concerning them remarkable and difficult of interpretation. We find however from Mr. Brodie that the insects lie in a certain bed or mass of thin beds in the Lias; similarly they occupy particular layers in the Oolite, the Wealden deposits, and in the tertiary accumulations of Aix, Oeningen, and Auvergne. In the latter region the calcareous incrustations gathering on the indusiæ, or larva-cases, of *Phryganidæ* have caused the formation of a peculiar limestone, called Indusial Limestone.

In the following summary of the groups of fossil insects in Great Britain the most recent stratifications come first. The catalogue commences with the Elephantoidal era. The authorities and localities are given for each case. (Morris's 'Catalogue of Fossils;' Brodie's 'Fossil Insects;' Lyell, in 'Geol. Proc.;' Phillips, 'Geol. Yorkshire;' Strickland, in 'Mag. of Nat. Hist.;' Buckland, in 'Bridgewater Treatise;' and 'Geol. Proc.')

1. Ossiferous Fresh-Water Deposits. (Pleistocene.)
Elytron of a *Chrysomela*. Bielbecks, in Yorkshire. (Phillips.)
Remains of *Copris lunaris*. Mundesley, Norfolk. (Lyell.)
Remains of *Donacia*. Mundesley, Norfolk. (Lyell.)
Remains of *Harpalus*. Mundesley, Norfolk. (Lyell.)
Remains of *Coleoptera*. Southwold, Suffolk. (Alexander.)

No truly aquatic beetle is mentioned among these. *Donacia* haunts aquatic plants. The others are strictly terrestrial. They must have been drifted into the lakes in which the *Planorbis*, &c., lived.

2. In the Cretaceous System, no insects have yet been found.

3. In the Wealden Strata of the Vale of Wardour. The specimens found by Mr. Brodie and examined by Mr. Westwood were:—

Land *Coleoptera*, of the families *Carabidæ* (?), *Harpalidæ* (?), *Staphylinidæ* (?), *Buprestidæ* (?), *Tenebrionidæ* (?), *Elateridæ* (?), *Curculionidæ* (?), *Cantharidæ* (?), and *Helophoridæ*.

Aquatic *Coleoptera*, of the families *Hydrophilidæ* (?) and *Dyticidæ* (?) (*Colymbetes*).

Orthoptera, of the genera *Acheta* and *Blatta*.

Hemiptera and *Homoptera*, including land-tribes, as *Cimicidæ*, *Cicada*, *Cercopis* (larva), *Aphides*, &c., and the aquatic races of *Velia* and *Hydrometra*.

Neuroptera.—In this water-hunting order occur *Libellula* and *Æshna*, *Corydalis*, *Libellulidæ*, *Termes* (?), and *Leptoceridæ*. *Trichoptera* (?), *Phryganidæ* (?).

Diptera.—*Simulium* (?), *Platyura* (?), *Tanypus* (?), *Chironomus* (?), *Culex* (?), *Tipulidæ* (?), &c. (Aquatic larva) *Empidæ* (?).

4. In the Oolitic Strata insects occur in the laminated probably littoral beds of Stonesfield and some other localities in Gloucestershire and near Bath. Dr. Buckland has described several species in the 'Geological Proceedings' and in his 'Bridgewater Treatise on Geology,' and Mr. Brodie has added others. The remains are chiefly elytra of *Coleoptera* and wings of *Neuroptera*. The following is abstracted from Mr. Brodie's list:—

Coleoptera, of the families *Prionidæ*, *Buprestidæ*, *Pimeliidæ* (?), *Chrysomelidæ* (?), and *Coccinellidæ*.

Neuroptera.—*Hemerobioides giganteus*. (Buckland.)

5. In the Upper Lias: at Dumbleton and Churchdown. (Brodie.)

In the Lower Lias: above the bone-bed of Aust Cliff, Waiulode Cliff, &c., on the Severn; Coombe Hill, Cracombe; Hasfield, Corsowood Hill, &c., in Gloucestershire. (Brodie.)

Mr. Westwood has examined 300 specimens of insects from the Lias beds.

Coleoptera, of the families *Buprestidæ* (?), *Elateridæ*, *Curculionidæ* or *Chrysomelidæ*, *Carabidæ*, *Telephoridæ*, *Melolonthidæ*, &c.; a species of *Gyrinus* (?).

Orthoptera, including *Gryllidæ* and *Blattidæ*.

Hemiptera and *Homoptera*. *Cicada* (?), *Cimicidæ* (?).

Neuroptera.—These are the best-determined of the fossil groups, owing to the structure of the wings being clear and characteristic:—

Libellula Brodiæi (Brodie), is found in Upper Lias, at Dumbleton, Gloucestershire.
L. Hopæi (Brodie). Strensham, Worcestershire.
Agrion Buckmanni (Brodie), in Upper Lias at Dumbleton.
Æshna liassina (Strickland). Bidford, Warwickshire.
Orthophlebia communis (Westwood). Waiulode, Forthampton, Strensham, Cracombe, Bidford.
Hemerobius (?) *Higginsii* (Brodie).
Chauliodes. Hasfield, Strensham, Bidford.
Ephemera. Strensham.
Diptera.
Asilus (?) *ignotus* (Brodie). Forthampton.

It is in the Lower Lias beds that the insects are most abundant. They occur in this part (between the ordinary lias limestones and the bone bed) so extensively as to justify the application to this genus of the term 'insect limestone' used by Mr. Brodie. As a whole the Lias insects appear to contain larger proportions of aquatic tribes than the Wealden. There is no decided evidence amongst them of the prevalence of a warm climate at the time and in the place of their existence. They are usually of small size, not so entire as to forbid the supposition of having been drifted (the *Neuroptera* may have been less drifted than the *Coleoptera*); and if there were islands or high coasts adjacent these might nourish, and in time of floods send down the small coleopterous insects to be imbedded with the fucoids, oysters, and *Modiolæ* of the coasts, and ferns and other plants of the land and streams.

6. In the ironstone nodules lying in the Carboniferous deposits of Coalbrook Dale Mr. Prestwick has discovered *Coleoptera*, *Curculioides Ansticii* (Buckl.), *C. Prestvicii* (Buckl.); and Sir R. Murchison ('Sil. Syst.' p. 105) mentions an insect to which the name of *Corydalis Brongniarti* is assigned. It is very possible that the laminated limestone deposits of Burdie House, near Edinburgh, and Ashford, in Derbyshire, may yield insect remains older than any yet mentioned; and seeing the frequent connection or proximity of fossil insects to fossil fishes it may be worth while to search the lower beds of the mountain limestone, where the rich fish-beds occur in it, on the Avon, in Caldy Island, and in Fermanagh. The fish-beds of the magnesian limestone (marl slate) may also be indicated for further research. A very interesting addition to the fossil insects of Aix has been made known by M. Coquand. It is a butterfly, and has been carefully examined by M. Boisduval, who has been able to recognise perfectly its generic and specific characters. It belongs to one of those genera the species of which are not numerous, and are at present confined to the islands of the Indian Archipelago, or the warmest countries of the Asiatic continent. It belongs to the genus *Cyllo*—it is an extinct species—and is named *C. sepulta*. M. Boisduval has examined the other fossil insects of Aix, and differing both from Curtis and Marcel de Serres, refers them to the extra-European genera, and to extinct species.

(Kirby and Spence, *Introduction to Entomology;* Westwood, *Introduction to the Modern Classification of Insects;* Burmeister, *Manual of Entomology; Insect Architecture, Transformations, and Miscellanies*, in *Library of Entertaining Knowledge;* Newman, *Grammar of Entomology;* Westwood, *Entomologist's Textbook; Episodes of Insect Life;* Curtis, *Illustrations and Descriptions of the Genera of British Insects;* Stephens, *Illustrations of British Entomology;* Carpenter, *Principles of Physiology;* Newport, Papers on the *Structure of Insects*, in *Philosophical Transactions*, and *Transactions of Linnæan Society;* Newport, article 'Insecta,' *Cyclopædia of Anatomy; Catalogues of Insects in British Museum; Insecta Britannica.*)

INSECTIVORA. [CARNIVORA.]

INSECTS. [INSECTA.]

INSECTS, FOSSIL. [INSECTA.]

INSESSO'RES, the name given by Mr. Vigors to the Perchers, the second order of Birds in his system, and, as the families of which it is composed are very numerous, he classes them in comprehensive sections or tribes, which he thus denominates:—*Fissirostres* (Cuvier), *Dentirostres* (Cuv.), *Conirostres* (Cuv.), *Scansores* (Auct.), *Tenuirostres* (Cuv.).

The FISSIROSTRES, according to Mr. Vigors, include the *Meropidæ*, the *Hirundinidæ*, the *Caprimulgidæ*, the *Todidæ*, and the *Halcyonidæ*.

The DENTIROSTRES include the *Muscicapidæ*, the *Laniadæ*, the *Merulidæ*, the *Sylviadæ*, and the *Pipridæ*.

The CONIROSTRES comprise the *Fringillidæ*, the *Sturnidæ*, the *Corvidæ*, the *Buceridæ*, the *Loxiadæ*.

The SCANSORES consist of the *Ramphastidæ*, the *Psittacidæ*, the *Picidæ*, the *Certhiadæ*, and the *Cuculidæ*.

The TENUIROSTRES are composed of the *Nectariniadæ* (?), *Cinnyridæ*, *Trochilidæ*, *Promeropidæ* (?), and *Meliphagidæ* (?).

Mr. Vigors finds the following parallel analogies by which the tribes of the *Insessores* represent the different orders of the class.

Dentirostres	*Raptores.*
Conirostres	*Insessores.*
Scansores	*Rasores.*
Tenuirostres	*Grallatores.*
Fissirostres	*Natatores.*

Of these the *Conirostres* are considered by Mr. Vigors the typical group. ('Linn. Trans.,' xiv.)

Mr. M'Leay conceives it to be demonstrated that, so far as relates to the analogies existing in nature between the orders of *Mammalia* and *Aves*, the *Primates* ought to be placed as analogous to the *Insessores*. Both are omnivorous. ('On the Comparative Anatomy of Certain Birds of Cuba,' by W. S. M'Leay, in 'Linn. Trans.,' xvi.)

Mr. Swainson, in accordance with his opinion that the primary divisions of every circular group are five apparently, but three actually, gives the following table as illustrating the

Circle of the order *Insessores*, or Perchers:—

1. Typical Circle.	Bill more or less conic, strong, slightly or not at all notched; mouth without bristles; feet robust, formed both for perching and walking. Omnivorous.		*Conirostres.*
2. Subtypical Circle.	Bill shorter and more compressed, with a distinct tooth-like notch; mouth generally defended by bristles. Insectivorous.		*Dentirostres.*
3. Aberrant Circle.	Bill entire; feet very short, not adapted for walking; position of the toes various.		*Curtipedes.*
	1. Feet formed for climbing.	*Scansores.*	
	2. Bill long; tongue extensile. Suctorial.	*Tenuirostres.*	
	3. Bill broad at the base. Feed upon the wing.	*Fissirostres.*	

The table of analogies set out by the same author is the same in substance with that of Mr. Vigors, differing only in the order in which the tribes and orders are placed. Mr. Swainson, who excludes Man from the Zoological circle, considers the *Insessores* to be analogous to the *Quadrumana*.

The *Dentirostres*, according to the last-named author, include the families *Laniadæ* [LANIADÆ], *Merulidæ* [MERULIDÆ], *Sylviadæ* [SYLVIADÆ], *Ampulidæ* and *Muscicapidæ* [MUSCICAPIDÆ], with their sub-families.

His families of the *Conirostres* are *Corvidæ* [CORVIDÆ], *Sturnidæ* [STURNIDÆ], *Fringillidæ* [FRINGILLIDÆ], *Musophagidæ* [MUSOPHAGIDÆ], and *Buceridæ* [HORNBILLS], with their sub-families.

Under the *Scansores* he comprises the *Rhamphastidæ* [RHAMPHASTIDÆ], the *Psittacidæ* [PSITTACIDÆ], the *Picidæ* [PICIDÆ], the *Certhiadæ* [CERTHIADÆ], and the *Cuculidæ* [CUCULIDÆ], with their sub-families.

The *Tenuirostres* are made to contain the *Meliphagidæ* [MELIPHAGIDÆ], the *Cinnyridæ* [CINNYRIDÆ], the *Trochilidæ* [TROCHILIDÆ], the *Promeropidæ* [PROMEROPIDÆ], and the *Paradisiadæ* [BIRDS OF PARADISE], with their sub-families.

The *Fissirostres* comprise the *Meropidæ* [MEROPIDÆ], the *Halcyonidæ* [HALCYONIDÆ], the *Trogonidæ* [TROGONIDÆ], the *Caprimulgidæ* [GOATSUCKERS], and the *Hirundinidæ* [SWALLOWS], with their sub-families.

INSPIRATION. [RESPIRATION.]

INTESTI'NA (Intestinaux), the second class of the *Radiata*, or fourth division of the animal kingdom, according to the classification of Cuvier. In the 'Règne Animal' this class is divided into two orders, *Cavitaria* and *Parenchymata*, which include all the *Entozoa* of Rudolphi; but the term *Intestina*, if retained at all, should be applied only to the true Intestinal Worms, or those parasites which live in the intestines of other animals, and should exclude the *Entoza* which are found in the cellular tissue and substance of the different viscera of the body.

The order *Cavitaria* ('vers intestinaux cavitaires') of Cuvier corresponds to the fifth order *Nematoidea* of Rudolphi, and the group *Cœlelmintha* of Owen. The *Parenchymata* ('vers intestinaux parenchymateux') includes the other four orders of Rudolphi, *Acanthocephala*, *Trematoda*, *Cestoidea*, and *Cystica*, and corresponds to Mr. Owen's group of *Sterelmintha*. [ENTOZOA.]

INTESTINAL WORMS. [ENTOZOA.]

INTESTINES are that portion of the digestive canal into which the food is received after it has been partially digested in the stomach, and in which its further assimilation, the separation and absorption of the nutritive matter, and the removal of that which is excrementitious, take place. In an adult the intestines consist of a convoluted tube of from 30 to 40 feet in length, and are, from the difference of their diameters in different parts, divided into *Small Intestines*, which comprise about the first four-fifths, and *Large Intestines*, which constitute the other fifth of their length. The former again are divided into the Duodenum [DUODENUM], into which the ducts from the liver and pancreas open, and in which the chyme from the stomach is converted into chyle [DIGESTION; CHYLE]; the Jejunum, in which the absorption of the nutritive matter of the food is principally effected; and the Ileum. The large intestines are divided into the Cœcum, Colon, and Rectum.

The walls of the intestinal canal are composed of three principal coats or membranes. The exterior, which is smooth and polished, is called the peritoneal, and its principal use is to permit the free motions of the intestines within the abdomen, and of their several convolutions against each other, by rendering the effect of friction as slight as possible. [PERITONEUM.] Next to and within the peritoneal coat is the muscular, which is composed of two layers of fibres; an external, in which they are directed longitudinally, and an internal, of which the fibres encircle the intestine. By these the motions of the intestines and the propulsion of their contents are effected; the longitudinal fibres tending to shorten each portion of the canal, while the circular contract its diameter; and the two sets together producing a motion of the tube somewhat like that of a worm, whence it has received the name of vermicular motion. Beneath these layers, and separated from them by a stratum of cellular tissue, which has been sometimes called the fourth or nervous coat, is the mucous membrane, which is the most important part of the intestinal canal.

The structure of these coats of the intestines has been most carefully observed by means of the microscope. The minute structure of the intestines corresponds to a considerable extent with what is met with in the stomach. There are however differences of structure especially in the mucous coat of the intestines. We shall describe first the muscular structure, and in doing this we shall follow Professor Kolliker in his 'Manual of Human Histology.'

The muscular coat of the smaller intestines is somewhat thicker in the duodenum and the upper portions, than in the lower; it has in general a thickness of ¼'''—⅓''', and is composed only of longitudinal and transverse fibres. The former are always less developed, and do not form a continuous layer, since they are very few or entirely absent along the attachment of the mesentery; they are usually most distinct upon the free border, though even here they may be readily torn away with the serous membrane, so as at once to leave the second layer exposed. The latter is complete and continuous, consisting of circular bundles, which not uncommonly anastomose at very acute angles.

In the large intestines the longitudinal fibres are reduced to the three ligamenta coli, muscular bands of 4'''—6''', or even 8''' broad, and ⅓'''—¼''' thick, which commencing upon the cœcum are united upon the sigmoid flexure into a single longitudinally fibrous layer, thinner than in the small intestines, and more especially developed in the duplicatures, which are known under the name of the plicæ sigmoideæ. All the fibres belong to the smooth or non-striated system of muscular fibres. Many of them present knot-like enlargements and frequently zigzag flexures, which produce the transversely striated appearance of the entire bundles of such muscles so frequently met with in spirit preparations. The arrangement of the fibre-cells in the different strata is simply this, mutually applied in their length and breadth, and coherent:—They are united into thin muscular bands, which when invested with a coating of connective tissue, and frequently also united into secondary bundles, constitute the thicker or thinner muscular tunics of the different regions; which, again are surrounded and separated from the contiguous parts by considerable layers of connective tissue.

Blood-vessels are very abundant in the smooth muscles; and their capillaries, of 0·003'''—0·004''', constitute a characteristic network with rectangular meshes. Nothing is known about the lymphatics; nor are the relations of the nerves yet ascertained, except that Ecker has observed the division of fine nervous tubules in the muscular tunics of the stomach of the frog and rabbit.

The mucous membrane of the small intestines is thinner than that of the stomach, but more complex in its structure, inasmuch as besides the tubular, or Lieberkühnian glands it presents a great number of permanent folds and villi, also imbedded in its substance, peculiar closed follicles, the so-called solitary and Peyer's glands, and, in the submucous tissue of the duodenum, Brunner's glands. The mucous membrane consists of connective tissue which is internally homogeneous, or indistinctly fibrillated; except where certain glands exist there is but little submucous tissue, so that it is pretty closely connected with the muscular tunic. Upon the inner surface of the mucous membrane there rests a cylinder-epithelium, whilst externally towards the submucous tissue it is bounded by a layer of smooth muscles discovered by Brücke, which measures at most 0·0177'''. They are disposed longitudinally and transversely, but in man their slight development renders it often very difficult to discover them.

The villi of the small intestines are small whitish elevations of the innermost portion of the mucous membrane, readily distinguishable with the naked eye, and which distributed upon and between the valvulæ conniventes through the whole extent of the small intestines, from the pylorus to the sharp edge of the ileocœcal valve, are set so close together as to give the mucous membrane its well-known velvety appearance. They are most numerous (50 to 90 upon a square line) in the duodenum and jejunum, less so in the ileum (40 to 70 upon a square line). In the duodenum they are broader and less elevated, resembling folds and laminæ $\frac{1}{10}$'''—¼''' in height, ¼'''—⅙''' or even ⅓''' in breadth. In the jejunum they appear for the most part to be conical and flattened; frequently they are even foliated or cylindrical, clavate, or filiform, the three latter forms predominating in the jejunum. The length of the villi is from ¼'''—⅓''', the breadth from ⅙'''—$\frac{1}{10}$''', or even $\frac{1}{12}$''', the thickness in the flattened forms $\frac{1}{30}$'''.

The villi are composed of two portions, a deeper coat belonging to the mucous membrane, and an epithelial superficial coat. The contour of the former, or villus proper, is similar to that of the entire villus; it is simply a solid process of the mucous membrane containing blood-vessels, lymphatics, and smooth muscles, whose matrix, through which a variable number of roundish nuclei are scattered, in general exhibits no morphological peculiarity more decided than that of the mucous membrane itself, yet must most undoubtedly be regarded as a metamorphosed connective tissue without any intermixture of elastic tissue. The bloodvessels of the villi are so numerous that when well injected those whose epithelium has been detached become coloured throughout; and in living animals, or in those which have just been killed, each villus if viewed from above appears as a red dot surrounded by a clear ring. In man every villus contains a close network of capillaries of 0·003'''—0·005''', with rounded or elongated nuclei, which lies immediately beneath the homogeneous external layer of the matrix, and is supplied by one, two, or three small arteries of 0·01'''—0·016'''. The blood is usually carried back directly into the larger trunks of the submucous tissue by a vein of 0·022''', which does not arise as in animals, by the arching round of the artery, but proceeds from the gradual confluence of the finest capillaries. The relations of the lacteals in the villi of man, have not hitherto been perfectly made out; for although the majority of investigators are inclined, like the older observers, to suppose that they commence by one or two cœcal branches, yet recently several observers have contended for the view that they originate in a filiform manner. On this subject Professor Kölliker remarks that in the human subject he has never succeeded in meeting with villi distended with chyle, and in empty ones, he has been unable to obtain any decisive evidence; on the other hand, in animals, he feels certain that in many cases only a single lacteal which has a cœcal and frequently enlarged end, and whose diameter is much greater than that of the capillaries, traverses the axis of the villus. He says he believes that all the narrow cylindrical and filiform villi will be found to present this condition, but that, on the other hand, the number and mode of origin of the lacteals may possibly be different in the broad and foliaceous forms.

In addition to these organs the villi also contain, as Brücke discovered a short time ago, a thin layer of longitudinal smooth muscles, situated more centrally round the lacteals; these however are not always distinct in man, they produce contractions of the villi, which are very evident immediately after death, and which, according to Brücke, are also perceptible in the living animal. They have in all probability an important influence over the propulsion of the chyle, and of the venous blood in the villi—always supposing that there is no objection to the assumption that they perform repeated contractions during life. Nothing is known of nerves in the villi. The epithelium of the villi and of the rest of the surface of the mucous membrane, although it is very intimately united with the deeper-seated parts during life, only becoming detached accidentally or by disease, separates very readily in the dead subject, and can only be observed in perfectly fresh portions of intestine. It consists everywhere of a simple layer of cylindrical cells slightly narrowed below of 0·01'''—0·012''' in length and 0·003'''—0·004''' in breadth, whose contents are usually nothing but fine granules, and an oval, clear, vesicular nucleus, provided with one or two nucleoli. During life, these cells, which agree in all their chemical characters with the deeper cells of the oral epithelium, are so intimately united, that even after death their contours in a longitudinal view, are at first either not at all or only indistinctly distinguishable, though on the surface they have the appearance of a beautiful mosaic. The cylinders only become quite distinct when they are either spontaneously or artificially detached, a process which usually takes place in such a manner that they hang together in continuous portions, all the cells covering a villus, sometimes coming off together like the calyptra of a moss.

The addition of water to these cells produces a separation of the cell-contents from the broad end, giving rise, in separate cells, to the appearance of a membrane thickened upon one side, and, in series of cells or entire villi, to that of a peculiar structureless coat, like the cuticle of plants; by its longer action, however, or by that of the intestinal fluids, the bursting of the cells produces apertures in them, or they become distended into large pyriform clear vesicles.

We may here refer to the changes which the epithelial cells and the villi in general undergo during digestion. The most striking circumstance is the occurrence of fat-globules in different parts of the villi, which may always be observed during the formation of a fatty milk-white chyle. The succession of the morphological steps is as follows:—The fat contained in the chyme at first enters only isolated epithelial cells in different regions of the villi, so that in each we soon observe a large ovate shining drop.

The number of these fat-cells rapidly increases, and then the villi acquire a very peculiar appearance, often as if beset with pearls, from the irregular alternation of cells filled with fat, and consequently bright and shining, with those which are empty and pale. In the end all the cells become filled with these drops, and the epithelium appears quite dark by transmitted, but whitish by reflected light, giving its aspect to the whole villus.

With the repletion of the entire epithelial covering of the villus, absorption commences, but up to this time nothing has entered the lacteals. This however soon takes place, and the first indication we observe is the breaking up of the large drops of fat in the cells into many tolerably minute fatty molecules. When this has occurred, these drops penetrate by degrees from all sides into the parenchyma of the villus itself, fill it more and more, and at last enter the central lacteal, whose whole length they eventually occupy. In the meanwhile, fresh fat has been continually passing in from the intestinal canal, not in the form of large drops however, but henceforward in small molecules or drops of the same kind as those which were at first developed secondarily in the cells. On the other hand, at a subsequent period, we not uncommonly meet in the interior of the villi with large round drops, which appear especially inclined to form considerable accumulations at their apex. In man the process is probably the same as in animals. These observations demonstrate that fatty matters are absorbed as such, and are not saponified; on the other hand, it cannot at present be certainly stated how it is possible that they penetrate the membrane of the epithelial cells, the parenchyma of the villi, and the walls of the lacteals.

The whole process may be compared to the imbibition of an emulsive fluid, such as milk, by a porous body; and the fatty molecules of the chyme are probably absorbed simply in consequence of their being carried along with its fluid part. While digestion is going on, we frequently find the whole parenchyma of the villi densely filled with small nuclei, here and there surrounded by cell-membranes—elements which are never entirely absent in a villus, but are at other times far fewer, and particularly are not to be distinguished in its interior.

The small intestines contain two kinds of true glands; 1, tubular glands, which are disposed over the whole mucous membrane; 2, racemose glands, in the submucous tissue of the duodenum.

The Racemose Glands, or as they are commonly named, after their discoverer, Brunner's Glands, form, at the commencement of the duodenum, upon the outer side of the mucous membrane, a continuous layer, which is best developed and thickest close to the pylorus, where it constitutes a considerable glandular ring, and extends about as far as the aperture of the biliary ducts. If the two layers of the muscular tissue be dissected off a stretched or distended duodenum, the glands may readily be recognised as yellowish flattened bodies of $\frac{1}{10}'''$—$1\frac{1}{2}'''$ (on the average $\frac{1}{4}'''$—$\frac{1}{2}'''$), with their angles rounded off, which inclosed within a little connective tissue, lie close to the mucous membrane, and send short excretory ducts into it. In their minute structure, Brunner's glands, the terminal vesicles of which measure 0·03'''—0·06''', even 0·08''', agree perfectly with the racemose glands of the mouth and œsophagus. Their secretion is an alkaline mucus, in which no formed elements are contained, having no digestive action upon coagulated protein compounds, and probably merely subservient to mechanical ends.

The Tubular, or Lieberkühnian Glands (cryptæ mucosæ), are distributed over the whole small intestines including the duodedum as innumerable straight narrow cœca, which occupy the entire thickness of the mucous membrane, and are frequently slightly enlarged at their extremities, though hardly ever dichotomously divided. The best idea of their number is obtained by viewing the mucous membrane either from above or in vertical section, under a low power. In the latter case we see the cœca standing close together, almost like palisades; in the former we observe that the glands do not occupy the whole surface, but only the interspace between the villi; here however they exist in such numbers as to leave no intervals of any width, the mucous surface between the villi appearing pierced like a sieve. Even on Peyer's patches, and over the solitary follicles, these glands are to be met with; but in man they leave those portions of the mucous membrane which lie immediately over the centre of the follicles free, and therefore are arranged like wings around the follicles.

The length of the Lieberkühnian glands equals the thickness of the mucous membrane and varies from $\frac{1}{5}'''$—$\frac{1}{3}'''$; their breadth is 0·028'''—0·036''', that of their aperture, 0·02'''—0·03'''. They are composed of a delicate homogeneous membrana propria, and of a cylindrical epithelium, which even during chylification never, like that of the intestine, contains fat; their cavity is filled during life by a clear fluid secretion, the so-called intestinal juice, which however becomes rapidly changed after death, or on the addition of water, so that the glands appear to be filled with cells, or with a granular mass.

The most important of the Closed Follicles are Peyer's patches (glandulæ agminatæ). They are rounded flattened organs, invariably situated along that surface of the intestine which is opposite the mesentery; they are most distinct upon the inner surface, where they appear as rather depressed smooth spots, without any very sharp definition, but they are also recognisable from the exterior by the slight elevation to which they give rise; by transmitted light they look like mere opaque portions of the membrane. These patches are usually the most abundant in the ileum, but they are not uncommonly to be met with in the lower part of the jejunum; occasionally they exist in the upper portion close to the duodenum, and even in the inferior horizontal portion of the duodenum itself. Ordinarily there are 20 to 30 of them; but when they are found higher up there may be as many as 50 to 60; but they are always most closely set in the lowest portion of the ileum. The dimensions of the separate patches are in general the larger the closer they are to the cœcum; their length is usually 5'''—$1\frac{1}{2}''$, but may diminish to 3''', and increase to 3'''—5''', or even 1'; their breadth varies from 3''' to 5''', or 9'''. Where the patches lie the valvulæ conniventes are usually interrupted; in the jejunum however these folds are also to be met with upon the Peyer's patches and in the ileum; rows of closely-set villi often take their place. More minutely examined, every Peyer's patch is seen to be an aggregation of closed follicles of $\frac{1}{4}'''$—$\frac{1}{2}'''$—1''' in diameter, either rounded or slightly conical towards the intestinal cavity, which lie partly in the mucous membrane itself, partly in the submucous tissue; and are on the one side not more than 0·02'''—0·03''' distant from the mucous surface, while on the other they are in immediate contact with the muscular tunic, which is here somewhat more closely united with the mucous membrane.

Viewed from the interior of the intestine their most striking feature in man is the presence of many small rounded depressions $\frac{1}{3}'''$—$\frac{1}{2}'''$—1''' apart, which corresponds with the separate follicles, and whose floor is indeed rendered slightly convex by the latter, but which present no villi whatever. The remainder of the patch is occupied by common villi, or by reticulated folds, and by the apertures of the Lieberkühnian glands; the latter are disposed around the slight elevations produced by the follicles in circlets of 6 to 10 and more apertures, the coronæ tubulorum of authors.

The Solitary Follicles (glandulæ solitariæ) resemble the separate elements of Peyer's patches so closely in size, contents, and general structure, that there is no reason for considering them as distinct, particularly as the number of follicles is subject to all possible varieties, and since, in animals at least, we find Peyer's patches with 2—3—5 follicles. In man, as all writers justly agree, their number is exceedingly inconstant; sometimes not one can be found, whilst in other cases the whole intestines, as far as the margins of the ileocœcal valve, is thickly beset with them; or, lastly, they may occur in the ileum and jejunum, but in no very great number. Their entire absence must probably be considered abnormal, since they are constant in newly-born children, being more abundant in the jejunum than in the ileum. The miliary vesicles however, which are often met with in immense quantities in the small intestines and stomach in catarrhal affections of the alimentary tract, may very probably be entirely or partially pathological, since the occurrence of such follicles has been demonstrated in other organs also (in the liver, according to Vorhow). The solitary follicles have the same structure as the elements of the patches, only they occur also in the mesenteric border, and support villi upon their intestinal surface, which is usually somewhat convex.

Professor Kölliker expresses himself as decidedly opposed to the notion that the follicles of Peyer's patches have any apertures. Of their functions he says:—"They and the follicles of the intestine in general appear to me to be closed glandular organs, analogous to the splenic follicles, the tonsils, and the lymphatic glands, which contain peculiar elements and a vascular network. In these a constant development of cells takes place, and at the same time substances are elaborated from the plasma, supplied by the bloodvessels, and perhaps also from matters not of a fatty nature, absorbed from the intestine, a part of which in all probability is at once taken up by the internal bloodvessels, while the larger proportion is excreted, and absorbed by the lymphatics."

The structure of the mucous membrane of the large intestines agrees so closely with that of the small intestines, that it need not be described separately. With the exception of the rectum it has no proper folds, for the transversely fibrous muscular layer also enters into the plicæ sigmoideæ. The villi are absent from the edge of the ileocœcal valve. The glandular organs are Lieberkühn's glands and solitary follicles. The latter are arranged close together in the processus vermicularis, and are very frequent in the rectum and cœcum, and are also usually more abundant in the colon than in the small intestines. [DIGESTION; FOOD; STOMACH; BILE; LIVER.]

INTESTINES, SMALL. [INTESTINES.]

INTRICA'RIA, a small Polypifer from the Oolitic rocks of France, allied to *Cellaria*.

INULA, a genus of Plants belonging to the natural order *Compositæ* and the sub-order *Asteraceæ*. It has a many-flowered heterogamous head. Florets of the ray female in one row, sometimes by abortion sterile, usually ligulate, sometimes somewhat tubular and trifid; those of the disc hemaphrodite, tubular, 5-toothed; involucre imbricated in several rows; receptacle flat or somewhat convex, naked; anthers with 2 setæ at the base; achenium without a beak, tapering, or in *I. Helenium* 4-cornered; pappus uniform in one row, composed of capillary roughish setæ.

I. Helenium, Elecampano, is found in pastures in various parts of Europe. It is a native of Great Britain. It has a thick branching root, which is aromatic, bitter, and mucilaginous. The stem is 3 feet high, leafy, round, furrowed, solid, branched, and most downy in the upper part. The leaves are large, ovate, serrated, and veiny; downy and hoary at the back, radical, 1-stalked; the rest sessile, clasping the stem. Flower-heads solitary at the downy summits of the branches, 2 inches broad, of a bright yellow colour; the scales of the involucre broad, recurved, leafy, finely downy on both sides; rays very numerous, long, and narrow, each terminating in three unequal teeth; achenia quadrangular, smooth; pappus roughish; receptacle reticulated, not quite smooth or naked. Various preparations of the boiled root have been recommended mixed with sugar to promote expectoration and to strengthen the stomach. Some think a spirituous extract contains most of its aromatic and tonic properties. The plant is generally contained in rustic gardens on account of its many reputed virtues. *Inulin*, the peculiar property contained in the root, is a white powder, like starch, is insoluble in cold, and soluble in hot water, from which it is deposited on cooling; and this distinguishes it from starch. With iodine it gives a greenish-yellow compound, which is not permanent. Inulin is distinguished from gum by its insolubility in cold water, and by not giving saccholactic acid when digested in nitric acid.

I. Conyza has the leaflets of the involucre all linear. Leaves ovate-lanceolate, downy, denticulate; lower leaves narrowed into a footstalk; florets of the ray subligulate; fruit terete. It is the *Conyza squarrosa* of Smith. The stem is from one to two feet high, leafy; heads corymbose. The flowers yellow, those of the circumference between tubular and ligulate, deeply divided on the inner side. It is found on calcareous soils in Great Britain, and is known by the name of Ploughman's Spikenard.

I. crithmoides has the leaflets of the involucre linear, taper pointed; leaves fleshy, linear, obtuse, or with three points. The stem about a foot high, slightly branched near the top, each branch terminating in a solitary head with an orange-coloured disc and yellow rays. It is found on rocks and in muddy salt marshes by the sea. It is called Golden Sampline.

INULIN. [INULA.]

INUUS, a genus of Monkeys. [QUADRUMANA.]

INVOLU'CRUM, in Botany, is any collection of bracts round a cluster of flowers. In umbelliferous plants it consists of separate narrow bracts placed in a single whorl; in many composite plants these organs are imbricated in several rows. If the bracts belong to a secondary series of the inflorescence, as in the partial umbels of an apiaceous plant, or in the solitary florets of *Echinops*, they form an involucel. The most singular state of the involucrum is that which is found in the genera *Castanea*, *Fagus*, *Quercus*, &c., where it forms a cup, or closed cover, remarkable in the European species of those genera, but much more so in the species of India.

IOLITE, a Mineral, also called *Dichroite* and *Cordierite*. It belongs to the group of anhydrous silicates of alumina. It crystallises in rhombic and hexagonal prisms, and usually occurs in 6- or 12-sided prisms, or disseminated in masses without distinct form. The cleavage is indistinct; but the crystals are often separable into layers parallel to the base. The colour is of various shades of blue—often deep blue in the direction of the axis, and yellowish-gray transversely. The streak is uncoloured. Lustre and appearance much like that of glass. Transparent to translucent. It is brittle, and has a hardness of 7 to 7·5. Its specific gravity is 2·6 to 2·7. A specimen from Connecticut, United States, had the following composition:—

Silica	48·3
Alumina	32·5
Magnesia	10·0
Protoxide of Iron	6·0
Protoxide of Manganese	0·1
Water	3·1
	——100

Before the blow-pipe it fuses with difficulty to a blue glass resembling the mineral. It is distinguished by this property from blue quartz, for which alone it could be mistaken.

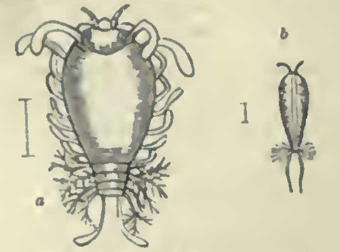
Iolite is found at Bodenmais in Bavaria, Arendal in Norway, Cabo de Gata in Spain, Tunaberg in Finland, also in Greenland, Ceylon, and the United States. It is occasionally employed as an ornamental stone, and when cut it presents different shades of colour, hence one of its names, Dichroite (δίχροια). Iolite refers to its violet colour (ἴδεις).

When Iolite is exposed to the air and moisture it undergoes a gradual alteration. It absorbs water, and becomes converted into a hydrate. It then assumes a foliated micaceous structure resembling talc. Hydrous *Iolite*, *Chlorophyllite*, and *Esmarkite* are names that have been given to altered Iolite, and *Fahlunite* and *Gigantholite* have probably the same origin.

(Dana, *Mineralogy*.)

IONE, or, as it is sometimes written, JONE, a parasitic genus of Crustaceans, placed by Desmarest under the *Isopoda*, but by Latreille, who established the sub-genus, under the *Amphipoda*. The latter founded his separation on the figure given by Montagu under the denomination of *Oniscus thoracicus* ('Linn. Trans.,' ix. iii. 3, 4); and observes that it presents particular characters which place it at a distance from all the other forms of the order. The body is composed of about fifteen joints, which are only to be distinguished by lateral incisions in the form of teeth. The four antennæ are very short: the external ones, longer than the two others, are only visible when the animal is seen on the back. The first two segments of the body in the female are each provided with two elongated fleshy flattened oar-like cirrhi. The feet are short, hidden under the body, and hooked. The last six segments are furnished with lateral fleshy elongated fasciculated appendages, which are simple in the males, but in the form of oars in the other sex. At the posterior extremity of the body are six other appendages, which are simple and curved, two of them being longer than the others. The abdominal valves are very large, cover all the lower part of the body, and form a species of receptacle for the eggs.

This parasite hides itself under the shell of *Callianassa subterranea* [CALLIANASSA], and there forms a tumor on one of its sides. Montagu extracted it, and kept it alive for some days. The females are always accompanied by their males, which are very inferior in size, and fix themselves firmly upon the abdominal appendages of the former by means of their claws. Latreille, whose account we have given, speaks of it as rare, and remarks that in its habits it approaches to *Bopyrus*. [ISOPODA.] (Montagu, 'Linn. Trans.')



Ione thoracica. *a*, female; *b*, male.

IONIDIUM, a genus of Plants belonging to the natural order *Violaceæ*. It has 5 sepals not prolonged at the base; corolla unequal, 2-lipped, consisting of 5 petals, the lowest of which is very large and unguiculate; stamens 5, hypogynous, unequal, the two anterior having anthers that are often appendiculate; capsule protected by the permanent sepals; petals and stamens few, or many-seeded. The species are herbaceous plants or shrubs.

I. Ipecacuanha is a native of the forests of Brazil. It has alternate lanceolate ovate leaves, serrated, acute at each end; stipules ovate-lanceolate, acute, membranous, ribbed in the middle; sepals semi-pinnatifid; lower petal very large, transversely elliptical. The roots are emetic, and are often collected as a substitute for the true Ipecacuanha.

I. Poaya is found in fields in the western parts of Minas Geraës, and elsewhere in Brazil. It is a very shaggy plant. The stem suffruticose, usually simple; leaves alternate, subsessile, ovate, somewhat cordate at the base, rather acute, obsoletely toothed; stipules linear, scarious, quite entire, hardly perceptible; lower petal very large, broadly obcordate; filaments bearded on the outside at the apex; membranous process of the anthers very small. Roots emetic, and like the last species substituted for true Ipecacuanha.

I. microphyllum is found at Quito near the foot of Chimborazo. The stems are somewhat quadrangular, smooth on the angles, downy on the sides, filiform, erect, apparently not above one foot high, if so much. The leaves are all opposite, ovate, wedge-shaped, and entire at the base, with two or three coarse serratures on each side towards the point, covered sparingly on each side with short fine down; the stipules are membranous, linear-ovate, acuminate, longer than the very short petioles; flowers small, axillary, solitary, and erect; peduncles filiform, slightly downy, twice as long as the leaves; sepals ovate-acute, with a little fine down along the middle of the back; lip panduriform, that is, unguiculate, roundish, emarginate, with the claw almost rhomboidal from the projection of its sides at opposite points. It is stated to be a specific in Elephantiasis tuberculata, the 'Mal de San Lazaro' of the Spanish Americans, and 'Cocobay' of Jamaica. Dr. Bancroft speaks most favourably of its effects in this disease. It is known by the name of 'Cuchunchully' in its native country. There is some difference of opinion as to the exact species which furnishes this preparation.

I. parviflorum has roots extremely like Ipecacuanha in appearance and properties.

I. brevicaule is a Brazilian plant. It is emetic, and a powder of the root rubbed up with sugar and milk furnishes an agreeably sweet medicine.

I. urticæfolium is also an emetic of the same country.

IÖRA, or JORA, a genus of Birds established by Dr. Horsfield, and placed by Mr. Swainson among his *Brachypodinæ*, or Short-Legged Thrushes. [MERULIDÆ.]

IPECACUANHA. [CEPHAELIS.]

IPHÆROCERA. [BORBORUS.]

IPOMÆA, a genus of Plants of the natural family of *Convolvulaceæ*, which is very closely allied to *Convolvulus*, or Bindweed, whence has been derived its name. From the more minute investigations of modern botanists considerable changes have taken place in the nomenclature of the species sometimes referred to this genus and sometimes to other nearly allied genera. M. Choisy, who has most recently examined the Oriental *Convolvulaceæ*, excludes many species usually referred here, and forms the genus of the species of *Ipomæa* and *Convolvulus* of authors. *Ipomæa* has a 5-sepaled calyx, a campanulate corolla, with five stamens included within it; style single; stigma bilobed; lobes capitate; ovary 2-celled; cells 2-seeded; capsule 2-celled. The species are very numerous, and found in the tropical parts of Asia, Africa, and America. A few ascend the mountains in such latitudes.

Most of the species are ornamental; others have been removed to *Quamoclit*, *Argyreia*, *Pharbitis*, &c., and one of the most useful as an article of diet in tropical countries, to *Batatas*. *B. edulis* produces the tubers so well known by the name of Sweet Potatoes. [BATATAS.]

I. Turpethum is found in the East Indies, Malayan Archipelago, Australia, Timor, Otaheite, Friendly Islands, Marianne Islands, Tinian, &c. Its root is perennial. The stems twining, several fathoms long, from 3- to 4-sided, a little downy, with winged angles; leaves stalked, varying in form from cordate to linear, all pointed and lobed, or angular and downy; peduncles axillary, downy, many-flowered; flowers large and white; bracts oval, concave, velvety, deciduous; ovary seated on a large glandular disc; stigma 2-lobed; capsules involved in the dry calyx, absolutely 4-sided, 2-celled, opening at the apex by a kind of operculum; seeds round, black, one in each cell. The root has been long employed in India as a common purgative. The bark of the roots is the part employed by the natives, as it contains all the active properties; they use it fresh, rubbed up with milk. About six iuches in length of a root as thick as the littlo finger they reckon a common dose. (Roxb.) It is reckoned an excellent substitute for jalap, and is free from the nauseous taste aud smell of that drug. The plant is a native of all parts of coutinental and probably of insular India also, as it is said to be found in the Society and Friendly Isles and the New Hebrides.

I. macrorhiza is supposed to be the *Convolvulus Jalapa* of Linnæus. It is a plant inhabiting the sandy soil of Georgia and the Carolinas, with white insipid farinaceous roots, weighing from 40 to 50 lbs. It is said to possess no purgative properties, but, liko *Batatas*, consists chiefly of saccharine and farinaceous matter.

I. pandurata is common in North America, in sandy fields and by fences, from Canada to Florida. It is the Mechameck of the Indians. It has a very large root, 2 or 3 feet long and as thick as the arm, of a yellow-ochre colour. The stem is downy; leaves on long stalks, broadly cordate, entire, acuminate, slightly repand; peduncles many flowered, cymose longer than the petioles; corolla large, campanulate, white, dull purple towards tho base; stamens white, the length of the tube. The powdered root acts like rhuburb; it requires to be giveu iu larger doses than jalap. It has an American reputation as a remedy for calculous affections, and in cases of gravel.

I. Purga (*I. Jalapa* of Nuttall) is found on the eastern declivity of the Mexican Andes near Chiconquiaco, and near San Salvador on the eastern face of the Côfre de Perote, at an elevation of about 6000 feet above the sea; and on the mountains near Orizaba. It has a tuberons fleshy root, with numerous roundish tubercles. Stem smooth, brownish, very slightly rough; leaves stalked, the first hastate, the succeeding ones cordate, acuminate, mucronate, smooth; peduncles axillary, 2-flowered, twisted, the length of the corolla;

Ipomœa Purga.

sepals obtuso, mucronate, smooth; corolla purple, with a long somewhat clavato tube, and an undulated limb with 5 plaits; filaments smooth, unequal, longer than the tube of the corolla; anthers linear, projecting; stigma capitate, deeply furrowed; capsule 2-celled; cells 2-seeded. It has long been employed as a modicinal agent, and

is considered by the traders in jalap to be extremely similar in quality to the true plant; and as it is the more abundant and larger of the two, at least in some districts, the probability is that it also forms a part of the imported samples of this drug.

I. Orizabensis is native of the temperate parts of the state of Oaxaca. It has a tuberous fleshy root, with numerous oblong tubercles; stem twining, green and hairy; leaves cordate, acumiuate, mucronate, hairy, the earliest oues hastate; peduncles 2-3-flowered, twisted, three times as long as the corolla; sepals oblong-obtuse, mucronate, hairy; corolla purple, campanulate, with a regular tube inflated in the middle, and a wavy limb with 5 plaits; stamens shorter than the tube, hairy at the base; capsule 2-celled; cells 2-seeded. Tho Spanish name of this plaut is Jalapa Macho.

I. tuberosa is found in Jamaica, where it is called Seven-Eared or Spanish Arbour-Vine. The root is tuberous, as large as a man's head; stems 200 or 300 feet long, purplish at the extremities; leaves smooth, downy beneath, palmate, or 7-lobed; the lobes much smaller at the side than in the middle, narrow, lanceolate, acuminate; peduncles many-flowered; flowers pale yellow, sweet scented; capsule as large as a waluut, membranous, shining, brown, 2-celled, with two black or dark-brown shaggy triaugular seeds in each cell. All the parts are purgative. Dr. Barham thinks scammony might be obtained from it.

I. cathartica is fonnd in moist places iu St. Domingo. The stems are twining, smooth, and herbaceous; leaves large, distinct, long-stalked, broad, oval, cordate, smooth, and 3-lobed; the two lateral lobes oval, shorter, acute; the terminal oval lanceolate, acuminate; peduncles axillary, usually 1-flowered; flowers large, deep bright-red; tube of the corolla thick, inflated, contracted and cylindrical at the base, an inch and more long, pale green; the limb broad, 5-lobed; stamens shorter than the corolla; stigma capitate. The roots furnish a resinous substance used as a purgative in St. Domingo. Its use is not however very safe, as it is apt to produce excessive purgation.

(Lindley, *Flora Medica;* Royle, *Materia Medica.*)

IPS, a genus of Insects belonging to the order *Coleoptera*, to the section *Pentamera*, aud the family *Empidæ*. The body is of an oblong-oval form and depressed, with the third joint of the antennæ longer than the second, and the club large aud rounded. The species are generally found under the bark of decayed trees. They are chiefly confined to Europe. The British species, of which there are four or five, are rare.

IRIDA'CEÆ, *Irids*, a natural order of Endogenous Plants, usually with equitant leaves, and a rhizoma or cormus for their stem, but

Leaves and flowers of *Sisyrinchium striatum*. 1, the stamens; 2, the ripe fruit.

more particularly characterised by having three stamens, the anthers of which are turned outwards, and an inferior ovary. The genera are numerous, and some not well defined; they inhabit the temperate parts of the world in preference to the hottest, where they are comparatively rare. The *Iris* and *Crocus* are representatives of the predominant northern form of the order, as *Gladiolus* and *Ixia* are of the genera prevalent in the southern hemisphere. All the species are sufficiently ornamental to deserve cultivation, and many are of striking beauty. They are principally natives of the Cape of Good Hope, or of the middle parts of North America and Europe. A few only are found within the tropics. Acrid, purgative, and emetic properties are met with in some plants of this order. Some are fragrant and aromatic, others supply starch and materials for dyeing. The position of the order is between *Hæmodoraceæ* and *Amaryllidaceæ*. It has 53 genera and 550 species. [IRIS.]

IRIDEA. [ALGÆ.]

IRIDINA. [CONCHACEA.]

IRIDIUM. [PLATINUM.]

IRIDOSMINE. This name is given to a compound of the metals Iridium and Osmium, found in the platinum mines of Russia, South America, and the East Indies. The crystals are hexagonal prisms of a pale steel-gray. It occurs in flat grains. Their composition varies. One variety contains rhodium. They are distinguished by the odour of osmium.

IRIS. [EYE.]

IRIS, a genus of Plants, the type of the natural order *Iridaceæ*. It has a tubular perianth with a petaloid membranous limb, the segments of the sepals revolute, often bearded, those of the petals erect and converging; 3 stamens, concealed beneath the lobes of the style; the style 3-parted near the upper end with petaloid segments overarching the anthers, and bearing a 2-lipped transverse stigma below their ends; the capsule 3-celled, bursting through the cells into three valves, coriaceous, with numerous flat or round and fleshy seeds.

I. versicolor, Blue Flag, has sword-shaped striated leaves, sheathing at the base, a stem 2 or 3 feet high, round on one side and acute on the other, and bearing from 2 to 6 flowers. This plant is a native of swamps and wet meadows in the United States. The rootstock has a nauseous acrid taste. It acts as a cathartic, and its action is attended with great depression of the nervous system and prostration of strength. It also acts upon the kidneys, and is useful in cases where diuretics are indicated.

I. pseud-acorus, Yellow Flag, has sword-shaped leaves; the stem round; perianth beardless, its inner segments narrower and shorter than the stigmas. It is a native of wet places in Great Britain, France, Germany, and most countries of Europe. The rootstock is acrid, and possesses an emetic and purgative action. The seeds when roasted are said to form a good substitute for coffee.

I. Florentina, Florentine Iris, has broad and somewhat falcate leaves, shorter than the stem, the petals two inches long and one inch broad, reflexed at the edge and rather plaited towards the base. The dried rootstock is known in the shops under the name of orris-root. The plant is a native of the southern parts of Europe and the islands of the Mediterranean. The rootstock has an aromatic odour and subacrid taste, and is employed as a dentifrice. It enters into the composition of Ruspini's tincture and tooth-powder, and other popular dentifrices. It was at one time used in medicine and admitted into the British pharmacopœias. The fresh rootstock acts as a purgative, and was also employed as an expectorant in diseases of the chest. When dried and turned into small balls it is used for issue-peas. According to Sibthorp this plant is found in Greece at the present day. It is the Ἶρις of Hippocrates ('Morb. Mul.,' 2, 673) and the Ἶρις ἰλλυρική of Theophrastus ('Hist. Plant.,' 7, 12).

I. fœtidissima, Stinking Flag, has sword-shaped leaves, the stem compressed, the perianth beardless, its inner segments about as long as the stigmas. This plant is a native of Great Britain and other parts of Europe. It has a peculiar smell, which some have compared to roast beef, but which to others suggests much less pleasant associations. It is the Ἶρις ἀγρία of Theophrastus ('Hist. Plant.,' 9, 8) and Ξυρὶς of Dioscorides (4, 12).

I. tuberosa has tetragonal leaves, the segments of the perianth acute, the roots tuberose. It is not a common plant in Europe, but has been naturalised at Penzance in Cornwall, and near Cork in Ireland.

Many other species of *Iris* have been described. *I. Germanica* has been used for the same purposes as *I. Florentina*, and they are considered by some botanists as identical. The roots of many of them contain starch, and Pallas says that the roots of *I. dichotoma* are eaten in Siberia. *I. edulis* is eaten by the Hottentots of Africa, where it is called Oenkjes. All these species are cultivated in gardens on account of handsome showy flowers.

(Fraas, *Synopsis Floræ Classicæ*; Lindley, *Flora Medica*; Sibthorp, *Flora Græca*; Babington, *Manual of British Botany*; Burnett, *Outlines of Botany*.)

IRON. Of all the metals iron is the most widely diffused, the most abundant, and the most useful. It is found not only intermixed with soils, and contained in rocks and minerals, but it is found in animal and vegetable bodies, and also in mineral waters.

Iron occurs rarely, if indeed at all, in nature in the metallic state, for almost the whole of it that has been found occurs as meteoric iron containing nickel, or in meteoric stones. It has however been stated that it has been discovered in situ near Canaan in the United States; it there occurs in a vein two inches thick in chlorite schist, filled with native iron. It appears that this iron is traversed by graphite. Its specific gravity is 5·95 to 6·71. The Uralian Mountains yield a kind of native iron which is accompanied with platinum.

The greatest quantity of iron is found either combined with oxygen, oxygen and carbonic acid, or with sulphur; the last mentioned is not however worked as an ore. The best iron-ores are oxides, which occur in primitive countries, where they generally form very large beds, such as those of Sweden; but the greater part of the iron-ore of Britain is an impure carbonate.

The properties of iron are, that it is grayish-white with a tint of blue; it is extremely ductile, so that it may be drawn into wire finer than the human hair, but it cannot be beaten into very thin leaves. It is of all metals the most tenacious, for a wire 0·787 of a line in diameter is capable of supporting a weight of about 550 lbs.

Iron is susceptible of a high polish. It is combustible when minutely divided, as in the state of filings, which is shown by sprinkling them in the flame of a spirit lamp. It is very hard at common temperatures, and this property may be increased by its being heated and then suddenly cooled; it then however becomes brittle. It requires a most intense heat to melt it, but when heated to redness it becomes soft and pliable, and possesses the valuable property of 'welding,' that is, two pieces of red-hot iron may be made to unite by hammering. Its texture is fibrous. Its specific gravity is about 7·77, but this varies in some degree according to the extent to which it has been drawn, rolled, or hammered, and it is increased by fusion. Iron, or rather steel, is capable of being rendered permanently magnetic, a property which no other metal possesses but nickel: when heated to redness this property is lost, and a loadstone suffers the same loss just below visible ignition; while a steel magnet loses its polarity when subjected to the temperature of boiling almond-oil. Iron has great affinity for oxygen and sulphur, and some other elementary bodies, and combines with them in various proportions.

Meteoric Iron.—There have been found in different parts of the earth large masses of native or metallic iron, of the history and origin of which nothing very accurate is known; but they are regarded as being of meteoric origin, for it is invariably found that, like the iron which occurs in meteoric stones, this metallic iron contains nickel, and no such compound or mixture is found in the earth in veins or beds; and in point of fact two masses of such iron were seen to fall at Hradschina, near Agram in Croatia, in 1751. They contained 3·5 per cent. of nickel. Similar masses have been found in Africa, America, and Siberia. That in the last-mentioned part of the world was discovered by Professor Pallas: it weighed 1600 lbs., had a cellular structure, and contained crystals and grains of a green substance of a vitreous appearance, which have been stated to be *Olivine* or *Chrysolite*. This iron contains only 1·5 per cent. of nickel. One of the largest masses is that found in Peru by Don Rubin de Celis; it weighed 15 tons, and contained nickel. This was also the case with the knives which Captain Parry obtained from the Esquimaux. The largest quantity of nickel contained in any specimen was about 10 per cent.

Meteoric Iron sometimes occurs crystallised; the primary form is the cube, and it is stated to have been found in regular octohedrons. It has no apparent cleavage. Fracture hackly. Hardness 4·5. Specific gravity 6·48 to 7·768. Opaque. Lustre metallic. Colour pale steel-gray.

Oxides of Iron.—The protoxide of iron does not occur in nature except in combination, and usually with carbonic acid; in this form it is found in mineral waters. The ore which most nearly approaches it is Magnetic Iron, sometimes called Oxydulous Iron and Octohedral Iron. This ore is found crystalline, massive, and arenaceous. The crystals occur attached and imbedded. The primary form is a cube, but it is generally met with in the form of the regular octohedron. Cleavage parallel to the planes of the octohedron, but not obtainable in some varieties. Fracture uneven or conchoidal. Hardness 5·5 to 6·5. Scratches fluor-spar, and is scratched by quartz. Specific gravity variously stated from 4·4 to 5·094. Opaque. Lustre metallic, occasionally bright. Colour iron- or steel-gray. Streak black. Obeys the magnet.

The massive varieties are amorphous; structure granular to compact. It is of this variety of iron-ore that native loadstones consist. This ore occurs in various parts of the world, especially in the north of Europe, and it is of it that the best Swedish iron is made, and so also is the iron which yields the wootz steel of the East Indies. It is generally found in primitive countries. This ore frequently contains titanium; but the varieties have not been well distinguished. By the blow-pipe it becomes brown, and loses its magnetic property, but does not fuse.

It consists of 28·4 of oxygen and 71·6 of iron, which are equal to—

Two equivalents of Sesquioxide of Iron . .	80
One equivalent of Protoxide of Iron . . .	36

There are several ores, which possess very different appearances, that are altogether composed of the sesquioxide or peroxide of iron, and which are principally the *Oligiste Iron Ore* and the *Hematite*.

Oligiste Iron; Specular or *Micaceous Iron.*—This occurs crystallised and massive. The crystals are attached; the primary form is a rhomboid. Cleavage parallel to the primary planes, and perpendicular to the axis in some varieties. Fracture uneven, conchoidal. Hardness 5·5 to 6·5; scratches phosphate of lime; is scratched by quartz. Specific gravity 5·0 to 5·25. Lustre metallic. Colour steel- and iron-gray; the surface frequently iridescent. Obeys the magnet slightly. Streak red and reddish-brown. It is found in the island of Elba and in many other parts of Europe. It also occurs in the lava of Auvergne in France, and in that of Vesuvius.

Göthite, Pyrosiderite occurs in very thin transparent crystalline plates in the cavities of black Hematite. Colour brownish-red, by reflection yellowish, in a strong light of a brilliant red. Lustre adamantine. It occurs in England and in Germany. The former yielded by analysis—

Peroxide of Iron	89·2
Water	10·8
	—100

Iron Froth consists of very thin brownish-red scaly particles, which have a greasy feel, and stain the fingers. It is found plentifully in Devonshire and Lancashire, and was ascertained by Dr. Henry to be pure Peroxide of Iron. The massive varieties are amorphous; structure foliated.

Red Hematite occurs in globular and botryoidal masses. Structure fibrous, radiating, opaque. Specific gravity 4·7 to 5. Lustre externally sometimes metallic, sometimes dull; internally, nearly dull. Colour externally red; grayish-red, &c., internally, and streak red. It occurs in large quantity at Ulverstone in Lancashire, and in other parts of Great Britain and Europe. According to D'Aubuisson it consists of—

Peroxide of Iron	94
Silica	2
Lime	1
Water	3
	—100

Brown Hematite; Hydrous Oxide of Iron; Brown Iron Ore, occurs in attached crystals and massive prisms. Primary form a right rhombic prism. Cleavage parallel to the short diagonal; fracture uncertain. Hardness 5·0 to 5·5. Specific gravity 3·93. Lustre adamantine; nearly opaque; translucent. Colour brown of various shades. Streak yellowish-brown. Occurs in Cornwall.

Massive varieties globular, reniform, and some of the varieties of brown and yellow clay iron-stone. Stalactitic, structure fibrous, or fibro-laminar. Sometimes occurs in pseudomorphous crystals. It occurs in most parts of the world Analysis by D'Aubuisson:—

	Fibrous.	Compact.
Peroxide of Iron	82	84
Water	14	1
Oxide of Manganese	2	2
Silica	1	2
	—99	—89

Franklinite is a mixture of the peroxide with oxide of zinc. [FRANKLINITE.] *Ilmenite* contains iron and titanium. [TITANIUM.]

Carbonate of Iron; Brown Spar; Spathose Iron Ore.—This occurs in attached crystals and massive. Primary form a rhomboid. Cleavage parallel to the primary planes, distinct. Fracture imperfect conchoidal. Hardness 3·5 to 4·5. Specific gravity 3·6 to 3·829. Transparent, translucent, opaque; lustre vitreous, inclining to pearly; colour white, yellow, red, and brown of different shades.

Massive varieties tabular, structure fibrous; botryoidal and globular (these being called *Sphærosiderite*), structure fibrous, diverging; amorphous, structure foliated, granular, compact. Found in Cornwall, Scotland, and Ireland, and in other parts of Europe; and also in America.

Before the blow-pipe it blackens and becomes magnetic, but does not fuse; in the reducing flame it colours borax bottle-green, and in the oxidating yellow; dissolves in acids with effervescence. Analysis, by Beudant, of the hexahedral variety:—

Carbonic Acid	38·72
Protoxide of Iron	59·97
Oxide of Manganese	0·39
Lime	0·92
	—100

Clay Iron-Stone, or *Argillaceous Iron-Ore*, consists essentially of carbonate of iron mixed with various proportions of earthy matter; on an average carbonate of iron forms about one-third of the abundant clay iron-stone of England, Wales, and Scotland. It occurs in beds and in coal deposits; it is found sometimes in globular masses, and also columnar.

Thomaite is a carbonate of iron from the Siebengebirge. *Junkerite* is common spathic iron. *Mesitine Spar* is a carbonate of iron and manganese; so also is *Oligon Spar*.

Sulphur and *Iron* exist in combination in enormous quantities; the compounds which it forms are called *Magnetic Iron Pyrites, Iron Pyrites*, and *White Iron Pyrites*.

Magnetic Iron Pyrites, Protosulphuret of Iron, occurs in imbedded hexagonal crystals and massive. Primary form a rhomboid. Cleavage parallel to all the planes, of a regular hexagonal prism; fracture uneven, sometimes conchoidal. Hardness 3·5 to 4·5; scratches calcareous spar, and is scratched by felspar. Specific gravity 4·63. Opaque; lustre metallic; colour bronze yellow mixed with red; streak grayish black. Obeys the magnet but feebly. Soluble in dilute sulphuric acid; when exposed to the blow-pipe on charcoal is converted into oxide of iron. Occurs at Kongsberg in Norway and Andreasberg in the Harz. Analysis by Hatchett:—

Sulphur	36·5
Iron	63·5
	—100

Massive varieties amorphous, structure foliated, granular, compact. Found in Cornwall, Wales, Germany, North America, &c.

Iron Pyrites; Martial Pyrites; Persulphuret, or *Bisulphuret of Iron*, occurs in attached and imbedded crystals, and massive. Primary form a cube. Cleavage parallel to the primary planes, distinct. less so parallel to the planes of the octohedron. Fracture uneven, sometimes conchoidal. Hardness 6·0 to 6·5; scratches felspar, and is scratched by quartz. Colour brass-yellow; streak brownish-black; lustre metallic opaque.

Massive varieties amorphous, structure granular, compact; globular and stalactitic, structure fibrous or columnar, radiating; surface frequently reddish brown, owing to the loss of sulphur and acquisition of oxygen. It sometimes contains gold; the pyrites of Anglesey, Sweden, and Bohemia contains selenium.

By the blow-pipe sulphur is expelled, and magnetic oxide of iron remains. It is scarcely acted upon by dilute sulphuric acid, but nitric acid dissolves iron and deposits sulphur. Analysis by Hatchett:—

Sulphur	52·15
Iron	47·85
	—100

Iron pyrites occurs abundantly in every part of the world. It is frequently found in the form of various fruits. The amorphous occurs sometimes to a great extent in coal-beds. Very large crystals occur in Cornwall and South America. The massive varieties in general more readily become oxidised and converted into sulphate of iron than the crystallised, and hence it is largely employed in preparing copperas. The sulphurets are not used for obtaining iron on account of the difficulty of separating the sulphur. The bisulphuret is principally used for procuring sulphate of iron, sulphuric acid, and sulphur. It is also used in preparing alum.

White Iron Pyrites occurs in attached crystals and massive. Primary form a right rhombic prism. Cleavage parallel to the planes of the primary form. Fracture uneven, granular. Hardness 6·0 to 6·5; scratches felspar, is scratched by quartz. Colour various shades of yellowish, greenish, and grayish-white; streak grayish-black; opaque; lustre metallic.

Massive varieties botryoidal, reniform, stalactitic, and amorphous. Structure diverging, fibrous, or columnar. It is found in Cornwall, Derbyshire, Bohemia, and various other mining districts. According to Berzelius it consists of—

Sulphur	53·35
Iron	45·07
Manganese	0·70
Silica	0·80
	—99·92

Arsenical Iron Pyrites, or *Mispickel*, consists of a mixture of iron, arsenic, and sulphur. It occurs in rhombic prisms, with cleavage parallel to the faces. The colour is silver-white; streak dark grayish-black; lustre shining. A cobaltic variety contains 4 to 9 per cent. of cobalt in place of a part of the iron. Mispickel is found mostly amongst primitive rocks, and is commonly associated with ores of lead, silver, iron, or copper. It is abundant at Freiburg and Munzig, on the continent of Europe, and in Cornwall in England. It is also found in the United States in many places. *Leucopyrite* is an arsenical iron without sulphur, found in Styria, Silesia, Carinthia, and the United States.

Chromate of Iron is a compound of chromic acid, protoxide of iron, and alumina and magnesia. [CHROMIUM.] It occurs usually in serpentine rocks, in imbedded masses or veins.

Columbite is a native columbate of the oxide of iron. [COLUMBITE.]

Wolfram is a combination of iron, tungsten, and manganese. [TUNGSTEN.]

Green Copperas, or *Green Vitriol*, is a sulphate of iron. It crystallises in the form of acute oblique rhombic prisms, but generally occurs pulverulent or massive. The colour is greenish to white; lustre vitreous. Taste astringent, sweetish, and metallic. It is brittle, and has a hardness of 2. The specific gravity is 1·83. It becomes magnetic before the blow-pipe. It yields a green glass when fused, and gives a black colour with gallic acid. By exposure it becomes covered with a yellowish powder, which is a persalt of iron. Green vitriol occurs as the result of the decomposition of iron pyrites. The old mine of Rammelsberg in the Harz near Goslar is its most noted locality, but it is found wherever pyrites is exposed to the air.

Coquimbite, or *White Copperas*, and *Yellow Copperas*, are names of two sulphates of the peroxide of iron. *Pittzite* and *Fibro-ferrite* are allied compounds. *Apatelite* is another containing but 4 per cent. of water.

Voltaite is a double sulphate of iron, alumina, potash, and water, crystallising like alum in octahedrons. It occurs at the Salfatara near Naples.

Phosphate of Iron—Vivianite. It occurs in modified oblique prisms, with cleavage in one direction highly perfect. It is also found radiated, reniform, and globular, or as coatings. The colour is deep blue to green. The crystals are usually green at right angles with the vertical axis, and blue parallel to it. The streak is bluish; lustre pearly to vitreous; transparent to translucent; opaque on exposure. The thin laminæ are flexible. It has a hardness 1·5 to 2; and a specific gravity of 2·66. It has the following composition:—

Protoxide of Iron	42·4
Phosphoric Acid	28·7
Water	28·9
	——100

It loses its colour before the blow-pipe, dissolves in nitric acid, and affords water in a glass tube. It is found with iron, copper, and tin ores, and sometimes in clay or with bog iron-ore, at St. Agnes in Cornwall, Bodenmais, the gold mines of Vöröspatak in Transylvania, and in the United States.

Blue Iron-Earth is an earthy variety. It contains 30 per cent. of phosphoric acid. *Anglarite* is a variety from Anglar in France.

Triphyline is an anhydrous phosphate of iron and manganese, with some lithia. It occurs at Bodenmais in Bayern in cleavable masses of a greenish gray or bluish colour.

Cacoxene is a handsome mineral. It is a phosphate of iron and alumina, and occurs in radiated silky tufts of a yellow or yellowish-brown colour. It is found on brown iron-ore in Bohemia, and with specular iron in the United States.

Carphosiderite is another yellow phosphate of iron from Greenland. It occurs in reniform masses.

Green Iron-Stone (*Kraurite*), *Alluandite*, *Melanchlor*, and *Beraunite* are names of phosphates of the peroxide of iron.

Oxalate of Iron occurs native. It is a soft yellow earthy mineral of rare occurrence. It blackens instantly in the flame of a candle. It is found in Bohemia, and is supposed to have resulted from the decomposition of those orders of such plants, such as *Cactaceæ*, which naturally contain oxalic acid.

Silicates of Iron.—There are several compounds of silica and oxide of iron, none of which are of special interest in an economical point of view.

Hedenbergite is a variety of Augite. [AUGITE.]

Iron Chrysolite differs from ordinary chrysolite in containing oxide of iron in place of magnesia.

Isopyre is a black glassy amorphous mineral found in granite. [ISOPYRE.] Its hardness is 6 to 6·5.

Yenite (called also *Lievrite* and *Ilvaite*) occurs in rhombic prisms, often with the sides much striated or fluted; its colour is black or brownish-black, streaked with greenish or brownish-black. Its hardness is 5·5 to 6. Its specific gravity, 3·8 to 4·1. It contains from 50 to 55 per cent. of oxide of iron, with 14 per cent. of lime, and 29 per cent. of silica. It fuses to a black globule. It is found in the island of Elba in large crystallisations, also in Norway, Siberia, and Silesia.

At Cumberland, in Rhode Island, *Yenite* occurs in slender black or brownish-black crystals in quartz; also in Essex county, New York.

The following are hydrous species, giving off water when heated in a tube before the blowpipe:—

Nontronite and *Pinguite* are earthy, almost like clay, of a yellowish or greenish colour.

Chloropal is a much harder species, of a greenish-yellow or pistachio-green coolour.

Grengesite, *Thuringite*, *Knebelite*, and *Kirwanite* are other allied species.

Green Earth includes different compounds of a green earthy appearance. The Green Earth occupying cavities in amygdaloid is near chlorite. It is a silicate of the peroxide of iron, with some potash, magnesia, and water; often with other ingredients.

The *Green Grains* of the *Greensand* of New Jersey consist of—

Silica	51·5
Alumina	6·4
Protoxide of Iron	24·3
Potash	9·96
Water	7·7
	——99·86

Hisingerite, *Cronstedtite*, *Anthosiderite*, *Polyhydrite*, *Sideroschisolite*, *Chamoisite*, *Stilpnomelane*, and *Xylite* are names of dark brown or black species.

Crocidolite has a fibrous structure much resembling Asbestus, and is frequently called *Blue Asbestus*. Colour lavender-blue or leek-green. Its hardness is 4, and its specific gravity is 3·2 to 3·3. It is found in Southern Africa.

Pyrosmalite occurs in hexagonal prisms, with a perfect basal cleavage and a pearly surface. Colour pale liver-brown, grayish, or greenish. Its hardness is 4 to 4·5; and its specific gravity 3·8. It contains 14 per cent. of chloride of iron, and gives off fumes of muriatic acid before the blow-pipe.

Iron Zeolite is a hydrous silicate of the oxides of iron and manganese, forming incrustations at a mine near Freyberg.

Arsenates of Iron.—*Cube Ore* occurs in cubes of dark green to brown and red colours. It is of an adamantine lustre, not very distinct, with a greenish or brownish streak. Its hardness is 2·5; and its specific gravity 3. It is a hydrous arsenate of the peroxide of iron, containing 38 per cent. of arsenic acid. It is found in the mines of Cornwall; also in France and Saxony.

Scorodite crystallises in rhombic prisms, modified. It is of a pale leek-green or liver-brown colour, with a colourless streak, of a vitreous lustre inclining to subadamantine; subtransparent, or nearly opaque. Its hardness is 3·5 to 4·8. Specific gravity, 3·1 to 3·3. Scorodite is a hydrous arsenate of the peroxides of iron, containing 50 per cent. of arsenic acid. It comes from Saxony, Carinthia, Cornwall, and Brazil. It occurs in minute crystals near Edenville, New York, with arsenical pyrites. The name of this species is from the Greek, σκόροδον (garlic), alluding to the odour before the blow-pipe.

Iron Sinter is a yellowish or brownish hydrous arsenate of the peroxide of iron, containing but 30 per cent. of arsenic acid.

Arseno-Siderite is another fibrous arsenate, containing 34 per cent. of arsenic acid.

Symplesite is a blue or green mineral, supposed to be an arsenate of the protoxide of iron. Its crystals are right rhomboidal, with a perfect cleavage. It hardness is 2·5; and its specific gravity is 2·96. It is found in Voigtland.

(Dana, *Mineralogy*.)

IRON-BARK-TREE. [EUCALYPTUS.]

ISARIA, a genus of *Fungi*, belonging to the division *Trichosporei*, and the tribe *Isareii* of Léveillé. It is characterised by a compound, solid, capitulated, or elongated receptacle. The species are found parasitic upon caterpillars and the larvæ of various insects. Robin enumerates the following species:—

I. Eleuteratorum has been found upon the *Carabidæ* in the autumn of the year.

I. floccosa, upon the larvæ and chrysalides of *Bombyx Jacobæa*.

I. strigosa, upon the chrysalides of *Noctua Upsilon*.

I. arachnophila, upon small spiders belonging to the genus *Geometra*, in the autumn.

I. leprosa, on the chrysalides of *Noctua instabilis*.

I. Tartarica, observed by Robin upon an unknown spider, in the autumn.

I. crassa, upon decaying chrysalides.

I. sphecophila, upon a dead hornet.

I. exoleta, upon the larva of a moth.

I. Aranearum, an American species, found on spiders in Carolina.

I. Sphingum, also found in America, upon the caterpillars of the silk-worm moths.

I. gigantea, found upon a Mygale in the island of Cuba.

(Robin, *Histoire Naturelles des Végétaux Parasites*.)

ISATIS, a genus of Plants belonging to the natural order *Cruciferæ* and the tribe *Isatideæ*. It has a laterally compressed pouch, 1-celled, 1-seeded, valves keeled, eventually separating.

I. tinctoria, Dyer's-Woad, has the radical leaves oblong, crenate; pouch abrupt, smooth, thrice as long as broad. It is a rare plant in cultivated and waste land in Great Britain. It yields a blue dye, long known and used in this country. It was before the introduction of indigo a plant of considerable importance commercially, and it was extensively cultivated in Somersetshire, especially about Glastoubury, which town received its name from the Celtic word 'Glas,' signifying 'Blue.' The ancient Britons are said to have painted their bodies with the blue colour obtained from this plant.

(Babington, *Manual of British Botany*.)

ISCHY'ODUS, a genus of Fossil Fishes included in *Chimæra* by Agassiz.

ISERINE. [TITANIUM.]

ISINGLASS. [GELATIN.]

ISNARDIA, a genus of Plants named by Linnæus in memory of M. Antoine Dante Isnard, member of the Academy of Sciences. It belongs to the natural order *Onagraceæ*, and has a 4-cleft calyx, 4 petals, 8 stamens, and a filiform style, with a clavate or cruciform stigma. There is one British species of this genus. *I. palustris* has a procumbent rooting glabrous stem, opposite ovate acute leaves, terminating in a petiole, axillary solitary sessile flowers, with the petals absent. It is found in pools and marshes in Europe, Siberia, and Persia, and in Sussex in England.

I. alternifolia has an erect branched stem, alternate leaves, rather scabrous on the margins, and hoary beneath. It is a native of Virginia and Carolina, in marshy places, and has oval yellow petals. The root is used as an emetic, and is called Bowman's Root.

None of the species of this genus possess qualities which entitle them to cultivation except in botanical gardens. They may however be reared in a hot-bed, and then planted in an open border in a moist situation.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*.)

ISOCA'RDIA, a genus of Conchiferous *Mollusca*. Linnæus placed the form under *Chama*; Bruguière arranged it among the *Carditæ*. Lamarck, who made it the last of the genera of his Cardiacées, separated it from the last-mentioned genus, giving it the generic name at the head of this article. Mr. G. B. Sowerby ('Genera of Recent and Fossil Shells') thinks that this separation was effected with good reason, because the involute divaricate umbones of *Isocardia*, and its consequently dichotomous ligament running in each valve to the point of the umbo, serve to distinguish it from the other *Carditæ* of Bruguière. M. De Blainville, under the name of *Isocardium*, inserts it between *Tridacna* and *Trigonia* among his Camacées. M. Rang retains it in the same family, but restores Lamarck's original termination of the name, and places it between *Caprina* and *Tridacna*.

M. Deshayes, in his edition of Lamarck, remarks that the *Isocardiæ* have in truth large and contorted umbones like *Chama* and *Diceras*, but that they are regular and always free, while the true *Chamæ* are adherent and irregular. From the *Carditæ*, he observes, they are to be distinguished, both as respects the shell and the animal. In *Cardita* the lobes of the mantle are separated throughout their length, and are without siphons. In *Isocardia* the lobes of the mantle are united posteriorly, and provided with two short siphons, or rather perforations, which may be compared with those of the *Cardia*. Here doubtless, says M. Deshayes, the *Isocardiæ* approach the *Cardiæ;* but when the foot and the form of the branchiæ in these two genera are compared, the distinction is obvious. In the *Cardia* [CONCHACEA], the foot is cylindraceous, very long, and bent in an elbow-like form in the middle; in the *Isocardiæ*, on the contrary, it is flat, subquadrangular, and rather short.

Isocardia has the following characters:—Animal more or less globular, having the borders of the mantle fringed with very fine tentacular papillæ, leaving a rather large opening between them at the lower part, and united posteriorly by a transverse delicate band, pierced with two orifices surrounded by papillæ, one for the vent, and the other, lower, for respiration; foot of moderate size and trenchant.

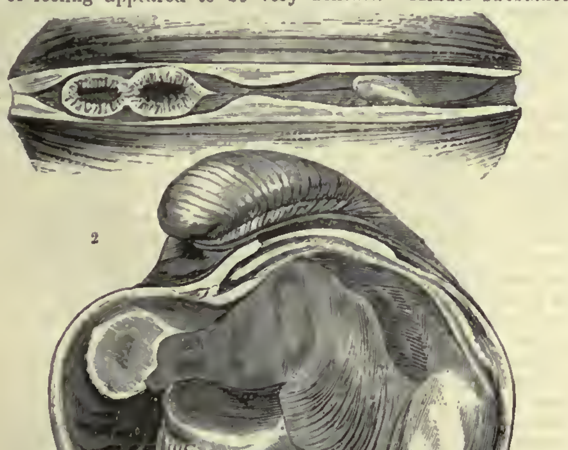
Shell sometimes with an epidermis, very convex, globulose, heart-shaped, equivalve, inequilateral; umbones divaricated, and widely divergent, curved forwards and outwards, and slightly spiral; hinge composed of two flattened hinge-teeth; ligament external, forked at one of its extremities; muscular impressions very distant.

I. Cor, the Heart-Shell, has been taken on the British coasts.

The Rev. James Bulwer, from whose figure in the 'Zoological Journal,' vol. ii., the two figures below are taken, saw the animal when in sea-water, and in the position represented at No. 1. The feelers, or ciliated fringe of the upper orifice (the largest) of the mantle, moved slowly, as if in search of food. Having remained in this situation about ten minutes, water was ejected with considerable force from the lower orifice, which had till then remained motionless. The expulsion of the water appeared to be effected by a sudden contraction of the muscles, because this was never done without the valves nearly closing at the same instant. After a few seconds the valves gradually returned to their open position, and remained quiescent as before, till the water was again ejected with a jerk; this alternating process was repeated during the whole time his specimens (which were trawled up in very deep water on the east coast of Ireland) were under his examination, but at shorter intervals on receiving fresh supplies of sea-water. The animal appeared to Mr. Bulwer to be insensible both to sound and light, as the presence or absence of either did not at all interrupt its movements; but its sense of feeling appeared to be very delicate. Minute substances

1

2



Heart-Shell (*Isocardia Cor*).

1, valves open, to show the animal and the feelers or ciliated fringe of the upper and lower orifices; 2, one of the valves, showing the animal with its sharp-edged foot and the muscular impressions.

dropped into the orifice of the mantle instantly excited the animal, and a column of water strongly directed expelled them from the shell; with so much strength was the water in some instances ejected, that it rose above the surface of three inches of superincumbent fluid. ('Zool. Jour.,' vol. ii.)

Shell of *Isocardia Cor*, valves closed.

Lamarck recorded four species, including *Isocardia semisulcata*. M. Deshayes, in his edition of that author, adds four others, reckoning that species: making eight in all, recent and fossil.

The species are found in the European and East Indian seas, and those of Australia. They have been dredged up from mud and sand at depths ranging from 10 to 20 fathoms.

Fossil Isocardiæ.

Mr. G. B. Sowerby remarks ('Genera of Recent and Fossil Shells') that several fossil species are given in plate 295 of Sowerby's 'Mineral Conchology,' one of which is from the London Clay, and the other from Kelloway's. Mr. G. B. Sowerby, in a note, states that a fossil species also occurs in the Crag, which so nearly resembles the *I. Cor* that he knows not wherein the specific difference consists; and, in the text, goes on to state that according to Brocchi ('Conch. Foss. Subap.,' ii. 520), two varieties of *I. Cor* are found in a fossil state in several parts of Italy; but as a subject upon which much diversity of opinion exists is here brought into question, he would recommend an attentive and comparative re-examination of the fossil with recent specimens, before the inquirer comes to an absolute decision upon this point. Another fossil species, he observes, is found at Piacenza, namely, *I. arietina*, Lam.; and he has figured *I. Basochiana* (Defr., 'Dict. des Sciences Naturelles'), a new species found by M. De Basoches de Falaise, in the district of Coutances. He thus concludes his remarks upon the fossil species of this genus:—"We think we may venture to express our opinion that all the fossil specimens published in various books, and existing in various collections, are not distinctly characterised *Isocardiæ*, but only the casts of the insides of other bivalves: the best distinguishing character is in the groove formed for the extension of the ligament from the hinge to the umbo. It is incumbent on us to mention that in *Isocardia* the line to which the mantle is attached, passing from one muscular impression to the other, is entire."

M. Deshayes, in his Tables, records two living species and three fossil (tertiary); and *I. Cor* as both living and fossil (tertiary).

Mr. Lea places his genus *Hippagus* (of which he gives an engraving) under the family *Cardiacea*. ('Contributions to Geology,' 8vo., Philadelphia, 1833.) He states that he has in vain endeavoured to place this shell in one of the established genera. In its general character he says that it approaches most closely to the *I. Cor*, but that it cannot be placed in that genus, being destitute of teeth. It bears, he adds, some resemblance to the genus *Inoceramus;* but, he continues, the hinge in that genus "closes by a series of oblong fossets," and besides it is very inequivalve. In its natural order he thinks that it seems to follow the genus *Isocardia*, and he proposes to place it in that position. *Hippagus* occurs in the Claiborne beds (tertiary of Alabama—Eocene of Lyell).

Other species of *Isocardia* have been found from the Oolitic beds upwards, but they resemble more closely tropical species than *I. Cor*.

ISOCRINITES, a genus of *Crinoidea*. (Goldfuss.)

I'SOETES (from ἴσος, equal, and ἔτος, year), a Cryptogamic genus of Plants belonging to the natural order *Lycopodiaceæ*. The capsule of the plant does not open, and the fructification is inclosed within the swollen base of the leaves; it has sporules of two kinds, which are attached to filiform receptacles. The organs of fructification in this plant are small cases, which are situated in the angles formed by the union of the leaves and the contracted stem; those seated in the axillæ of the outer or inferior leaves are divided into three cavities, containing about fifty spherical bodies (granules); the cases in the axillæ of the internal or superior leaves are divided by numerous transverse partitions into many cavities, all of which are filled with an impalpably fine powder, in the early stages of its development white, but subsequently becoming black.

The species of *Isoetes* grow at the bottoms of ponds and lakes, and are said to afford excellent food for fish. They are called Quillworts from the rush or quill-like appearance of the leaves.

I. lacustris, Quillwort, has subulate roundish-quadrangular leaves with four longitudinal jointed tubes. The rhizoma of this plant is a blunt tuber; the leaves are slender, broad, and flat at the base, but elsewhere between cylindrical and quadrangular. It is found in Great Britain at the bottom of lakes and ponds in hilly districts. The structure of the fructification of this plant, and other species of the genus, is only imperfectly understood. It is on this account referred to *Marsileaceæ* by some authors, and made to form an independent order by others. Lindley refers it to *Lycopodiaceæ*, and observes, "I follow De Candolle and Brongniart in referring it here." Delile has published an account of the germination of *Isoetes setacea*, from which it appears that its sporules sprout upwards and downwards, forming an intermediate solid body, which ultimately becomes the stem or cormus, but it is not stated whether the points from which the ascending and descending axes take their rise are uniform; as no analogy in structure is discoverable between these sporules and seeds, it is probable that they are not. Delile points out the great affinity that exists between *Isoetes* and *Lycopodium*, particularly in the relative position of the two kinds of reproductive matter. "In *Lycopodium*," he says, "the pulverulent thecæ occupy the upper ends of the shoots, and the granular thecæ the lower parts; while in *Isoetes* the former are found in the centre and the latter at the circumference. If this comparison is good, it will afford some evidence of the identity of nature of those thecæ, and that the pulverulent ones are at least not anthers, as has been supposed; for in *Isoetes* the pulverulent inner thecæ have the same organisation, even to the presence of what has been called their stigma, as the outer granular ones; so that if *Isoetes* has sexes, it will offer the singular fact of its anther having a stigma."

(Babington, *Manual of British Botany*; Newman, *History of British Ferns*; Lindley, *Natural System*; Burnett, *Outlines of Botany*.)

ISONANDRA, a genus of Plants belonging to the natural order *Sapotaceæ*. It is distinguished by the stamens being all fertile, and twice as numerous as the lobes of the corolla.

I. Gutta (Hooker), the Gutta-Percha Tree, has its leaves on long stalks, obovate-oblong, with a short point golden beneath; flowers axillary, fascicled; stamens 12. This tree is a native of the Malayan Archipelago.

The substance yielded by this tree, and designated by the name of Gutta-Percha (pronounced 'Pertsha'), is, like Caoutchouc, a carburet of hydrogen, and isomeric with that substance, and possesses a great number of the properties which characterise India-Rubber [INDIA-RUBBER], but exhibits certain special properties which admit of its being applied to particular uses to which caoutchouc is not adapted. Gutta-Percha possesses as great an indestructibility by means of chemical agents as caoutchouc. It has an intermediate consistence between that of leather and wood; it is capable of being softened by heat, and of regaining its primitive consistence on cooling. It is therefore at the same time capable of taking and of retaining the most delicate impressions. The important uses to which it has been latterly applied are only the forerunners of those to which it will be adapted hereafter, provided the lack of this precious material (which unfortunately is produced in much less quantities than India-Rubber, and in localities much more circumscribed) does not present an obstacle to it.

Whilst the plants which furnish caoutchouc abound in the whole of the territorial zone which extends between the tropics, the *Isonandra Gutta* is the only tree which yields Gutta-Percha. It grows scarcely anywhere except in certain parts of the Malayan Archipelago, and up to the present time has been almost exclusively obtained from Singapore. It was brought for the first time into England in the days of Tradescant, as a curious product, under the name of Mazer-Wood; and subsequently it was frequently brought from China and other parts of the East, under the name of India-Rubber, in the form of elastic whips, sticks, &c. In 1843 Doctors D'Almeida and W. Montgomery drew particular attention to it, together with its various singular properties, its easy manipulation, and the uses for which the Malays employed it. The most common employment of it was for whips; and it was by the introduction of a horse-whip made of this substance that its existence was for the first time known in Europe. The specimens of the products of the East Indies, shown in the Great Exhibition of 1851, proved that the natives of the country in which the *I. Gutta* grows know also how to appropriate it to the manufacture of different kinds of vases, and that European industry has little more to do than to imitate their processes.

The importation of Gutta-Percha into England, where the employment of this substance first drew attention, was in 1845 only 20,600 lbs.; but in 1848 it had increased to above 3,000,000 lbs.; and during the last five years the importation has amounted to a much larger quantity, and one which begins to cause some apprehension as to the possibility of the supply sufficing for the requirements of the novel uses in store for it in the future. It is true that during its use Gutta-Percha is but little consumed, and the waste from the articles in this material, submitted to a proper softening, can be made to serve new uses; nevertheless its constantly increasing consumption, added to the barbarous manner in which the product has hitherto been extracted, may well justify some apprehension.

During the first few years of the employment of Gutta-Percha it was the custom to cut down the tree for the purpose of obtaining the juice, which, left to itself, very soon allowed the Gutta-Percha to separate and coagulate of its own accord. There is reason to hope that European industry will soon be embarked in the cultivation of this product, and that the Niato (which is the name that the Malays give to the tree which produces Gutta-Percha), multiplied by means of a regular culture, naturalised in other countries than those to which it is indigenous, and worked by regular incisions, which will only take from the tree a portion of its juice without hindering its development, will be the means of furnishing at a low price a substance which is destined to render notable services to industrial and domestic economy.

The Gutta-Percha which arrives in Europe in the form of lumps of some pounds weight is far from being pure. The natives of the Malayan Archipelago make no scruple of introducing into it stones, earth, &c.; the presence of which in the interior of these blocks renders a purification indispensable, which purification however is capable of being attained without much manipulation.

Indestructible by water, and at the same time a bad conductor of electricity, Gutta-Percha has been found available for inclosing the metallic wires employed in the electric telegraph; and the use of this substance may certainly claim its share in the success of the submarine telegraph, by means of which London and Paris and the other great cities of Europe are now brought within a few minutes of each other.

It may be conceived to what a variety of forms a substance can be turned which, becoming soft without adhering at the temperature of boiling water, regains at the ordinary temperature the slight elasticity and the consistence of leather. [GUTTA-PERCHA, in ARTS AND SC. DIV.]

ISO'PODA, Latreille's name for the fifth order of the class *Crustacea*. The *Isopoda*, according to that zoologist, approach the *Læmodipoda* by the absence of mandibular palpi, though they are removed from them by several points; the two anterior feet are not annexed to the head, and, like the succeeding ones, depend upon their particular segment. The feet are always fourteen in number, unguiculated, and without any vesicular appendage at their base. The under part of the tail is furnished with appendages which are very apparent, and in the form of leaflets or vesicular purses. Of these the two first, or external ones, ordinarily cover the others, either totally or in great part. The body is generally flattened, and wider than it is thick. The mouth is composed of the same pieces as in the *Crustacea*, which precede it in M. Latreille's system, but in the order before us those which answer to the two superior jaw-feet in the *Decapoda* present more the appearance of a lower lip terminated by two palpi. Two of the antennæ, the mesial ones, are almost obliterated in the last genera of this order, which are all terrestrial, and differ besides from the other by their respiratory organs. The male sexual organs are indicated most frequently by the presence of linear or filiform appendages, and sometimes by hooks placed at the internal origin of the first subcaudal laminæ. The females carry their eggs under the breast, either between the scales or in a membranous pouch or sac that opens to afford a passage for their young, which are hatched with the form and parts proper to the species, and only cast their skin as they increase in size. The greater number live in the water. Those which are terrestrial have need, like other *Crustacea* that live out of water, of a certain degree of atmospheric humidity, in order that respiration may be carried on, and that their branchiæ may be in a fit state for performing this function.

Messrs. Victor Audouin and Milne-Edwards have studied very carefully the organisation of the *Isopoda*, the *Ligiæ* especially. It appears from their observations that the heart has the form of a long vessel extended above the dorsal surface of the intestine. Its anterior extremity gives off three arteries, as in the *Decapoda*. The lateral branchiæ may also be seen directed from the heart towards the feet. At the edge of the two first articulations of the abdomen, or tail, this organ receives, both right and left, small canals (the branchio-cardiac vessels), which seem to come from the branchiæ. According to the demonstrations of these zoologists in the case of the *Ligiæ*, it would appear that the venous system is less complete than in the Macrurous *Decapoda*; and that the blood driven from the heart to the different parts of the body passes into lacunæ, which the organs leave between them at the lower surface of the body, and which have a free communication with the different vessels of the branchiæ. The blood, after having traversed the respiratory apparatus, returns to the heart in traversing the branchio-cardiacal vessels. This disposition would establish the passage from the circulating system of the Decapodous *Crustacea* to that of the *Branchiopoda*. According to

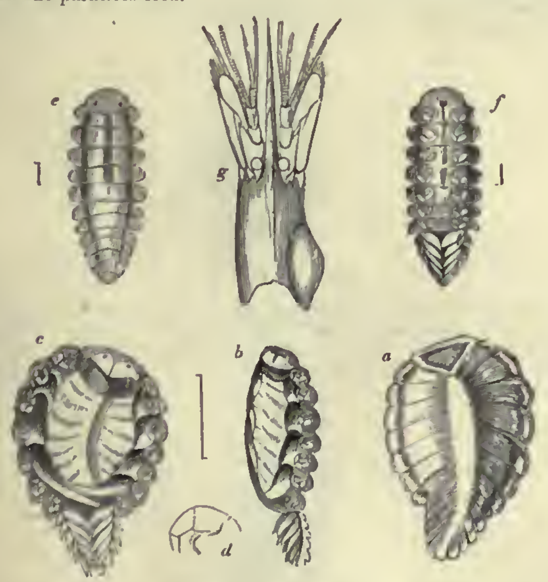
Cuvier, the two anomalous chords composing the mesial part of the nervous system of the *Onisci* (and probably of the other *Isopoda*, and even of the *Amphipoda*) are not entirely approximated, and may be well distinguished throughout their length. There are nine ganglions, without counting the brain; but the first two and the last two are so approximated that they may be reduced to seven. The second and the six following furnish the nerves to the seven pairs of feet; the four anterior feet, although analogous in the order of succession of the parts to the last four jaw-feet of the *Decapoda*, are really feet, properly so called. The segments which immediately succeed, or those that form the tail, receive their nerves from the last ganglion. These segments may be considered as simple divisions of a single segment, represented by that ganglion; and we accordingly see that the number of these posterior segments varies.

The following is the arrangement of M. Latreille:—

The order consists of six sections.

1. Epicarides (Latreille).—These are parasitical *Isopoda*, which, according to M. Latreille, are without either eyes or antennæ; the males however have eyes, though the females are blind. The body is flat, very small and oblong in the males, but much larger in the females, taking in their case the form of an oval, which is narrowed and a little curved posteriorly, hollow below, with a thoracic border, divided on each side into five membranous lobes. On this border the feet, which are very small and unfit either for walking or swimming, are situated. The under part of the tail is furnished with five pairs of small ciliated imbricated leaflets, answering to as many segments, and disposed in two longitudinal rows; but the posterior extremity is deprived of appendages. The mouth presents distinctly only two membranous leaflets applied one upon the other, of the same consistence, and quadrilateral. The lower concavity, forming a sort of flat basket, is filled with eggs. Near the place of their issue is constantly found an individual, which is presumed to be the male; but M. Latreille adds, that the extreme smallness of its size seems to forbid the possibility of copulation. According to M. Desmarest, this individual is furnished with two eyes; its body is straight and nearly linear. One sub-genus only belongs to this section.

Bopyrus (Latreille).—The most common species is *B. Crangorum*. Those who are in the habit of eating prawns will probably have observed a tumour occasionally presenting itself under the carapace on one of the sides, which is bulged out. On lifting this part of the shell, the parasite will, in such cases, be discovered immediately under it and upon the branchiæ. We have frequently detected the *Bopyrus*, but on whatever species of prawn it has been found, we have never remarked that the animal to which it adhered was more meagre than its fellows, though this perhaps may have arisen from the prawn not having been long subject to the visitation of the parasite. But there is another reason why the prawn should not suffer much from the adhesion of the parasite. The author of 'Horæ Entomologicæ' informs us that he has lately found three specimens of *Bopyrus* (females) with their backs turned to the branchiæ of the prawns; and he is of opinion that they and other crustaceous parasites which adhere to the anterior parts of fishes and *Crustacea*, fix themselves there for the sake of the currents (produced by the branchiæ in respiration), which bring with them the animalcules on which the parasites feed.



Bopyrus Crangorum.

a, the upper side; *b*, the animal seen in profile; *c*, the under side; *d*, one of the feet, much magnified (female); *e*, small individual, considered as the male, upper side; *f*, the same, lower side; *g*, carapace of a Prawn deformed on the right side by the presence of *Bopyrus*. (Desmarest.)

B. Crangorum is found on *Palemon serratus* and *Palemon squilla*, but most frequently on the former.

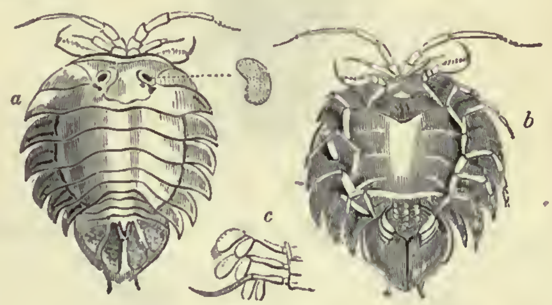
M. Risso has described another species, under the female of which he states that he found 800 or 900 living young ones.

2. Cymothoada (Latreille).—This section comprises those *Isopodæ* which have four very apparent antennæ; these are setaceous, and nearly always terminated by a pluriarticulate stem. These crustaceans have eyes, a mouth of the ordinary formation, vesicular branchiæ, disposed longitudinally in pairs, a tail consisting of from four to six segments, with a fin on each side, and the anterior feet most frequently terminated by a strong but small nail or hook. These *Isopodæ* are all parasitic according to Latreille; but *Serolis* appears not to be a parasite. Sometimes the eyes are mounted on tubercles at the summit of the head. The tail is composed of only four segments.

Serolis (Leach). One species only known, *S. Fabricii* (*Cymothoa paradoxa* of Fabricius).—Antennæ placed on two lines, and terminated by a pluriarticulate stem. Under the first three segments of the tail there are between the ordinary appendage three others, which are transverse, and terminated posteriorly in a point.

M. Desmarest describes the animal thus:—Superior antennæ formed of four joints, larger than the first three of the inferior antennæ; the last joint composed of many others, and smaller. Inferior antennæ with five joints, the first two small; the third and fourth (principally this last) elongated; the fifth composed of many others, smaller. Second pair of feet having the penultimate joint enlarged and the nail or claw much elongated; the sixth pair ambulatory, rather spiny, and having the nail slightly curved. Anterior appendages of the belly, or branchial laminæ, formed of two equal parts, which are foliaceous, rounded at their extremity, furnished with hairs at their base, placed upon a common peduncle; the two posterior and lateral appendages small and narrow, especially the interior one, which hardly projects.

This is a very interesting animal, and has been considered to offer some resemblance at first sight to the extinct form of the *Trilobites*. [Trilobites.]

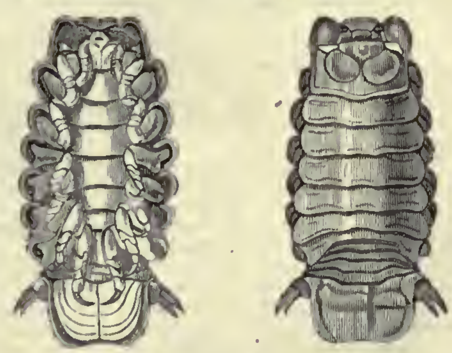


Serolis Fabricii.

a, back; *b*, under surface, showing the union of crustaceous legs with the membranous branchiæ; *c*, magnified view of branchiæ.

This creature has been found at Tierra del Fuego, Straits of Magalhaens (Banks), and Senegal (Dufresne). Captain Phillip Parker King, R.N., collected many specimens on the east coast of Patagonia, and also at Port Famine, in the Straits, where Captain King saw the beach covered with dead specimens. He also observed them alive swimming close to the bottom among the sea-weed. They moved slowly and gradually, unlike a shrimp. He never saw them swimming near the surface: their legs seemed adapted for swimming and crawling on the bottom.

Cymothoa (Fabr.)—Antennæ nearly equal in length; eyes but little apparent; last segment of the tail squared, and the two pieces terminating the lateral fins linear, equal, and styliform.



Cymothoa œstrum.

a, upper side; *b*, lower side.

Ichthyophilus (Latreille; *Nerocila*, *Lironeca*, Leach).—Antennæ of equal length, and eyes not very visible; last segment of the body nearly triangular, with two pieces terminating the lateral fins, in form of leaflets or blades: the exterior of these is greatest in *Nerocila*, and of the same size as the others in *Lironeca*.

M. Latreille observes that in the four following sub-genera the superior antennæ are manifestly shorter than the inferior.

Many, as well as the *Cymothoæ*, have all the feet terminated by a powerful and strongly-arched nail (onglet); the last eight are not spiny; the eyes are always distant and convex. These, in the method of Dr. Leach, form three genera, but M. Latreille is of opinion that they may be united under one sub-genus, namely:—

Canolira (Leach; *Anilocra*, *Olencira*, of the same).—In those *Canoliræ*, designated by Dr. Leach as *Olenciræ*, the blades of the fins are narrow and armed with points. In those named by the same zoologist *Anilocræ* the external blade of the fins is longer than the internal one; the inverse of which is the case with the *Canoliræ*, in which, besides, the eyes are but very little granulated, while they are very sensibly granulated in *Anilocra*.

M. Latreille remarks that in the three following sub-genera the second, third, and fourth feet only are terminated by a very strongly-curved nail (onglet), and the last eight are spiny. The eyes ordinarily have but little convexity, and are large and converging anteriorly.

Canolira (Anilocra) Capensis.

Æga (Leach).—Two first joints of the superior antennæ very large and compressed.

Æga emarginata.

a, upper side; *b*, anterior foot; *c*, posterior foot; *d*, under side.

Rocinella (Leach).—Two first joints of the superior antennæ nearly cylindrical, but approaching the *Ægæ* in their large and anteriorly approximated eyes.

Conilira (Leach).—Antennæ as in *Rocinella*; but the eyes are small and distant; and the edges of the segments are nearly straight, and not falciform and prominent.

Synodus (Latr.).—Antennæ upon two lines, lower antennæ always short, tail of six segments; distinguished from all the preceding by their great and projecting jaws. Only one species.

Cirolana (Leach).—Length of the lower antennæ surpassing the half of that of the body. Six segments in the tail.

Nelocira (Leach).—Length of lower antennæ as in *Cirolana*. Five segments only in the tail. Cornea of the eyes smooth.

Eurydice (Leach).—Resembling *Nelocira* in the number of the caudal segments, but differing from that form in its granulous eyes.

M. Latreille is of opinion that this sub-genus conducts us to those whose eyes are formed of small grains, or which have those organs smooth, and which have besides the four antennæ inserted upon the

Nelocira Swainsonii.

same horizontal line, consisting of four joints at most, all the feet ambulatory, and the tail composed of six segments. Such a form is—

Limnoria (Leach).—The only living species known is *L. terebrans*, which, although only two lines in length, is nevertheless highly injurious in consequence of its multiplication and its habits. The rapidity with which this little crustacean pierces the timber of ships makes its attacks not only mischievous but alarming. The pier at Southampton and also that at Herne Bay, have suffered from the attacks of this crustacean. It rolls itself up like a wood-louse when it is seized. It is a native of all the European seas.

3. SPHÆROMIDES (Latr.).—The *Isopoda* composing this section have four very distinct antennæ, which are either setaceous or conical; and, with the exception of *Anthura*, they are always terminated by a stem divided into many small joints, and short. The lower antennæ, which are always the longest, are inserted under the lower part of the first joint, which is large and thick. The mouth has the usual form. The branchiæ are vesicular or soft, naked, and disposed longitudinally in pairs. The tail has only two complete and moveable segments, but has often impressed transverse lines upon it, indicating the vestiges of other segments. On each side of its posterior extremity is a fin terminated by two leaflets, the lower of which is moveable, while the upper one is formed by an internal prolongation of the common support. The branchial appendages are curved internally; the internal side of the first is accompanied in the males by a small linear and elongated piece. The anterior part of the head, situated below the antennæ, is triangular, and in the form of a reversed heart. Some have an oval or oblong body, contracting ordinarily into the form of a bowl. The antennæ are terminated by a pluriarticulate joint, and the lower ones at least are sensibly longer than the head. The lateral and posterior fins are formed of a peduncle and two blades, composing, together with the last segment, a fan-like fin. In these the impressed and transverse lines of the anterior segment of the tail, always shorter than its successor, or the last, do not reach the lateral borders. The first joint of the superior antennæ is in the shape of a triangular battledore (palette). The head seen from above forms a transversal square. The leaflets of the fins are very much flattened, and the intermediate piece, or last segment, is enlarged and rounded laterally.

Zuzara (Leach).—Leaflets of the fins very large, the upper of which is shortest, separated from the other to form a border to the last segment.

Sphæroma (Latr.).—Leaflets of moderate size, equal, and applied one over the other.

Sphæroma dentata.

In others the impressed lines, or transverse sutures of the anterior segment of the tail, attain the lateral border and cut it. The first joint of the superior antennæ forms an elongated palette, which is square or linear. The leaflets of the fins are ordinarily narrower

Næsa bidentata.

and thicker than in the preceding; the exterior sometimes (as in *Cymodocea*) envelops the other: their point of junction resembles a kuot or joint. Sometimes the sixth segment of the body is sensibly longer than the preceding segments and the succeding one. One of the leaflets of the fins only is projecting.

Næsa (*Campecopæa*, Leach).—Sometimes the sixth segment of the body is of the length of the preceding segments, and of the succeeding one, as in *Cilicæa*, where one of the leaflets of the fins only is projecting, the other leaning against the posterior border of the last segment.

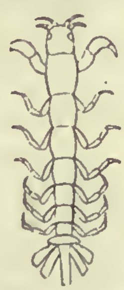
Cilicæa Latreilli.

Cymodocea (Leach).—In this form the leaflets of the fins are projecting and directed backwards. The sixth segment is not prolonged posteriorly, aud the extremity of the last segment has a small blade in a notch.

Cymodocea Lamarckii.

Dynamene.—Resembling *Cymodocea* in the projection and direction of the leaflets of the fins, but having the sixth segment prolonged backwards, and the last with a simple slit only, there beiug no blade.

Others again, as *Anthura*, have a vermiform body, and the antennæ, hardly so long as the head, consisting of four joints. The leaflets of the posterior fins form by their disposition and approximation a sort of capsule. The anterior feet are terminated by a monodactyle claw.



Anthura gracilis, magnified.

4. Idoteidæ (Leach). — This section consist of *Isopoda* whose antennæ are four in uumber, but upon the same horizontal and trans-

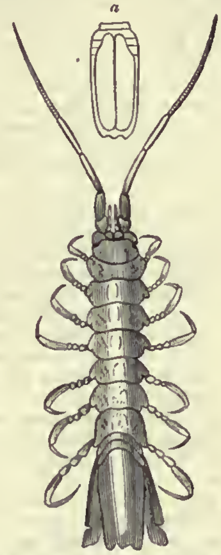
Idotea tricuspidata.

verse line; the lateral ones are terminated by a stem ending in a point, gradually decreasing and pluriarticulate; the intermediate antennæ are short, filiform, or a little the largest towards the eud, and 4-jointed, none of the joints beiug divided. The conformation of the mouth is the same as iu the preceding sections. The branchiæ are in the form of bladders, white in the greater part, susceptible of being blown up, capable of aiding in swimming, and covered by two blades or valvules of the last segment, adhering laterally to its borders, longitudinal, biarticulate, and opening in the middle by a straight line, like a folding door. The tail is formed of three segmeuts, the last of which is much the largest, without appendages at the end or lateral fins. These Crustaceans are all marine.

Idotea (Fabr.).—All the feet strongly unguiculated and identical; the body oval or simply oblong, and the lateral antennæ shorter than the half of the body.

Stenosoma (Leach).—Differing from *Idotea* iu the linear form of the body and the length of the antennæ, which surpasses the half of that of the body.

a



Stenosoma lineare, natural size.
a, laminæ of the under part of the abdomen.

Arcturus (Latreille).—Very remarkable for the form of the second and third feet, which are directed forwards, and terminated by a long bearded joint, unarmed or feebly unguiculate; the two anterior feet are applied upon the mouth and unguiculated; the last six are strong, ambulatory, thrown backwards, and bidentated at their extremity. In the length of the antennæ and form of the body *Arcturus* approaches *Stenosoma.* M. Latreille (1829) says that he never saw but one species, *A. tuberculatus*, brought home from the North Seas by oue of the last English expeditions to the North Pole.

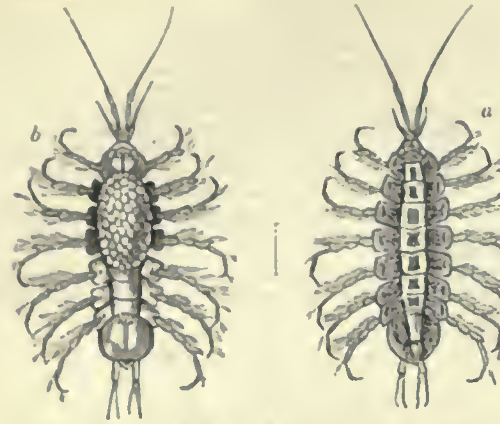
5. Asellota (Latreille). — The fifth section consists of *Isopoda* with four very apparent antennæ which are disposed on two lines, and are setaceous and terminated by a pluriarticulate stem. There are two mandibles, four jaws, ordinarily covered by a species of lip formed by the first jaw-feet. The branchiæ are vesicular, disposed in pairs, aud covered by two longitudinal and biarticulate but free leaflets. The tail is formed of a single segment, without lateral fins, but with two bifid needle-like processes, or two very short appendages in the form of tubercles at the middle of its posterior border. Thero are other lamellar appendages situated on its inferior base, more numerous in the males than in the females, and these serve to distinguish the sexes.

Asellus (Geoffroy).—Two bifid needle-like processes at the posterior extremity of the body; eyes distaut; superior antennæ at least as loug as the peduncle of the inferior antennæ. Hooks at the end of the feet entire.

A. aquaticus is very abuudant in fresh stagnant waters, as in the pools about Paris. It moves slowly when not terrified. In the spring it comes forth from the mud, in which it has passed the winter. The male, which is much larger than the female, carries her about for a space of eight days, holding her by means of his fourth pair of feet. When he quits her she is pregnant with a great number of eggs, inclosed in a membranous sac placed under her breast, aud opening by a longitudinal slit to give passage to the young.

Oniscoda (Latreille).—These, the *Janiræ* of Dr. Leach, differ from the *Aselli* in the approximation of their eyes, in having their superior antennæ shorter than the peduncle of the inferior ones, and iu the hooks of the tarsi, which are not bifid. M. Latreille remarks that the only species known (*Janira maculosa* of Leach) has been found on the coasts of England among the sea-weeds and *Ulvæ*.

Jæra (Leach).—This form, in the place of the needle-like processes (stylets) at the end of the tail, has only two tubercles. M. Latreille remarks that only a single species (*J. albifrons*, Leach) has been fouud,



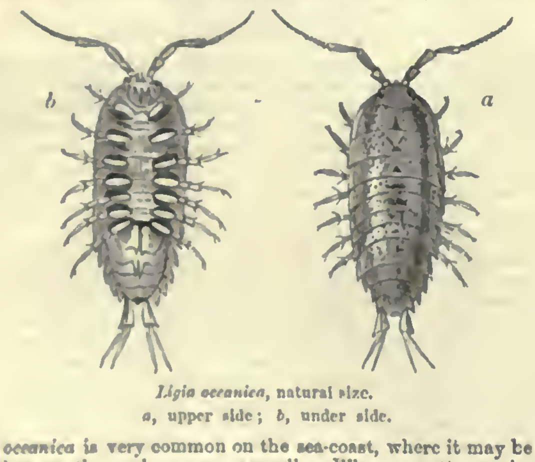
Asellus aquaticus (*Idotea aquatica*, Fabr.), female, magnified.
a, upper side; *b*, under side.

and that it is very common on the English coast, under stones and among the sea-weed.

6. CLOPORTIDES (*Oniscidæ*, Latreille).—This, the last section of *Isopoda*, according to the arrangement of M. Latreille, consists of those forms which have indeed four antennæ, but the two intermediate ones are very small, little apparent, and consist of two joints at most: the lateral antennæ are setaceous. The tail is composed of six segments, with either two or four needle-shaped appendages at the posterior border of the last segment, and without lateral fins. Some are aquatic, others terrestrial. In the latter the first leaflets below the tail exhibit a row of small holes, where the air penetrates to the organs of respiration there inclosed.

Some have the sixth joint of their antennæ, or their stem, so composed that in counting the small articulations of this part the total number of all the joints is nine at least. These are marine, and consist of two sub-genera.

Ligia (Fabr.).—Stem of the lateral antennæ composed of a great number of small joints, and two very projecting stylets, separated at the end into two branches, at the posterior extremity of the body.



Ligia oceanica, natural size.
a, upper side; *b*, under side.

L. oceanica is very common on the sea-coast, where it may be seen creeping on the rocks or on sea-walls. When an attempt is made to seize it, the animal quickly folds its feet and lets itself drop.

Tylos (Latreille).—These seem to have the faculty of rolling themselves up. The last segment of the body is demicircular, and exactly fills the notch formed by the preceding. The posterior appendages are very small and entirely inferior. The antennæ have only nine joints, the last four of which compose the stem. On each side is a tubercle representing one of the intermediate antennæ; the intermediate space is elevated. The branchiæ are vesicular, imbricated, and covered by laminæ.

T. Armadillo, an inhabitant of the Mediterranean, may be taken as an example.

Philoscia (Latreille).—Lateral antennæ divided into eight joints and exposed at their base. The four posterior appendages nearly equal. These occur in moist places. *Oniscus sylvestris* (Fabr.) is an example.

Cloportes, properly so called; *Oniscus*, Linn. (Wood-Lice).—Eight joints to the lateral antennæ, but their base is covered; and the two external appendages of the tail are much larger than the two internal ones. These animals frequent dark and retired places, such as caves, cellars, holes in walls, &c., and are also found under stones and old logs. Their food consists of decayed vegetable and animal substances; and they scarcely ever come forth from their retreats except in rainy or moist weather. They move slowly when not in danger. The eggs are inclosed in a pectoral pouch. The young at their birth have a thoracic segment, short, and consequently only twelve feet. These *Crustacea* were formerly used in medicine; but they no longer form part of the Materia Medica.

Wood-Louse (*Oniscus murarius*).

Porcellio (Latreille).—Distinguished from the true Wood-Lice by the number of joints of their lateral antennæ, which are only seven. In other respects *Porcellio* resembles *Oniscus*.

Armadillo (Latreille).—The posterior appendages of the body are not projecting; the last segment is triangular. A small blade, in form of a reversed triangle, or more large and truncated at the end, formed by the last joint of the lateral appendages, fills up on each side the void between the segment and the preceding. Lateral antennæ with only seven joints. The upper subcaudal scales are pierced with a row of small holes.

Armadillo pustulatus.
a, expanded; *b*, rolled up.

Such is the arrangement of M. Latreille.

Lamarck divided the *Isopoda* into two great sections: the first consisting of those which have the branchiæ situated under the tail, and comprising two subdivisions; the second composed of those which have their branchiæ placed under the anterior part of the abdomen, between the feet.

Under the first he arranged the genera *Armadillo, Oniscus, Philoscia, Ligia, Asellus, Idotea, Sphæroma, Cymothoa, Bopyrus, Typhis, Anceus, Praniza, Apseudes*, and *Ione*. Under the second he included the genera *Leptomera, Caprella*, and *Cyamus*.

M. Desmarest also divided the *Isopoda* into two great sections, with many subdivisions.

His first section, which he makes equivalent to the Phytibranchiate Isopods of Latreille, consists of the genera *Typhis, Anceus*, including *Gnathia* of Leach, *Praniza, Eupheus*, and *Ione*.

His second section, which he makes equivalent to the Ptérygibranches of Latreille, comprises the genera *Idotea, Stenosoma, Anthura, Serolis, Campecopea, Næsa, Cilicæa, Cymodocea, Dynamene, Zuzara, Sphæroma, Eurydice, Nelocira, Cirolana, Conilera, Rocinella, Æga, Canolira, Anilocra, Olencira, Nerocila, Livoneca, Cymothoa, Limnoria, Asellus, Janira, Jæra, Ligia, Philoscia, Oniscus, Porcellio, Armadillo*, and *Bopyrus*.

M. Milne-Edwards (edition of Lamarck, 1838) states, in a note to that part of Lamarck's definition of an Isopod Crustacean, 'mandibules sans palpes,' that Lamarck, Latreille, and most authors are in error when they assign this character to the *Isopoda*, for in a great number of these Crustaceans the mandibles are provided with a palpiform stem, entirely resembling that which may be seen in the greater part of the *Amphipoda*.

He further remarks that the respiratory lamellæ situated under the abdomen are hardly ever branchiæ, properly so called, but only one of the branches of the false feet become membranous and vascular, as in one of the appendages of the thoracic feet in the *Amphipoda*. The female of *Ione*, he observes, exhibits an exception, for she carries ramose branchiæ on each side of the abdomen.

M. Milne-Edwards, in his notes, further states that those *Crustacea* whose respiratory appendages are placed under the thorax (which Lamarck calls abdomen) ought not to remain in the order of *Isopoda*, but belong to the *Læmodipoda* of M. Latreille. The egg-pouch he describes as being formed of the flabelliform appendages, which have become foliaceous, and are raised against the sternum.

The same acute zoologist (loc. cit.) says that the *Isopoda*, properly so called, are Edriophthalmous Crustaceans, whose abdomen is never rudimentary, and carries below five pair of false branchial feet, having all nearly the same form and the same functions. The appendages of the penultimate ring (or the false feet of the sixth pair) have a form and use different from those of the preceding. The thorax, composed in general of seven rings, but sometimes having only five, carries nearly always seven pair of feet, which are often furnished with a foliaceous palp, serving to protect the eggs and young, but they hardly ever carry a vesicular appendage proper for respiration, as in the *Amphipoda* and *Lœmodipoda*. Finally, the conformation of their buccal apparatus varies, and the greater part of authors are in error when they assign to them as a character the possession of mandibles deprived of palpiform appendages.

M. Milne-Edwards is of opinion that the *Isopoda* form three natural families, namely, the Idoteidians, the Cymothoadians, and the Cloportidians, and he thus distinguishes them:—

A. Jaw-feet operculiform, and deprived of a palpiform stem, or only showing the vestiges of it.

* Thoracic feet ambulatory; last segment of the abdomen smaller than the preceding segments; internal antennæ rudimentary.

These form the family of—

Cloportidians.

** Thoracic feet anchor-like (ancreuses), last segment of the abdomen nearly always much larger than the preceding segments; internal antennæ in general well developed.

These form the family of—

Cymothoadians.

AA. Jaw-feet palpiform. Last abdominal ring much more developed than the preceding ones; all or nearly all the feet ambulatory.

These form the family of—

Idoteidians.

In this classification, says the author, the family of the Cloportidians has the same limits as in the method adopted by Lamarck, and comprises the Terrestrial Isopods.

The family of Cymothoadians is composed of the Parasitic Isopods, and comprehends *Cymothoa* of Lamarck, *Ione*, *Anceus*, and *Typhis*.

The family of Idoteidians consists of Marine Isopods not parasitic, and embraces the genera *Idotea*, *Sphæroma*, *Anthura*, *Asellus*, &c. [CRUSTACEA.]

Fossil Isopoda.—M. Latreille states that Professor Germar had sent to M. le Comte Dejean the figure and description of a small Fossil Crustacean which appeared to him (M. Latreille) to be referrible to the sub-genus *Limnoria*; and he further remarks that *Oniscus prægustator*, figured in Parkinson's work, comes near to that species, or at least appears to belong to the same section.

M. Desmarest ('Histoire Naturelle des Crustacés Fossiles') enumerates two fossil species of the genus *Sphæroma*: one, *S. antiqua*, found in a fragment of white fine-grained calcareous stone, analogous in that respect to the Pappeheim stone, but of which he knows not the origin; the other, *S. Margarum*, from the horizontal beds of green fissile marl (marne verte fissile) at Montmartre, above the gypseous beds, mingled with Spirorbes.

ISOPYRE, a Mineral which occurs amorphous in granite. The fracture is flat and conchoidal. It is brittle, with a hardness of 5·5 to 6. The colour is velvet- or grayish-black, occasionally dotted with red. The colour of the streak is greenish-gray. It slightly obeys the magnet. Lustre vitreous; opaque or slightly translucent. The specific gravity is 2·9 to 3. It is with difficulty acted upon by acids, and fuses before the blow-pipe. It occurs in the granite of St. Just, near Penzance, in Cornwall. According to Turner's analysis, it consists of—

Silica	47·09
Alumina	13·91
Lime	15·43
Peroxide of Iron	20·07
Oxide of Copper	1·94
	98·44

ISO'TELUS, a genus of Fossil *Crustacea* (*Trilobites*) from the Silurian strata, especially of North America. (Green.)

ISOTOMA. [LOBELIACEÆ.]

ISPIDA. [HALCYONIDÆ.]

ISTIO'PHORI, a family of Bats. [CHEIROPTERA.]

ISTIU'RUS, a genus of Saurians. [IGUANIDÆ.]

ITABALLI. [VOCHYACEÆ.]

ITACOLUMITE, a Micaceous Granular Quartz with which gold and topaz are associated. It is found in Brazil. [DIAMOND.]

ITCH-MITE, [ACARIDÆ.]

ITTNERITE. This Mineral occurs crystallised in rhombic dodecahedrons and massive. It has a compact structure. The fracture is imperfect, conchoidal, passing into uneven. Hardness 5·0 to 6·0. The colour is bluish or ash-gray. The lustre resinous to vitreous. Specific gravity 2·3. It forms a jelly when put into acids, and fuses per se before the blow-pipe, with effervescence of sulphurous acid, into an opaque blebby glass. It yields by analysis—

Soda	11·29
Potash	1·57
Silica	30·17
Alumina	28·40
Lime	5·24
Oxide of Iron	0·62
Sulphate of Lime	4·89
Common Salt	1·62
Sulphuretted Hydrogen and Water	10·76
	94·56

IU'LUS, a genus established by Linnæus for such *Insecta Myriapoda* as now form the order *Chilognatha* (χεῖλος, γνάθος), the first division of *Myriapoda* in the arrangements of Leach and Latreille. The *Chilognatha* have crustaceous and usually cylindrical bodies, formed of numerous unequal segments, very short feet, each terminating in a single hook; a vertical rounded head, furnished with two mandibles, which are either thick and robust or united with the labium and elongated. They have no palpi. The antennæ are two, very short, either slightly thickened towards their extremities, or filiform throughout, and composed usually of seven, more rarely (as in the genus *Sphæropœus*) of six joints. Their eyes are smooth and vary greatly in number. These animals move slowly and with a gliding motion. When disturbed, they roll themselves up spirally, or into a ball. They feed on decomposing animal and vegetable matter.

The position assigned to the *Chilognatha*, at the head of the *Myriopoda*, by Latreille and others, has been disputed by Professor Brandt and by Mr. Newport. The following remarks on this subject by the latter naturalist, of all living zoologists the most competent to decide in questions affecting this difficult class, are taken from his catalogue of *Chilognatha* in the British Museum, published in the 'Annals of Natural History for April, 1844,' and afford in a brief compass much information respecting these curious animals.

"The *Chilognatha*, have usually been regarded by naturalists as the first order of *Myriapoda*, partly in consequence of the more compact form of the head, and its similarity to that of the larva state of hexapod insects, and partly from the general form of their bodies being similar to that of the larvæ. This was the view taken of these animals by Latreille, Leach, Gervais, and some others, and very recently by Lucas. But a different and, as I believe, more correct view and arrangement have been followed by Professor Brandt, who regards the *Chilopoda* as the first, and the *Chilognatha* as the second division of the class. Although I cannot entirely agree with Brandt in his division of the *Chilognatha* into masticating and sucking species, because, as Lucas has recently remarked, there are species even among the *Chilopoda* which have the external organs of nutrition fitted only for taking liquid food, as in the little *Scolopendrella*, I fully agree with him in the superiority of the *Chilopoda*, as an order, over the *Chilognatha*, notwithstanding the less compact structure of the head in the former. The general characters of the *Chilopoda* certainly point them out as the most perfect animals of the osculant class of *Articulata*. The more compact frame of body, the reduced number of the organs of locomotion, the greater activity, and the predaceous habits of the higher species, approximate the *Chilopoda* to the predaceous insects on the one hand, and to the *Arachnida* on the other. The form of the head, in the two divisions of *Myriapoda*, seems to have reference chiefly to the particular habits of the species. Thus, in those which seize their prey and subsist like the Arachnidans on living objects, those segments which in reality compose the whole head are not all anchylosed together, but are in part freely moveable on each other, and thus allow of a more prehensile function to the large forcipated foot-jaws, the true mandibles of the *Articulata*. Some naturalists have believed that these foot-jaws in the *Chilopoda* are not the true analogues of insects and of *Chilognatha*; but I am satisfied, by recent examinations, that this is truly the case. In the *Chilognatha* the foot-jaws have the form of true mandibles, because the habits of the species require that compact form of the organ which alone can be subservient, not to the seizing and piercing of living prey, but to the grinding or comminuting of more or less solid vegetable matter, on which most of the genera of *Chilognatha* entirely subsist. In all other respects, both in their internal as well as their external anatomy, and in their physiology and mode of growth, the *Chilognatha* are decidedly inferior to the *Chilopoda*. They seem to conduct us down to the *Annelida* from the vegetable-feeding *Crustacea*, as the *Chilopoda* do from the Arachnidans to the same class."

The Chilognathous *Myriapoda* are found in all parts of the world, certain genera however affecting certain geographical divisions. Thus the species of *Glomeris* are European; those of *Spirastreptus* and *Sphæropœus* African and eastern. The genus *Iulus*, in its most limited sense, includes European, Asiatic, and North American species. *Iulus terrestris* is a familiar British example.

A synopsis of the genera of *Chilognatha* will be found in the third part of the nineteenth volume of the 'Linnæan Transactions,' appended to a valuable memoir on the *Myriapoda* by Mr. Newport. Professor Brandt's papers on these animals are published in the

'Transactions and Proceedings of the Imperial Academy of St. Petersburg.' [MYRIAPODA.]

IVORY. [TEETH.]

IVORY, VEGETABLE. [PHYTELEPHAS.]

IVY. [HEDERA.]

IVY, GROUND. [NEPETA.]

I'XALUS, a form of herbivorous Mammifers, placed by Mr. Ogilby under his family *Moschidæ*.

IXODES. [ACARIDÆ.]

IXOLYTE, a Mineral Resin found with others in brown coal.

IXO'RA, a genus of Plants belonging to the tribe *Cinchonaceæ* and the genus *Rubiaceæ*, so named, it is supposed, from the Indian god Iswara. The genus is characterised by having a small 4-toothed calyx; corolla 1-petaled, funnel-shaped; tube long, with the four stamens in its mouth; ovary 2-celled, 1-seeded; style single; berry drupaceous, inferior, 2-seeded. The species are numerous, and chiefly confined to India and the Oriental Archipelago. They form shrubs or small trees, with opposite leaves, and stipules arising from a broad base, but acute at the apex. The flowers are in terminal corymbs, and are usually red, but sometimes white, and are generally highly ornamental, whence several are cultivated in our hot-houses, where they require to be kept in a moist heat to thrive well. Some of the species are used medicinally, but not to any extent. Dr. Horsfield mentions *I. coccinea* as employed in Java as a stimulant, and Rheede two or three other species; but none appear to be possessed of any very active properties.

IXOS, a genus of Birds established by M. Temminck, for those Thrushes which have the bill shorter than usual, and embracing the greatest part of the *Brachypodinæ* and nearly the whole of the *Crateropodinæ* of Swainson.

J

JABIRU, the name or a genus of Grallatorial or Wading Birds, called *Mycteria* by Linnæus. It is thus characterised:—

Bill long, conical, smooth, robust, compressed, and pointed; upper mandible trigonal and straight, the lower thicker and turned up. Head and neck more or less bare of feathers. Anterior toes united at the base by a membrane. Size gigantic.

The species are found in South America, Western Africa, and Australasia. Its habits are almost entirely the same with those of the Storks. There are three species known, distributed geographically as above.

M. Americana may be taken as an example.

This bird is very large in size, white; the head and neck (excepting the occiput) without feathers, and covered with a black skin, which becomes reddish towards the lower part. On the occiput are a few white feathers. Bill and feet black.

It is found in South America, where it frequents the borders of lakes and marshes, preying on reptiles and fish.

Mycteria Americana.

JACARANDA, a genus of Monopetalous Exogenous Plants belonging to the natural order *Bignoniaceæ*. It has a 5-toothed calyx, sometimes entire; corolla with a short tube or campanulate throat, and a 5-lobed bilabiate limb; stamens 4, didynamous, with the rudiment of a fifth; lobes of anthers divaricate; capsule ovate, rather ligneous. The species are trees, natives of South America. They have showy panicled terminal flowers. They have very much the habit of the fine-leaved Acacias.

Several species, as *J. Bahamensis, J, Braziliens, J. tomentosa*, are cultivated in stoves in this country.

JACARANDA, a wood known in commerce, and which is said by Prince Maximilian to be the timber of a Brazilian *Mimosa*. (Burnett, *Outlines of Botany*.)

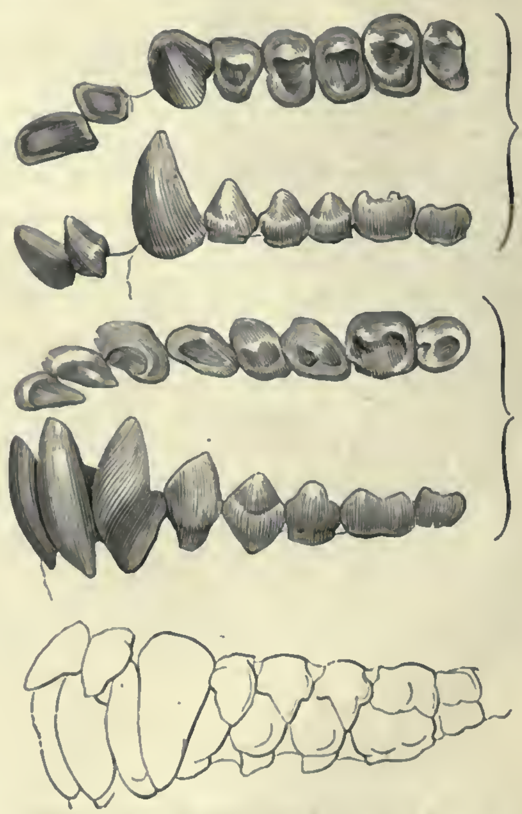
JACARÉ. [ALLIGATOR.]

JACCHUS, or IACCHUS, the name of a genus of Monkeys applied by Geoffroy, Desmarest, and others to the form denominated *Hapale* by Illiger, *Ouistitis* of the French, the type of which may be considered to be the *Simia Jacchus* of Linnæus.

M. Geoffroy treats them as a family divided into two sub-genera (Hapale and Midas), under the name of *Arctopitheci*; but the term *Arctopithecus* has been applied by Gesner to another animal, probably the Three-Toed Sloth, whilst the latter uses *Galeopithecus* to designate the Sagoin.

The characters of Jacchus are:—Upper intermediate incisors larger than the lateral ones, which are isolated on each side; lower incisors elongated, narrow, and vertical, the lateral ones longest; upper canine teeth conical and of moderate size; two lower ones very small.

Dental Formula:—Incisors, $\frac{4}{4}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{6-6}{6-6} = 36$.



Teeth of *Jacchus*, four times larger than nature. F. Cuvier.

Size small, muzzle short, facial angle about 50°. Head round, prominent at the occiput; the five fingers armed with claws, with the exception of the thumbs of the posterior extremities, which are furnished with nails; thumb of the anterior extremities in the same direction as the fingers; fur very soft; tail full and handsome.

The species are natives of South America. How Ludolph, who figures two in his 'History of Ethiopia,' could have been so far misled as to place the form in that part of the world, does not appear.

The species, which are not few, have been separated into two sections: the first consisting of those which have an annulated tail, as

J. vulgaris; and the second of those whose tail is not annulated, as *J. melanurus.*

J. vulgaris appears to be the *Simia Jacchus* of Linnæus and others; *Callithrix Jacchus* of Erxleben; *Hapale Jacchus* of Illiger and Kuhl; *Cercopithecus Jacchus* of Blumenbach; Cagui, Sagouin, Sagoin, Sanglain, and Sanglin, of Edwards and various authors, the latter terms being probably derived from Sahuim, the name by which it is said to be known near Bahia; Ouistiti of Buffon and the French; Striated Monkey of Pennant.

Length of body about 8 inches; tail rather more than 11 inches; colour olive-gray, darkest on the head and shoulders, where it becomes nearly black; tail and lower part of the back barred or annulated with pale-gray; lower parts of extremities brownish-gray. Face of a flesh-colour; two tufts of pale hair spring round the ears; front claws hooked and thick.

Jacchus vulgaris.

It is a native of Guyana and Brazil. The habits of the genus generally are squirrel-like, though they are, occasionally at least, carnivorous. *J. vulgaris*, in a wild state, is omnivorous, feeding on fruits, roots, seeds, insects, and little birds or nestlings. The individual (in captivity) from which Edwards took his drawing fed upon biscuits, fruit, greens, insects, snails, &c., and once, when loose, it suddenly snatched a Chinese gold-fish from a basin of water and devoured it: Mrs. Kennon, to whom it belonged, after this gave it live eels, which frightened it at first by twisting round its neck, but it soon mastered and ate them. Mrs. Moore, of Rio Janeiro, sent a living specimen of *J. penicillatus*, which was said to have been obtained from Bahia, to the Zoological Society of London, with the following note:—"Like most monkeys, it will eat almost anything; but its chief and favourite food, in its wild state, is the banana. It is a very delicate animal, and requires great warmth; and its very beautiful tail is in this respect eminently conducive to the comfort of the little creature, who, on all occasions when he requires warmth, rolls himself up in the natural boa with which Providence has in its wisdom endowed him."

The Ouistitis, or Sanglins, not unfrequently breed in confinement. Edwards notices a pair that bred in Portugal, and F. Cuvier possessed two which had young. Three little ones were born, and the female soon ate off the head of one; but the others beginning to suck, she became careful of them and affectionate to them. The male seemed more fond of them than the mother, and assisted her in her care of them. Lady Rolle addressed a letter to the secretary of the Zoological Society of London (February, 1835), giving an account of the birth of two young ones, the produce of a pair of Ouistitis (*J. penicillatus*, Geoff.) in her ladyship's possession. The parents were obtained in London during the preceding summer, and the young were brought forth on the 1st January. One was born dead, but the other was surviving at the date of the letter, being then about six weeks old, and appearing likely to live. It was every day put on the table at the dessert, and fed upon sweet cake. Lady Rolle stated that the mother took great care of it, exactly in the manner described by Edwards in his 'Gleanings.' It was observed that young of the same species had been born at the Society's Gardens, but not living, and that a female in the collection of the president, the Earl of Derby, at Knowsley, had produced, about the same time as Lady Rolle's, two living and healthy young ones, which were then still thriving. ('Zool. Proc.')

Dr. Gray places the form among the Anthropomorphous *Primates*, in the family *Sariguidæ*, and in its last sub-family (the 5th) *Harpalina* (*Hapalina?*), which is immediately preceded by *Saguinina*.

Mr. Swainson, who arranges it under his family *Cebidæ*, gives the group the appellation of Mouse-Monkeys, because the large cutting teeth in the lower jaw strongly indicate, in his opinion, "a representation of the order *Glires*."

JACK. [ESOX.]

JACK-IN-A-BOX, a name given to a species of *Hernandia*, in which the seeds make a noise when shaken in their pericarps. [HERNANDIACEÆ.]

JACK-OF-THE-HEDGE. [ERYSIMUM.]

JACK-SNIPE. [SCOLOPACIDÆ.]

JACK-TREE. [ARTOCARPUS.]

JACKAL. [CANIS.]

JACKDAW, the well-known English name for *Corvus Monedula* of Linnæus. [CORVIDÆ.]

JACKSAW, one of the provincial English names for the Dun Diver. [DUCKS.]

JACOB'S-LADDER. [POLEMONIUM.]

JADE, a name which has been given to several Minerals which resemble each other but little, except in colour, and therefore it is one which it would be well should fall into disuse.

Serpentine, *Nephrite*, and *Saussurite* have all been described under the name of *Jade*. *Yu*, or Chinese Jade, is supposed to be *Prehnite*.

JÆRA. [ISOPODA.]

JAGER. [LARIDÆ.]

JAGUAR. [FELIDÆ.]

JALAP. [IPOMÆA.]

JAMESONITE, a Mineral which occurs crystallised and massive. Its specific gravity is 5·564. It consists of—

Sulphur	22·5
Lead	38·7
Antimony	34·9
Iron	2·6
	98·7

JANIA. [CORALLINACEÆ.]

JANIPHA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has monœcious flowers; calyx campanulate, 5-parted; petals wanting; stamens 10 in the male flowers, filaments unequal, distinct, arranged round a disc. In the female flowers the style is one; stigmas 3, consolidated into a rugose mass; capsule 3-coccous.

J. Manihot (*Jatropha Manihot* of Linnæus) is a native of Brazil. It has an oblong tuberous root, as big as a child's head, full of a wheyish venomous juice. The stems are white, brittle, having a very large pith, and several knobs sticking out on every side like warts, being the remains of the foot-stalks of the leaves, which have dropped off, usually 6 to 7 feet high, with a smooth white bark; branches crooked, and have on every side near their tops leaves irregularly placed on long terete petioles, broadly-cordate in their outline, divided nearly to their base into 5 spreading lanceolate entire segments, alternate at both extremities, dark-green above, pale-glaucous beneath; the midrib strong, prominent below, and there yellowish-red: from it there branch off several oblique veins, connected by lesser transverse ones; stipules small, lanceolate, acuminate, caducous; panicles, or compound racemes, axillary and terminal, 4 to 5 inches long, bearing sometimes all male or female flowers, at other times these are mixed on the same peduncle; pedicels with small subulate bracts at their base. Male flowers smaller than the female. Calyx purplish on the outside, fulvous-brown within, cut about half-way down into five spreading segments; disc orange-coloured, fleshy, annular, 10-rayed; stamens 10, alternate with the lobes of the disc; filaments shorter than the calyx, white, filiform, free; anthers linear, oblong, yellow. Female flowers of the same colour as the male, deeply 5-parted; the segments lanceolate, ovate, spreading; disc an annular orange-coloured ring, in which the purple ovate furrowed ovary is imbedded; style short; stigmas 3, reflexed, furrowed and plaited, white; capsule ovate, 3-cornered, 3-coccous; seeds elliptical, black, shining, with a thick fleshy funiculus. The expressed juice is dangerously poisonous. Fecula of the root harmless when separated from the juice and exposed to heat. It is called Cassava—a principal article of diet in South America. The nutritious substance known as Tapioca is the Cassava differently prepared and granulated. [FOOD.] These preparations are obtained by crushing the roots after the bark has been removed, and straining off the water, when the mass is gradually dried in pans over the fire.

(Lindley, *Flora Medica.*)

JANI'RA (Oken), a genus of *Acalephæ*, apparently nearly allied to the *Callianiræ*.

JA'NTHINA, or IANTHINA, Lamarck's name for a genus of Turbinated Testaceous Mollusks of remarkable habits.

Linnæus placed the form among the *Helices*, under the name of *Helix Janthina*, between *H. perversa* and *H. vivipara;* and he was aware of its pelagic distribution.

Lamarck arranges it next to *Natica* the last genus of his

Neritaceans, between which family and the Macrostomes it appears in his list of Phytophagous (Plant-Eating) Trachelipoda.

Cuvier assigns to the *Janthinæ* a place among his Pectinibranchiate Gastropoda, between the *Pyramidellæ* and the *Neritæ*.

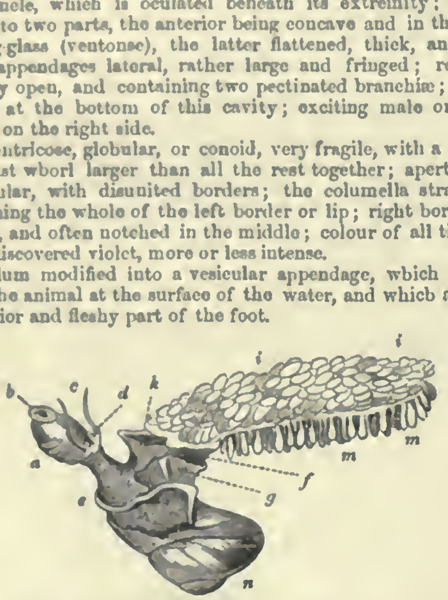
De Blainville elevates the group into a family, under the name of Oxystomes, being the fifth and last of his order *Asiphonobranchiata*. This family comes next to the Hemicyclostomes, which comprise the Nerita, &c.

M. Rang makes *Janthina* a genus of the Trochoids of Cuvier, giving it a position between *Ampullaria*, Lam., and *Litiopa*, Rang.

This genus has the following characters:—Animal with a very large head and a proboscidiform muzzle, at the extremity whereof is the mouth, furnished with two vertical subcartilaginous lips (which are armed with long and very sharp points curved inwards), and with a lingual enlargement (renflement); tentacles two, conical, pointed, not very contractile, and very distant, each bearing at its base a rather long peduncle, which is oculated beneath its extremity; foot oval, divided into two parts, the anterior being concave and in the form of a cupping-glass (ventouse), the latter flattened, thick, and fleshy; natatory appendages lateral, rather large and fringed; respiratory cavity very open, and containing two pectinated branchiæ; orifice of the ovary at the bottom of this cavity; exciting male organ very small and on the right side.

Shell ventricose, globular, or conoid, very fragile, with a low spire, and the last whorl larger than all the rest together; aperture large, subtriangular, with disunited borders; the columella straight and long, forming the whole of the left border or lip; right border or lip trenchant, and often notched in the middle; colour of all the species hitherto discovered violet, more or less intense.

Operculum modified into a vesicular appendage, which serves to suspend the animal at the surface of the water, and which adheres to the posterior and fleshy part of the foot.



Common Oceanic Shell (*Janthina fragilis*). Shell with the animal, the float expanded.

a, head; *b*, mouth; *c*, tentacles; *d*, eyes; *e*, border of the mantle at the entrance of the branchial cavity; *f*, foot, the posterior part, which is flat; *g*, lateral expansion of the mantle, provided for swimming; *k*, foot, anterior part forming a sort of pouch; *i*, bunch of aerated vesicles, serving to suspend the mollusc at the surface of the water; *m*, eggs suspended under the vesicular bunch; *n*, shell. (Rang.)

The geographical distribution of this genus is very extensive, the form having been met with in the four quarters of the world floating on the ocean or driven on the shores by tempests. It has occurred on the coasts of our own islands, but there is reason for thinking that it is not to be found in very cold latitudes. In warm climates it is very plentiful.

Sir Everard Home published in the 'Philosophical Transactions' for 1817 a paper which is appended (Appendix. No. iii.) to Captain Tuckey's 'Narrative of the Expedition sent to explore the River Zaire, usually called the Congo,' wherein he describes and figures among other ova of Molluscs, or *Vermes testacea*, as he denominates them, the camerated nidus of *Helix Janthina* (pl. xiii., figs. 1, 2, 3, 4, 5, 6). "This animal," observes Sir Everard, "not living at the bottom of the sea, like the *Vermes testacea* in general, deposits its ova upon its own shell, if nothing else comes in its way. One of the specimens of the shell of the *Janthina* caught in the voyage to the Congo fortunately has the ova so deposited." And he then refers to the drawings of Mr. Bauer, engraved as above quoted.

In the 4th vol. of the 'Journal of the Philadelphia Academy' will be found 'Remarks on the Floating Apparatus and other peculiarities of the genus Janthina,' by Reynall Coates, M.D. This highly interesting paper, the result of the author's personal observations during a voyage to the East Indies, establishes the correctness of Cuvier's remark, that no anatomical connection exists between the animals and the air-cells of their float; but does not corroborate the views of Sir Everard as to the camerated nidus on the shell which he saw with so much satisfaction. Dr. Coates placed some *Janthinæ* in a tumbler of brine, and having removed a portion of the float of one with scissors, the animal soon set to work to supply the deficiency after the following manner:—The foot was advanced upon the remaining vesicles until about two-thirds of that part rose above the surface of the water; it was then expanded to the uttermost, and thrown back upon the water, like the foot of a *Lymnæa* when it begins to swim; it was then contracted at the edges, and formed into the shape of a hood, inclosing a globule of air, which was slowly applied to the extremity of the float. There was now a vibratory movement throughout the foot, and when it was again thrown back to renew the process the globule was found inclosed in its newly-made envelope. From this it results that the membrane inclosing the cells is secreted by the foot, and that there is no attachment between the float and the animal other than that arising from the nice adaptation and adjustment of proximate surfaces. Dr. Coates states that the float varies in different species. In *Janthina fragilis* he describes it as convex, subcarinate above and concave beneath, straight, and composed of large vesicles: in *J. globosa* he found the vesicles smaller, and the float flat both above and beneath, added to which it is formed by the reunion of one of the edges into a spiral and nearly circular disc. In *J. exigua* it was straight, narrow, and flattened, and the vesicles were small. Along the under surface of the float a little line of pearly fibres was remarked, to which are attached the eggs of the animal.

Although Dr. Coates had no opportunity of observing the eggs of *J. fragilis*, he is strongly inclined to believe that the eggs figured and described in 'Phil. Trans.,' as above alluded to, belong to some other marine animal; and he grounds his belief on the dissimilarity between those figures and the eggs of *J. globosa* and *J. exigua*. In these two species the eggs are contained in little membranous bags of some consistence, which are attached in rows to the pearly fibres of the under surface of the float by small filamentous pedicles similar in appearance to the fibres. These bags are covered with minute gelatinous conical eminences, and are partially divided by incomplete septa, as may be seen by the aid of a powerful lens. In *J. exigua*, the division is very partial; but in *J. globosa* it gives to the whole sac a chambered appearance. It would seem that the animal consumed considerable time in depositing its eggs, for the bags nearest to the extremity of the float were constantly found empty, while the central bags contained young shells fully formed: those towards the animal were filled with eggs. The probability is, that the young animals when hatched ascend the float of the mother, and thus gaining access to the surface, construct the elements of their future support.

M. Rang, who also notices Sir Everard's statement, mentions it as certain that *Janthina* deposits its eggs sometimes in considerable number, as he has had occasion to remark, under the float, where they are attached by means of small pedicles; and he goes on to say, that the animal abandons them, together with the float, which is then charged with their preservation. M. Rang adds, that it is possible that, at this epoch, the natatory appendages of the mantle, being sufficiently developed, permit the animal to use them for swimming, and thus supply the loss; or one must suppose that these animals have the faculty of replacing the float. That they have that faculty we have above seen.

Browne, in his 'Natural History of Jamaica,' gives by no means a bad account of the floats of these animals, many of which he encountered between the Bermudas and the Western Islands, in his voyage from Jamaica. He says, "I have observed many of the vesiculæ themselves swimming upon the surface of the water, which induced me to think that they were thrown off as the creatures retired." Sloane also saw these oceanic snails, and figures them.

In January, 1833, Dr. Grant exhibited to a meeting of the Zoological Society of London numerous specimens of *J. vulgaris*, Lam., and of *Velella limbosa*, Lam., both animals of rare occurrence on the English coast, and chiefly met with floating in tropical or warmer seas. They were obtained by him at the beginning of September, 1832, in Whitsand Bay, close to the point of the Land's End, Cornwall, where they were thrown in great numbers on the sands, after a storm of three days' continuance from the north-west: they must, he observed, consequently have been floating before they were directed to the coast by the storm, in latitudes at least as high as that in which they were found. Dr. Grant regards it as probable that neither of these animals is capable of discharging at will the gaseous fluid by which they are supported on the surface of the sea; otherwise, in such a violent and continued tempest as that which stranded them, they would have emptied their vesicles and have sunk to the stiller bottom. ('Zool. Proc.') Browne on the other hand says, speaking of the float, "This raises and sustains it while it pleases to continue on the surface; but when it wants to return, it throws off its bladder and sinks."

Lamarck places *Janthina* among the Plant-Eaters: but in the communication by Dr. Grant above noticed, it is suggested that *Janthina*, a predaceous Gastropod accompanying *Velella*, as there described, may prey upon it, and acquire from it the blue colouring matter of its shell.

Several authors speak of the beautiful purple liquor which the living animal diffuses when it is touched.

J. fragilis, Common Oceanic Snail, has the shell pale; body whorl angulated; the base flattened, striated, and deep violet; aperture broader than long; outer lip deeply emarginate. (Swainson.)

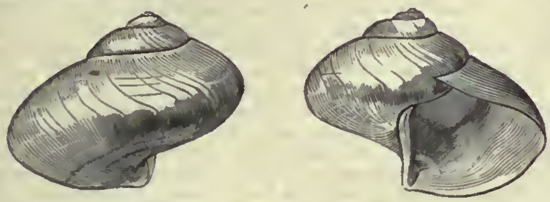
It occurs in warm and temperate climates; several instances are recorded of its capture on and near the British Islands.

J. exigua has been found on the English and Irish coasts.

J. pallida is a species nearly allied to *J. globosa*. This species is very rare, and has been obtained only twice from the coast of Ireland.

Mr. Swainson, who, in his 'Zoological Illustrations,' has given beautifully correct figures of *J. fragilis* and *J. globosa*, justly remarks that the shells are so brittle that it is rare to find them perfect.

M. De Blainville is inclined to think that those shells which are notched belong to females.



Shell of Common Oceanic Snail (*Janthina fragilis*).

Fossil Janthinæ.—Mr. G. B. Sowerby ('Genera') states that he has never seen any fossil species of this genus, nor is he aware that any exist, but he refers to a fossil engraved in 'Min. Con.,' pl. 10, which bears a very near resemblance to it. The fossil is named, in the valuable work alluded to, *Helix carinata*, and the solid gray limestone near Settle in Yorkshire is said to be the locality..

JASIONE, a genus of Plants belonging to the natural order *Campanulaceæ*. It has a 5-leaved rotate calyx, anthers cohering at the base, a hairy trifid style, 2-celled capsules, opening by a large and somewhat valvular pore at the base. There is but one British species of this genus—

J. montana, Sheep's Scabious, has a simple root, bluntish oblong wavy leaves, and stalked flowers. The stems are from 6 inches to 2 feet long, pilose, simple, or branched, leafy below, bare and glabrous above, and ascend from the crown of the root. The flowers are small, in terminal bracteated heads, having a light blue corolla.

(Babington, *Manual of British Botany.*)

JASMINA'CEÆ, *Jasminworts*, a natural order of Monopetalous Exogens, deriving its name from the *Jasminum*, which forms one of its genera. It is one of the very few orders of that class with regular diandrous flowers, and is only to be mistaken for *Oleaceæ*, which have a valvate corolla, and which otherwise are scarcely different. Only five genera of this order have yet been discovered, the principal being *Jasminum* itself, which consists of a large number of species, sometimes fragrant, sometimes scentless, erect or twining, inhabiting the hot or temperate regions of Europe, Africa, and Asia, including Australia, but hardly known in America. The order is characterised by having opposite or alternate, simple or compound exstipulate leaves; monopetalous flowers, the segments of whose corolla are imbricated, and seldom correspond with those of the calyx; two stamens, and a superior 2-celled few-seeded ovary. The species, about 100 in number, are chiefly valued for their fragrance; a few species have been regarded as bitter and astringent. [JASMINUM.]

Common Jasmine (*Jasminum officinale*).

1, a longitudinal section of the corolla; 2, a longitudinal section of the ovary and calyx.

JASMINUM, a genus of Plants belonging to the natural order *Jasminaceæ*. It has a tubular 5- or 8-cleft calyx; a 5- or 8-parted corolla; stigma 2-lobed or bifid; berry didymous, having one of the lobes usually abortive; seeds without albumen. The species are usually twining shrubs. Leaves simple or compound; petioles articulated; flowers white or yellow.

J. Sambac, Single-Flowered Arabian Jasmine, is a twining plant; the leaves almost sessile, membranous, from cordate to oblong, acute or obtuse, glabrous; berries globular; branches, petioles, and peduncles downy. It is a native of the East Indies. The flowers generally form small trichotomous umbellets, white and fragrant. The berries are black. A perfume, known as Oil of Jasmine, is obtained from this species.

J. angustifolium, Narrow-Leaved Jasmine, is a native of the Coromandel coast. It is a twining bright plant, with ovate or oblong leaves, smooth, of a shining deep-green colour. The flowers are large, white, with a faint tinge of red, star-shaped, having a peculiar but very pleasing fragrance. The bitter root of this species, ground small and mixed with powdered *Acorus Calamus* root, is considered in India as a valuable external application in cases of ringworm. The plant being constantly covered with leaves of a bright deep-green, sometimes as small as those of Box, render it always beautiful and well adapted for screening windows and covering arbours in warm climates.

J. officinale, Common Jasmine, is a native of the South of Europe. It has opposite leaves, pinnate; leaflets ovate-accuminate; buds erectish. The plant is glabrous, the branches angular. Calycine segments 5, subulate; corolla white, 4- or 5-cleft, sweet-scented; the terminal leaflet is the longest. The Common Jasmine has been a favourite wall-shrub from time immemorial. Its native country, as well as the date of its introduction, are unknown. Gerarde in 1597 says it was in common use for covering arbours. There are golden and silver-edged leaved varieties of the Common Jasmine, as well as a double flowered variety.

J. grandiflorum has opposite pinnate leaves, leaflets bluntish, the outer ones 3- to 5-confluent, buds horizontal. It is a native of the East Indies, and greatly resembles *J. officinale*, except in the size of the leaflets and in the exterior ones being confluent and the flowers larger and reddish underneath. Both this and the former species yield the true essential oil of jasmine of the shops.

The leaves of *J. undulatum* are slightly bitter. The root of *J. pubescens* is thought to be elexiteric.

(Lindley, *Vegetable Kingdom.*)

JASPER. [QUARTZ.]

JASSA, a genus of Amphipodous *Crustacea*, established by Dr. Leach.

The general characters resemble those of *Corophium*, Latr.; but differ from them as well as from those of *Podocerus*, Leach, in the considerable size of the bands of the first four feet, which are oval; those of the second pair being the greatest, and armed with teeth more or less numerous on the internal border. Eyes not projecting.

Dr. Leach records two species, one, *Jassa pulchella*, from the south coast of Cornwall, where it was found in the midst of sea-weed; the other, *Jassa Pelagica*, found near the Bell Rock, Scotland.

JATROPHA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has monœcious flowers; a 5-parted or lobed calyx; corolla 5-parted or absent; stamens 8 or 10, with unequal monadelphous filaments; styles 2, bifid or dichotomous; capsule 3-coccous.

J. Curcas, Physic-Nut, is a very common small tree, or bush, on the coast of Coromandel. The bark is smooth and light ash-coloured; leaves scattered, stalked, broad, cordate, 5-angled, smooth, about 6 inches each way; petioles round, smooth, 4 to 6 inches long; stipules absent; panicles terminal or from the exterior axils cymose, bearing many small yellow flowers. The male flowers at the extremities of the ramifications on short articulated pedicels, and the female ones in their divisions with their pedicels not articulated. Bracts, a small one below each subdivision of the panicle, and generally one pressing on the calyx; calyx 5-leaved; corolla 5-petaled, campanulate, somewhat hairy; disc of 5 glandular bodies round the base of the filaments; filaments 6, the central one very thick, columnar, the 5 exterior ones filiform towards the base, adhering to the central one, all erect, and a little longer than the calyx; anthers 10, sagittate, equal: 5 supported by the large general filament, and 1 by each of the others. The leaves are rubefacient and discutient; warmed and rubbed with castor-oil, they are applied by the natives of India as poultices. The seeds are violently emetic and drastic; their expressed oil is reckoned a good application in itch and herpes, and also, a little diluted, in rheumatism. The milky juice is considered detergent and healing; it dyes linen black. The oil boiled with oxide of iron forms a varnish used by the Chinese for covering boxes. In large doses the seeds are energetic poisons.

J. glauca is found in Arabia Felix. It has leaves from 3-5-lobed, mucronate, serrate, toothed; petioles naked; stipules palmate, with setaceous branched divisions, glandular at the apex. The seeds yield a stimulating oil recommended by the Hindoos as an external application in cases of rheumatic and paralytic affections.

J. glandulifera is a native of the East Indies. The leaves about the extremities of the branchlets are alternate, petioled, and generally palmate; the lobes from 3 to 5, oblong, serrate, with each serrature ending in a short green glandular-beaded bristle; stipules bristly, many-cleft, each division ending in a glandular head; panicles terminal, about as long as the leaves. Male flowers most numerous and terminal, small, of a pale yellowish-green colour. The female flowers few, and subsessile in the divisions of the panicle. The pale or whey-coloured thin juice which exudes from a fresh wound is employed by the Hindoos as an escharotic to remove films from the eyes.

J. multifida is a native of tropical America. It has palmate 11-lobed smooth leaves, the segments wedge-shaped and pinnatifid; stipules setaceous, multifid; flowers corymbose, scarlet, with coloured pedicels. The seeds are one of the best of all emetics and purgatives, acting briskly, but without inconvenience: their effects are readily stayed by the administration of a glass of good white wine.

J. Manihot is now referred to the genus *Janipha*. [JANIPHA.]

(Lindley, *Flora Medica.*)

JAVELIN-SNAKE. [MELEAGRIS.]

JAY. [CORVIDÆ.]

JEFFERSONITE, a Mineral belonging to the varieties of *Augite*. [AUGITE.]

JEFFREYSIA, a genus of *Mollusca* belonging to the family *Littorinidæ*, established by Mr. Alder, and named after Mr. Jeffreys of Swansea. The species were originally referred to *Rissoa*. Forbes and Hanley give two species, *J. diaphana* and *J. opalina*, as inhabiting British seas.

JEJUNUM. [INTESTINES.]

JELLY. [FOOD.]

JERBOA. [MURIDÆ.]

JER-FALCON, or GYR-FALCON, the English name of the *Falco Islandicus* of Latham, Gerfaut of the French, Hebog Chwyldro of the Welsh. [FALCONIDÆ.]

JERICHO, ROSE OF, a name applied to the *Anastatica*, a genus of Plants belonging to the natural order *Cruciferæ*. This genus has the following characters:—Silicle ventricose, with the valves bearing each an appendage on the outside at the end; petals obovate. There is but one species—

A. Hierochuntina, the Rose of Jericho, or Holy Rose. The whole plant is small, the stem branched, dichotomous; the leaves oblong or ovate, narrowed at the base into the petiole; the pods somewhat pubescent. The leaves fall off from the plant after flowering, and the branches and branchlets become dry, hard, and ligneous, and rise upwards and bend inwards at their points; hence they become contracted into a globular form, and in this state the plant is with facility removed from the sand by the wind, and blown from the desert places where it grows into the sea. When the plant is immersed in water the branches gradually expand, and the pods open and let out the seeds, which are again thrown on the shore by the tide. This plant long preserves the power of expansion when immersed in water, hence many wonderful stories are told of its influence. It is called Kaf Maryan, or Mary's Flower, in Palestine, where it is believed that this plant opened at the time of the birth of our Saviour. It is a native of the arid wastes in Egypt near Cairo, also of Palestine and Barbary. It grows on the roofs of houses and on rubbish in Syria, and on the sandy coasts of the Red Sea.

(Don, *Dichlamydeous Plants.*)

JET, a variety of Coal, which occurs sometimes in elongated reniform masses, and sometimes in the form of branches, with a woody structure; fracture conchoidal; soft and brittle; specific gravity but little greater than that of water; lustre brilliant and resinous; colour velvet black; opaque. It is found in Saxony, and also in the Prussian amber-mines, in detached fragments. The finer sorts are used for the manufacture of ornaments and trinkets, and the coarser kinds as fuel; it burns with a greenish flame and a strong bituminous smell, and leaves a yellowish ash. [COAL.]

JOHANNITE. [URANIUM.]

JOHNSTONITE. [LEAD.]

JOINT-FIRS. [GNETACEÆ.]

JONE'SIA, a genus of Plants of the tribe *Cassieæ*, and of the natural family of *Leguminosæ*, which was named by Dr. Roxburgh in honour of Sir William Jones, who, in the midst of his numerous other avocations, found time to pay attention to Indian plants. The species are few in number, and indigenous in the islands of the Malayan Archipelago, as well as on the eastern frontier of Bengal, that is, in Silhet and lower Asam. They form trees which are highly ornamental from their handsome shining abruptly-pinnate leaves, and from the showy nature of their crowded racemes of flowers.

J. Asoca, the best known species, is often referred to by Hindoo poets by the name which has been adopted by botanists to distinguish it as a species. Dr. Roxburgh says, and we can in a great measure coincide with him in opinion, "When this tree is in full blossom, I do not think the whole vegetable kingdom affords a more beautiful object." ('Flora Indica,' ii. p. 220.)

JUDAS-TREE. [CERCIS.]

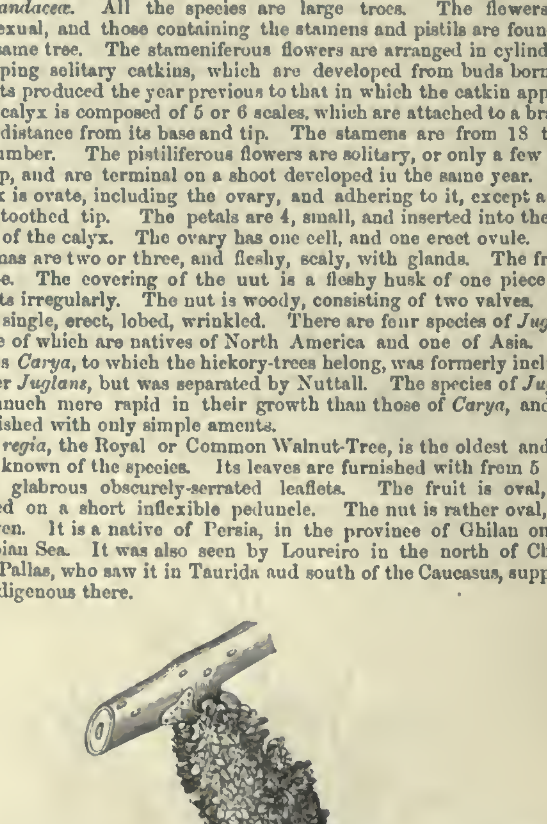
JUDCOCK. [SCOLOPACIDÆ.]

JUGLANDA'CEÆ, *Juglands*, are a natural order of Apetalous Exogenous Plants, consisting of trees or shrubs having eatable nuts and somewhat resinous leaves. The former are the walnuts and hickory nuts of the markets; the first produced by the genus *Juglans*, the latter by that called *Carya*. The leaves are alternate and pinnated; the flowers usually monœcious, those which are male collected in catkins. The calyx of the latter consists of a few scales attached obliquely to a single bract, and surrounding a variable number of stamens; that of the females is superior. The ovary is 1-celled, and has one solitary erect ovule, which changes into a 4-lobed seed, with crumpled cotyledons, inclosed in a 2-valved nut, clothed with a fleshy epicarp. The Common Walnut (*Juglans regia*), a native of Persia, is well known for its excellent timber, from which musket-stocks (and formerly cabinet-work) are manufactured, for its agreeable wholesome nuts, and the sweet drying oil which they furnish when pressed. *Carya alba*, the White Hickory, bears nuts like those of the walnut, only smaller, smoother, and with a thicker shell, and furnishes a valuable tough elastic white timber much employed in the construction of carriages and other vehicles. Other species of Hickory are also eaten, especially the Pecan Nut, the produce of *Carya olivæformis*, a small and delicate sort. Although the fruit of these plants is eaten, it contains a purgative principle, which renders some of the species cathartic, as is the case with *J. cathartica* and *J. nigra*, two North American species; and even the common walnut participates so much in this quality, when the fruit is young, that a laxative conserve well known in domestic medicine is prepared from it. *J. nigra*, the Black American Walnut, is a tree of remarkable size and beauty.

The species are chiefly found in North America, a few are East Indian, one species a native of Persia and Cashmere, another of Caucasus, and a third of the West India Islands. There are 4 genera and 27 species.

JUGLANS, a genus of Plants belonging to the natural order *Juglandaceæ*. All the species are large trees. The flowers are unisexual, and those containing the stamens and pistils are found on the same tree. The stameniferous flowers are arranged in cylindrical drooping solitary catkins, which are developed from buds borne by shoots produced the year previous to that in which the catkin appears. The calyx is composed of 5 or 6 scales, which are attached to a bractea at a distance from its base and tip. The stamens are from 18 to 36 in number. The pistiliferous flowers are solitary, or only a few in a group, and are terminal on a shoot developed in the same year. The calyx is ovate, including the ovary, and adhering to it, except at the four-toothed tip. The petals are 4, small, and inserted into the free part of the calyx. The ovary has one cell, and one erect ovule. The stigmas are two or three, and fleshy, scaly, with glands. The fruit a drupe. The covering of the nut is a fleshy husk of one piece that bursts irregularly. The nut is woody, consisting of two valves. The seed single, erect, lobed, wrinkled. There are four species of *Juglans*, three of which are natives of North America and one of Asia. The genus *Carya*, to which the hickory-trees belong, was formerly included under *Juglans*, but was separated by Nuttall. The species of *Juglans* are much more rapid in their growth than those of *Carya*, and are furnished with only simple aments.

J. regia, the Royal or Common Walnut-Tree, is the oldest and the best known of the species. Its leaves are furnished with from 5 to 9 oval glabrous obscurely-serrated leaflets. The fruit is oval, and seated on a short inflexible peduncle. The nut is rather oval, and uneven. It is a native of Persia, in the province of Ghilan on the Caspian Sea. It was also seen by Loureiro in the north of China; and Pallas, who saw it in Taurida and south of the Caucasus, supposed it indigenous there.



Royal or Common Walnut-Tree (*Juglans regia*).

1, a catkin of male flowers; 2, a single male flower; 3, a cluster of female flowers.

The Walnut-Tree was known to the Greeks under the name of Persicon, Basilicon, and Caryon. It is uncertain at what time it was first cultivated in Europe, but it was cultivated by the Romans before the death of the emperor Tiberius. Its wood was much valued by the Romans, and the nuts were also eaten. There is no history of the introduction of this tree into Great Britain, but it is now very commonly cultivated in this country, although it fails to propagate itself by its seeds. It is only however in the southern and middle parts of England that the walnut brings its fruit to perfection.

The walnut, when full-grown, is a large handsome tree with strong spreading branches. Its trunk is thick and massive, and covered with a deeply furrowed bark; the branches are of a gray colour, and smooth. The leaves, when bruised, give out a very peculiar aromatic odour, and in the heat of summer this scent is sometimes so powerful as to produce unpleasant effects on persons who approach these trees. The foliage is graceful and light, and of a bright yellowish-green colour, which contrasts well with trees having foliage of a darker shade. Its leaves are almost the latest to appear, and the first to fall. It grows very rapidly and vigorously in the climate of London, and trees will attain a height of 20 feet in ten years. It sends down into the earth a large tap-root, with numerous branches, and, on account of the size and strength of the roots, there is no tree more able to resist the effects of wind, or better adapted for exposed situations. It is said that plants will not grow under its shade; this probably arises from the bitter properties of its leaves: when they are not allowed to accumulate, the shade of the walnut does not appear more injurious than that of other trees.

The uses of the walnut are very various. Before the introduction of mahogany and other woods, the wood of the walnut was held in higher estimation than that of any other European tree. It is on this account that it was so extensively cultivated in this country and on the continent three or four centuries since. The timber of the walnut is light, a cubic foot weighing when green 58¼ lbs., and when dried scarcely 47 lbs. When the tree is young, the wood is white, and in this state very much subject to be worm-eaten; but as the tree grows older, the wood becomes more compact, and is of a brown colour, veined and shaded with brown and black. In France and Germany it is still much used by turners, cabinet-makers, joiners, coachmakers, and musical-instrument makers, who prefer the wood which has grown on poor hilly soils. The wood of the roots is the most beautifully veined. One of the most important uses of walnut-timber is the making of gun-stocks. For this purpose it is well adapted on account of its strong lateral adhesion, its lightness, and its not being liable to splitting or warping in the working. The demand for walnut-wood for this purpose was immense during the last war on the continent, and it was stated in 1806 that France required 12,000 trees annually for the making of guns. The government of France still maintains large plantations of walnut-trees for supplying her army with gun-stocks. In England the walnut has seldom been used except for the higher-priced fire-arms, but such was the demand for it for that purpose at the beginning of the present century, that single walnut-trees were sold for as much as 600*l.* This led to the importation of walnut-timber from the Black Sea, and also of the timber of the black walnut from America, so that the cultivation of the tree as timber is almost at an end in England.

The walnut is of more value at the present day on account of its fruit than of its timber. In almost every stage of its growth the fruit of the walnut is used for the table. When young, green, and tender, it is pickled and preserved with the husks on. About the end of June they may be preserved with or without their husks. "The green and tender nuts," says Gerarde, "boyled in sugar and eaten as suckade, are a most pleasant and delectable meat, comfort the stomach, and expell poyson." When they are about half ripe, a liqueur is distilled from them, which is considered to possess medicinal properties. In August, before they are quite ripe, the French eat them in what they call 'cerneaux,' scooping out the kernel with a knife, and eating it with vinegar, salt, pepper, and shallots. When the nuts are fully ripe, which is generally at the end of September or the beginning of October, the kernel, deprived of its investing skin, is eaten in great quantities. As long as the skin can be easily removed they are a nutritious and healthy article of diet; but when they get dry, so that their skins stick to them, they become indigestible. In no part of England do they constitute an important article of diet, but in many parts of France, Spain, Germany, and Italy, people live during the season of their ripening almost entirely on walnuts. A great number of the walnuts consumed in England are of foreign growth. In 1831 there were imported from France and Spain 23,578 bushels, which then paid a duty of 2*s.* per bushel. As they are now free of duty, the importation is not registered. On account of the large consumption of the fruit, both as an article of diet at home and for exportation, the walnut-tree is still largely cultivated on many parts of the continent. The district of the Bergstrasse on the Rhine, between Heidelberg and Darmstadt, is almost entirely planted with walnut-trees. Evelyn states that such is the importance attached to the growth of this tree, that "in several places between Hanau and Frankfort in Germany, no young farmer is permitted to marry a wife till he brings proof that he is a father of a stated number of walnut-trees; and the law is inviolably observed to this day for the extraordinary benefit which this tree affords the inhabitants." The fruit of the walnut is commonly gathered by thrashing the tree with a long pole. By many this process is thought to be beneficial to the tree, and barren walnut-trees are often thrashed to make them bear. But although barren trees may be made to bear by reducing the excessive growth of their shoots by breaking them off, it is no proof that the same process is good for healthy-bearing trees. The natural process of separating the fruit from the tree is undoubtedly the best, and gently shaking the branches till the fruit falls has been recommended by many walnut-growers as much preferable to thrashing. The nuts should be gathered at the time they easily fall out from the husk, and then exposed to dry for a day or two in the sun. The best mode of keeping the nuts fresh for eating is to bury them in dry soil or sand, so deep as not to be reached by frost or the heat of the sun, or by rain: or they may be placed in dry cellars, and covered with straw. "When the nut is to be preserved through the winter for the purpose of planting in the following spring, it should be laid in a rot-heap as soon as gathered, with the husk on; and the heap should be turned over frequently in the course of the winter." (Loudon.)

The albumen which constitutes the bulk of the seed of the walnut contains an oil, which is used in large quantities, especially on the Continent. It is obtained by reducing the seeds to a pulp by means of a stone wheel and basin, and then expressing the oil, first without heat and then by the application of heat. The oil requires great care in keeping, as it becomes tainted by slight changes in the state of the atmosphere. That which is cold-drawn keeps best, and is alone used for the purposes of diet. It has however always the taste of the walnut, which is to some persons disagreeable. The oil obtained by heat is used by artists, and also for lamps. Artists use this oil in mixing white, or any delicate colour; and they prefer it on account of the rapidity with which it dries. In copper-plate printing also, in Paris, walnut-oil is considered indispensably necessary in order to obtain a fine impression, whether in black or in colours. For this purpose the oil is prepared in various ways, according to the several colours with which it is to be mixed. In all cases it is reduced in bulk by boiling or by setting fire to it, so as to reduce it to the required consistency. One bushel of nuts, it is said, will yield about 7 lbs. of this oil. The mass which is left after the oil is expressed is made into cakes, and used as food for swine, sheep, and poultry, and in some places it is made into candles, which give a tolerably good flame.

The husks and root of the walnut both yield a dye, which is much used by gipsies and theatrical performers for staining the skin brown. It is also used by cabinet-makers and joiners to stain white and yellow woods of a dark-brown or black colour, like that of the walnut. In the preparation of the dye from the husks they should be allowed to rot, and then boiled in water, adding to the decoction fresh water, according to the colour required to be produced by the solution. The sap of the walnut-tree contains a large quantity of saccharine matter; and in some countries the trees are tapped for the purpose of obtaining the sap, which by evaporation is converted into sugar. It is also in many parts of Europe and Asia fermented and made into wine, and a spirit is also distilled from it. The leaves of the walnut, as well as other parts of the tree, contain a large proportion of alkali in them; and in some parts of France they are collected and burned for the sake of the potash contained in the ashes.

The bark of the leaves, the husks, and the oil of the walnut have all been used in medicine, and had at one time a great reputation. All parts of the plant, excepting the albumen of the seed, possess a bitter principle, which acts as a tonic and an anthelmintic, and has been its great recommendation as a medicine. Cowley, in his 'Plants,' sums up the virtues of the walnut in the following lines:—

"On barren scalps she makes fresh honours grow.
Her timber is for various uses good:
The carver she supplies with useful wood.
She makes the painter's fading colours last.
A table she affords us, and repast.
E'en while we feast, her oil our lamp supplies.
The rankest poison by her virtues dies;
The mad dog's foam and taint of raging skies.
The Pontic king, who lived where poisons grew,
Skilful in antidotes, her virtues knew."

Anglers employ an infusion of the leaves or husks for pouring upon the earth, in order to procure worms, which it speedily brings to the surface.

There are several distinct varieties of the walnut cultivated. The *J. maxima* is known by the large size of its nuts, and is called the Double Large French. The nuts are twice the size of any other; but in drying the kernels shrink to half their size, so that they ought to be eaten as soon as they are gathered. This is a fine handsome tree with large leaves, but its timber is not so durable as that of the Common Walnut.

J. r. tenera, the Thin-Shelled or Titmouse Walnut, has very thin shells, so much so that birds of the titmouse family pierce them with their bills, and eat the kernel. The fruit of this variety is considered the best for eating, and it also yields the largest quantity of oil.

J. r. serotina, the Late-Leaved Walnut, is a very desirable variety in districts where the frosts are severe in spring. Its leaves do not appear before the end of June, and it ripens its fruit as early as the other varieties. There is a variety known in Norfolk and Suffolk by the name of the Highflier, which is said to yield the best nuts of any of the English varieties. Several other varieties are enumerated in continental lists; and in the 'Fruit Catalogue of the Horticultural Society for 1832,' nine varieties were recorded as growing in the gardens of the Society.

J. nigra, the Black Walnut-Tree, has leaves with from 13 to 17 leaflets, which are unequal at the base, serrated, and somewhat downy. The fruit is globose, roughish, with minute prominent points, situated upon a short inflexible peduncle. The nut is globose, somewhat compressed at the sides, ridged, and furrowed. This is a North American tree, and is found in all parts of the United States, as far as 40° 50′ N. lat. It is abundant in the forests about Philadelphia, and is met with from Goshen to the banks of the Mississippi, throughout an extent of 2000 miles. It is one of the first trees that was introduced from America to Europe, having been brought to England by the younger Tradescant in 1656. The Black Walnut is a rapid-growing tree, and attains a height of 50 or 60 feet in about forty years. It bears fruit in this country, but it is very much inferior to that of the European walnut. The wood of this tree is used almost for the same purposes as that of the last. It is heavier, stronger, susceptible of a finer polish than the European species, and is not so liable to be attacked by worms.

J. cinerea, the Gray Walnut or Butternut-Tree, has 15 to 17 leaflets, rounded at the base, serrate, and tomentose beneath; the petiole villous; the fruit oblong-ovate with a taper tip, downy, and covered with small transparent vesicles containing a viscid matter. The nut is oval with very prominent irregular ridges. This tree is from North America. It is found in Upper and Lower Canada, and in the temperate regions of the United States. This tree attains in its native regions a height of about 50 or 60 feet. Although it was introduced into this country about the same time as the last species, there are very few large specimens at the present time. The kernel of the nuts is thick and oily, and soon becomes rancid, and hence probably the names of Butter-Nut and Oil-Nut. The wood is used in the districts where it grows for the same purposes as the last. Its bark possesses considerable medicinal powers, and is used in the United States as a purgative and as an application in toothache. Its leaves also are so acrid that they are employed, when powdered, as a substitute for cantharides.

All the species of walnuts are best propagated by the nut, which, when the tree is intended for ornament or timber, should be sown in the place where it is wished it should remain, as the large tap-root of these trees is likely to be injured by removing them, although with great care they may be successfully transplanted. When trees are planted for the sake of their fruit they are mostly increased by budding, grafting, and sometimes by layering. "The most approved and successful mode of budding, and which is the one chiefly adopted on the continent, is that called the 'flute' method; in performing which an entire ring of bark, containing one or more buds, is exactly fitted to the upper extremity of the stock, which is also denuded of its bark; should the stock be larger than the ring containing the buds the ring requires to be slit up, but if this exceeds the stock, then a small portion requires to be cut out so as to make it fit. Mr. Knight also invariably succeeded in budding the walnut by using the minute buds that are found at the base of the annual shoots of this tree, which, as he says, 'are almost concealed in the bark, and which rarely if ever vegetate, but in the event of the destruction of the large prominent buds which occupy the middle and opposite ends of the annual wood.'" (Selby.) These he inserted on yearly stocks which grew in pots, the vegetation of which had been retarded by exposing them during the spring and early part of the summer in a northern aspect, until the above-mentioned buds were formed on the current year's shoots of the trees intended to be propagated, when the pots containing the young plants were brought into a forcing-house, and there budded. There is no tree that requires less pruning than the walnut, and where large branches are cut off it is almost invariably followed by a decay of the tree at the spot where abscission was performed. The best soil for the walnut is a deep, stiffish, dry-bottomed loam. It will thrive however almost anywhere, provided the soil is free from stagnant moisture. The best fruit is obtained from trees growing on calcareous soils.

Previous to the time of the publication of Nuttall's 'Genera of North American Plants,' the various species of North American trees called Hickory were regarded as species of the genus *Juglans*. These Nuttall referred to a new genus, *Carya*. [CARYA.] There is another species, formerly referred to *Juglans*, and called *J. fraxinifolia*, that Kunth has made into a genus called *Pterocarya*. It differs from *Juglans* in its fruit having two wings, and in the embryo not being accompanied by albumen. It is a native of moist woods at the foot of the Caucasus, and hence called *P. Caucasica*. It is a small tree with an ample bushy head, attaining a height of 30 or 40 feet. Its leaves are alternate, very large, commonly having 19 leaflets, which are oblong, denticulate, with blunt teeth. Each of the leaflets has one of the sides shorter than the other. It has not been much planted in Great Britain, but is well adapted for small gardens and arboretums as an example of the natural order *Juglandaceæ*.

(Loudon, *Arb. et Frut. Brit.*; Selby, *British Forest-Trees*; Burnett, *Outlines of Botany*; Michaux, *North American Sylva*; *Encyclopædia of Gardening*.)

JUGULAR VEINS, the large venous trunks by which the greater part of the blood is returned to the heart after having circulated in the head, face, and neck. There are two on each side, an external or superficial, and an internal or deep. The external jugular lies on each side just under the skin, and extends from near the angle of the jaw to the middle of the clavicle, behind which it opens into the subclavian vein. It conveys the blood of the confluent streams from the jaws, temples, and front and sides of the neck, and of some of those from the face. The internal jugular, which is far larger than the external, lies deep in the neck, by the side of the carotid artery. It receives all the blood from the skull and the brain, from the eyes and ears, and from the scalp, face, tongue, palate, pharynx, &c. The internal jugular veins extend from the base of the skull just in front of the vertebral column, down the neck, to some depth behind the clavicles, where they unite with the subclavian veins, by which all the blood is brought from the arms and upper part of the chest and neck to form the venæ innominatæ, which by their union form the vena cava superior, which opens directly into the right auricle of the heart. [HEART.]

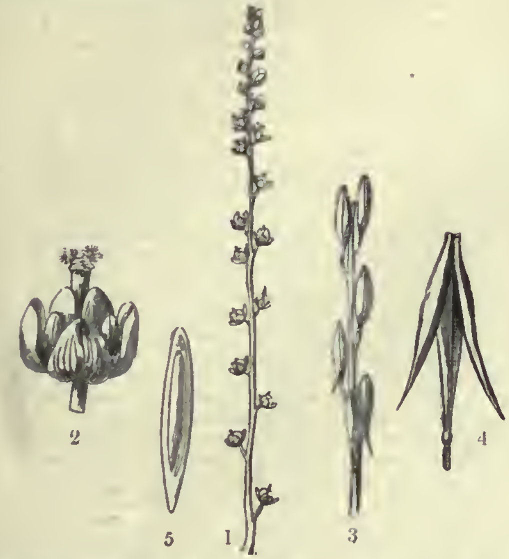
JULIS, a genus of Fishes belonging to the family *Labridæ*. The head is smooth; cheeks and gill-covers without scales, the lateral line bent suddenly downwards when opposite the end of the dorsal fins. In other respects this genus resembles *Labrus*. [LABRIDÆ.] An example of a very beautiful species of this genus, known under the name of the Rainbow-Wrasse, was described by Donovan as taken off the coast of Cornwall. It is the *J. Mediterranea* of Risso, the *J. vulgaris* of Fleming and Cuvier. This fish is most remarkable for its varied colours. Its back is greenish-blue; the longitudinal band is orange; beneath that are lilac-coloured bands on a silvery ground; the head is varied with brown, yellow, blue, and silver; the dorsal fin orange, with a purple spot on the membrane connecting the three spinous rays. (Yarrell, *British Fishes*.)

JUNCA'CEÆ, *Rushes*, a small natural order of Endogenous Plants, so named from *Juncus*, the Rush, which is considered its type. It is principally composed of obscure herbaceous plants, with brown or green glumaceous hexandrous flowers, and would perhaps be with more propriety considered a section of *Liliaceæ* than a separate order. It forms one of the transitions from complete Endogens to the imperfect glumaceous form of that class. The species are chiefly found in the colder parts of the world, some even in the coldest; two existing in the ungenial climate of Melville Island. Some however are known in the tropics. Eight are mentioned as inhabiting the tropical parts of Australia. They are only employed for mechanical purposes, as the rush and others. There are 13 genera and 200 species. [RUSHES, in ARTS AND SC. DIV.]

Juncus articulatus.

1, a flower spread open; 2, a capsule; 3, a seed cut through its longer axis, showing the embryo.

JUNCAGINA'CEÆ, *Arrow-Grasses*, a small and unimportant order of Endogenous Plants, consisting of marsh plants with thin minute scaly flowers formed of 3 sepals, 3 petals, and as many stamens, which are opposite them. Their ovaries are 3 or 6 in number, contain each one or two ascending ovules, and when ripe form a dry fruit. The embryo has a lateral slit for the emission of the plumule, on which account they are regarded as allied to *Araceæ*. The genus *Scheuchzeria* is a transition from Arrow-Grasses to Rushes. *Triglochin* is the commonest genus of the order, and inhabits the fresh or salt marshes of most parts of Europe. Marshy places in most parts of the world may be expected to indicate traces of this order, which is found in Europe, Asia, North America, the Cape of Good Hope, and equinoctial America.



1, *Triglochin palustre*; 2, a flower magnified; 3, a spike of ripe fruit; 4, a ripe capsule; 5, a section of one of the cells of the capsule, with the seed inclosed in it.

Potamogeton occurs in ditches and swamps as far north as Iceland. The root of *Potamogeton natans* is said to be eaten in Siberia; the foliage of others is regarded as a styptic. There are 7 genera and 44 species.

JUNCALES. [Endogens.]

JUNCUS, a genus of Plants belonging to the natural order *Juncaceæ*. This genus is distinguished by its inferior perianth, composed of 6 glumaceous leaves; its 3-celled 3-valved capsules, the seed-bearing dissepiments of the valves being in their middle. The species are numerous, and are found mostly in moist boggy situatious in the colder parts of the world: several are however inhabitants of tropical regions.

J. effusus, the Soft Rush, and *J. conglomeratus*, the Common Rush, are used in many parts of the country for plaiting into mats, chair-bottoms, and for constructing small toy-baskets. The wicks also of the candles known as rush-candles are made from the pith, or more properly speaking the soft inner portion of the stem of the same species, which is chiefly composed of cellular tissue. The species is cultivated in Japan like rice entirely for making floor-mats.

Rushes of various kinds form frequently very troublesome weeds in agriculture. They grow best on rich land that is wet and cold. They may be destroyed by covering them over with dry materials of various kinds, as ashes, lime, aud drift from roads; but the best mode of getting rid of them is to fork them up by the roots in the summer, and after letting them lie for a fortnight or three weeks to dry to burn them. This however will be found only a temporary mode of getting rid of them unless the ground on which they grow is well drained.

JUNGERMANNIA'CEÆ, *Scale Mosses*, a rather extensive natural order of Cryptogamic Plants, or Acrogens, resembling mosses in appearance, but very distinct from them in many points of structure. Their foliage is much more cellular; their seed-vessel, or theca, splits into four valves, has no operculum, and instead of a central column has a number of tubes, each furnished internally with a double elastic spiral thread, and called an elater, to which the spores stick, and by the aid of which they are supposed to be dispersed. The species inhabit the trunks of trees, damp earth, or even the young shoots and leaves of other plants in hot moist climates. Some have the stem and leaf formed into a frond, or thallus, resembling that of a lichen, but more commonly the species have leaves with stipules at their base. A large number of genera has of late been formed out of the old genus *Jungermannia*, but the opinions of botanists are much divided as to the value of these new divisions; and they have not been generally adopted. Hooker's 'Monograph of the British Jungermanniæ' gives a valuable account of the species inhabiting these islands. A more recent account of the whole European genus is to be found in Nees von Esenbeck's 'Naturgeschichte der Europäischen Lebermoose,' 2 vols., 8vo., with plates.

The following is a synopsis of the genera:—

Sub-order *Jungermanneæ*.

Metzgeridæ.
Metzgeria.
Aneuridæ.
Trichostylium.
Aneura.
Haplolaenidæ.
Blasia.
Symphyogyna.
Pellia.
Diplomitridæ.
Hollia.
Codonidæ.
Fossombronia.
Jubulidæ.
Lejeunia.
Phragmicoma,
Frullania.
Physananthus.
Ptychanthus.
Madotheca.
Radula.
Ptilidæ.
Ptilidium.
Trichocolla.
Mastigophoridæ.
Sendtnera.
Schisma.
Trichomanidæ.
Physiotium.
Herpetium.
Lepidozia.
Mastigobryum.
Calypogeia.
Geocalycidæ.
Gongylanthus.
Geocalyx.
Saccogyna.
Jungermannidæ.
Gymnoscyphus.
Cheiloscyphus.
Harpanthus.
Gymnanthe.
Lophocolea.
Jungermannia.
Plagiochila.
Gymnomitridæ.
Alicularia.
Acrobolbos.
Sarcoscyphus.
Gymnomitrium.
Haplomitrium.

Sub-order *Anthoceroteæ*.

Anthoceros.
Cladobryum.
Monoclea.

Jungermannia nemorosa, highly magnified.

1, a branch in fruit; 2, a leaf, with sori upon it; 3, the contents of those sori; 4, the calyptra, before it is burst by the theca; 5, abortive thecæ, in a very young state; 6, elaters.

JUNIPER. [Juniperus.]

JUNI'PERUS, a genus of hardy evergreen woody Plants, belonging to the natural order *Coniferæ*. Its distinctive character consists in its female fructification being succulent, consolidated, and reduced in the number of its parts below what is usual in the order to which the genus belongs. Like other *Coniferæ*, its fruit is composed of scales representing carpels spread open, and collected in a spiral manner round a common axis. But they are not more than six in number, generally three, and when ripe are fleshy, and consolidated into a body resembling a drupe. In the language of the Pharmacopœia they are berries, in that of botanists they are termed *Galbuli*.

About 20 species are known, the most important of which are the following:—

J. communis, the Common Juniper. This is a common bush, with long narrow sharp-pointed leaves, which are coucave and glaucous on the upper side, but convex and green on their under, and with blackish fruit. It grows wild iu all the northern parts of Europe, and, as is said, in North America also and the north of India, but it is doubtful whether the plants called Juniper by travellers in the Himalaya Moutains are not some other species. Occasionally the Juniper becomes a small tree. The fruit is used in considerable quantities in the preparation of gin, and in medicine as a powerful diuretic; a kind of beer called genévrette is also obtained in some parts of France by fermenting it with barley. The words 'gin' aud 'Geneva' are derived from the French uame of this species, Genevre. Oil of Juniper, obtained from the *Galbuli*, is said to be a useful diuretic.

J. Sabina, the Savin. This species is readily known from the last by its leaves being small, scale-like, and pressed close to the stem, besides which, its fruit is a light bluish-green. It forms a compact gloomy-looking bush, in some cases spreading near the ground, in others acquiring the stature of a low tree. It is found wild in the middle of Europe and the west of Asia, inhabiting the most sterile soil, and is frequently met with in this country in shrubberies. Like the common Juniper, it is a diuretic aud uterine stimulant. For this purpose it is ofteu used criminally, but whilst it often destroys life it seldom accomplishes the object for which it is taken. Oil of Savin is a local irritant, producing blisters when applied to the skin; taken iuternally it is drastic and emetic.

J. Virginiana, the Red Cedar. Notwithstanding its popular name this is not generally the plant that yields the cedar wood used by cabinet-makers and pencil-manufacturers, the Bermuda cedar being principally so employed; its timber however is of great excellence and durability. It is a native of North America, from Cedar Island in Lake Champlain as far as the southern side of the Gulf of Mexico, chiefly preferring the vicinity of the sea. In general it is a large bush; but in favourable situations, and in such a climate as that of Virginia aud Carolina, it becomes a tree 40 feet high. The branches of this species are erect, the leaves arranged in threes, small, scale-like, and but little spreading; the fruit is deep blue, covered with a mealy resinous powder. A great many fine plants occur in this country; it is not however with us an object of any importance to the forester, except for the sake of variety.

J. Bermudiana, the Bermuda Red Cedar. Very little known in Great Britain, in consequence of its not bearing the climate without protection. It is a native of the Bermudas, where it becomes a large tree, with a soft fragrant wood, the value of which is well knowu from its use in cabinet-work and the manufacture of pencils. It has, when young, long narrow spreading leaves growing in threes, but on the branches of old trees they become shorter, are placed in fours, and thus give the shoots a four-cornered appearauce.

Of the other Junipers, *J. excelsa* aud *J. Chinensis* are handsome hardy trees; *J. Lusitanica*, the Goa Cedar, is also of great beauty, because of its drooping habit and light gray branches, but it will not live loug in Euglaud except in the warmest of the southeru couuties; and *J. Phœnicea* is a handsome bush: the others are of little moment.

JUNKERITE. [IRON.]

JURA KALK, the German equivaleut of the Oolitic system of England.

JURGON. [ZIRCONIA.]

JUSTI'CIA, a genus of Exogenous Plants belonging to the natural order *Acanthaceæ*. The species of this genus inhabit all the tropical parts of the world, preferring however damp woods to dry and open plaius. It is especially in the forests of Brazil and India that they occur. Many of them are never woody, some are bushes or small trees, and a small number are valued by gardeners as objects of ornament. As limited by Linnæus, the genus compreheuded a very discordant collection of species; modern writers have accordingly broken it up into many new genera. As now limited, *Justicia* itself scarcely coutains a plant of any importauce.

As among the species now removed from *Justicia* to other genera there are some which are useful as medicinal agents, especially in India, it may be as well to mention them here, instead of referring to genera which are not yet generally known. Thus *J. Adhatoda*, celebrated in Sauscrit works by various names, as Vidiumatri, Vasika, &c., has been called *Adhatoda Vasika*, and is chiefly esteemed as a demulceut in coughs. *J. nasuta* is now *Rhinacanthus communis*, and is much employed in Indian medicine, especially for the cure of ringworm and other cutaneous affectious, mixed, according to Dr. Roxburgh, with lime-juice and pepper. It is also one of their remedies for suake-bites, but is no doubt inefficacious for such purposes. *Andrographis* (formerly *Justicia*) *paniculata* is the best known and probably the most valuable of all, as one of its names, Muha-tita, implies Chief, or King of Bitters; it is also very commouly called Kalup-uath, and well known to Europeans in the peninsula of India by the uame of Creyat, or Kreat, and has been prescribed with benefit as a bitter in this country. It forms one of the ingredieuts of the Drogue Amère, which is well known in India, and at one time obtained cousiderable repute as a cure for cholera; but it can be useful ouly as a stimulant and tonic.

K

KÆMPFE'RIA, a small genus of Indian *Scitamineæ*, or *Zingiberaceæ* of some authors, of which the species are indigenous to the Islands of the Archipelago and the southern parts of the continent of India, as Bengal and the districts on its eastern frontier. All are furnished with tuberous roots like the turmeric and ginger plants. The spikes of the flowers are short and rising from the root, in some species before, in others with, and nestled among the leaves; all are highly ornamental, and *K. rotunda*, called by the natives Bhooi Chumpa, or Ground Chumpa, is much cultivated in gardens on account of the beauty and fragrance of its flowers. It was supposed to yield the round Zedoary of the shops, but incorrectly, as Dr. Roxburgh thinks, since he considers his *Curcuma Zedoaria* to be the plant. So *K. Galanga* was, equally incorrectly, long supposed to yield the Galanga of the shops. [GALANGA.] It is a native of the mountainous districts beyond Chittagong, and there called Kumula, and is cultivated by the Mugs; by them it is sold to the people of Bengal, who use it as an ingredient in their betel. The roots possess an agreeable fragrant smell, and a somewhat warm, bitterish, aromatic taste. The Hindoos use them, according to Dr. Roxburgh, not ouly as a perfume, but also medicinally. The roots of *K. angustifolia* are, according to the same authority, used as a medicine for cattle by the people of Bengal.

KAFFIR-BREAD [ENCEPHALARTOS.]

KAHAU. [NASALIS.]

KAIL, or KALE. [CRAMBE.]

KAKATERRA-TREE. [DACRYDIUM.]

KAKOXENE, a Mineral occurring in small crystals, which appear to be 6-sided prisms terminated by pyramids, disposed in radiating tufts. The colour yellow of several shades, and sometimes brownish-red. The lustre silky, sometimes adamantine. Adheres to the tongue, and has an earthy smell.

It occurs in clayey brown iron-stone at Zbirow, in Bohemia. Analysis by Steinman:—

Phosphoric Acid	17·86
Fluoric Acid and Water	25·95
Peroxide of Iron	36·82
Alumina	10·01
Silica	8·90
Lime	0·15
	——99·69

When placed on a hot coal it emits a green phosphoric light, and before the blow-pipe on charcoal decrepitates: with borax forms a deep green-coloured glass, and with soda a blackish mass.

KALE, SEA. [CRAMBE.]

KALI, the name of the Maritime Plant from the ashes of which soda is obtaiued by lixiviation; and from the name of this plant, with the Arabic article *al*, is derived that of a class of substances possessing peculiar properties, which are called alkalies. Kali was also formerly employed to designate the alkali Potash.

KALIPTRITE, a Mineral consisting of the oxide of iron, manganese, and zinc, with water and silica.

KALMIA, a genus of Plants named by Linnæus in honour of Peter Kalm, professor at Abo in Finland, belonging to the natural order *Ericaceæ*. It has a small 5-leaved calyx, a cyathiform corolla, with an angular very open limb, having 10 niches in its sides. The capsules 5-celled and many-seeded. The species are evergreen shrubs, with alternate or verticillate leaves.

K. latifolia has its leaves on long petioles, scattered or three in a whorl, smooth and green on each side. It is a native of North America from Canada to North Carolina, on the sides of stony hills. It has various names in the United States, Laurel Ivy, Spoon-Wood, Calico-Bush, &c. The flowers are red, and when in blossom have a very elegant appearance. The leaves of this species are said by Barton to be poisonous to man and beast, but their action can be but feeble and unimportant, for animals are known to feed on the plant without any evident effect. Bigelow however states that the flesh of pheasants having eaten this plant has produced some cases of severe disease attributable to this cause alone. The flowers of the *K. latifolia* exude a large quantity of sweet nectarous juice, which is greedily collected by bees and wasps, but the honey formed from it is injurious to man, and the juice, if swallowed by itself, will produce an intoxication of an alarming kind. A brown powder which adheres to the shoots and branches is used as a sternutatory by the Americans.

K. angustifolia, Haulm-Leaved Kalmia, has petiolate leaves, scattered or three in a whorl, oblong, obtuse, rather rusty beneath; corymbs lateral, bracts linear; peduncles and calyxes clothed with glandular pubescence. It is a native of North America from Canada to the Carolinas, in bogs and swamps, and sometimes in dry mountain lands. It is a shrub 7 or 8 feet in height, with dark red flowers, It is called Sheep-Laurel in North America, as it is supposed to be very injurious to sheep. Several varieties of this plant with lighter and darker flowers have been described. There are several other species, all of them natives of North America. They are all remarkable for the irritability of their stamens, and each of the stamens has a little cavity formed for it in the corolla, to serve as a protection to the anthers.

They are handsome shrubs when in blossom, and are great favourites in gardens and shrubberies. They grow best in a peat soil, or they may be planted in a very sandy loam or vegetable mould. They may be propagated by layers or seeds. When the seeds are used they should be sown early in the spring in flat pans or pots filled with peat-earth, and very slightly covered over; the pots may be then set in a close frame, or in the front of a hothouse, till the plants come up, when they may be transplanted to other pots, which should stand in a close frame till they have struck root; they should then be hardened to the air by degrees.

(Don, *Dichlamydeous Plants*; Burnett, *Outlines of Botany*.)

KAMMERERITE, a Mineral, consisting of a hydrous silicate of alumina and magnesia which occurs crystallised and massive. The common form of the crystal is a 6-sided prism. The cleavage is perpendicular to the axis only. Cleavage planes have a pearly lustre. Colour, that of some crystals, which, by daylight is so dark that their red colour is scarcely perceptible, appears by candlelight quite red. Massive variety, usually composed of fine laminæ. The colours are sometimes dark violet-blue, sometimes yellowish or greenish, or greenish-white. Translucent on the edges, particularly after immersion in water. Fracture compact, fine-grained, becoming splintery or leafy on the less compact varieties; flexible. Dull, or of a greasy lustre, often glistening. When scratched it gives a light peach-blossom red or almost white streak. Hardness 2·0 to 2·5. Specific gravity 2·64. Found in the Ural Mountains. Analysis, by Hartwell:—

Silica	37·0
Alumina	14·2
Magnesia	31·5
Lime	1·5
Oxide of Chromium	1·0
Water	13·0
	98·2

KANGAROO, the common name of the animals belonging to the genus *Macropus*, and the family *Marsupiata*. [MARSUPIATA.]

KANGAROO APPLE. [SOLANUM.]

KAOLIN. [CLAY; FELSPAR.]

KARPHOLITE, a Mineral which occurs in minute crystals and in stellated silky fibres. It scratches fluor-spar, and is scratched by felspar. Colour wax or straw-yellow. Lustre of the crystals vitreous; of the fibres silky. Specific gravity 2·93.

Before the blow-pipe on charcoal it fuses into a dark glass, which becomes darker in the interior flame. With borax it melts into a transparent glass, which in the exterior flame has a manganese colour, and in the interior becomes greenish. The following are analyses by Stromeyer and Steinman:—

	Stromeyer.	Steinman.
Silica	36·154	37·53
Alumina	28·669	26·48
Oxide of Manganese	19·160	17·09
Oxide of Iron	2·290	5·64
Lime	0·271	...
Fluoric Acid	1·470	...
Water	10·780	11·36
	98·794	98·10

KARPHOSIDERITE, a Mineral consisting of a hydrous phosphate of iron, which occurs in reniform masses. Its structure is granular, compact. Fracture uneven. Hardness 4·0 to 4·5. Specific gravity 2·5. Colour pale and bright straw-yellow, and streak the same. Lustre resinous. Feels greasy. Opaque. When heated in a tube gives off water, and a vapour which reddens litmus paper.

Before the blow-pipe, per se, it becomes black, and melts into a globule which obeys the magnet; with salt of phosphorus, it forms a black scoria. It is found at Labrador.

KAWRIE-PINE. [AGATHIS.]

KEELING, a Fish. [MORRHUA.]

KELLIADÆ, a family of minute *Mollusca* belonging to the Lamellibranchiate *Acephala*. Forbes and Hanley place this family between *Lucinidæ* and *Cycladidæ*. The British *Kelliadæ* embrace the genera *Montacuta*, *Turtonia*, *Kellia*, *Lepton*, and *Galeonura*. [MONTACUTA; TURTONIA; LEPTON.] The genus *Kellia* has two British representatives, *K. suborbicularis* and *K. nitida*. They are small but elegant bivalves, living in the crevices of rocks, or on shells or sea-weeds, spinning a byssus, or lying free. There are about a dozen species known in different parts of the world. This genus, from which the family takes its name, was named after Mr. O'Kelly of Dublin.

KEMAS. [CAPREÆ.]

KERMES-MINERAL. [ANTIMONY.]

KERODON (F. Cuvier), a genus of *Rodentia*, bearing in some respects resemblance to that of *Cavia*, but differing both in the locomotive and masticatory organs.

Dental Formula:—Incisors, $\frac{2}{2}$; molars, $\frac{4-4}{4-4} = 20$.

Teeth of *Kerodon*. F. Cuvier.

The molars all resemble each other, and are composed of two equal parts, each of a triangular or rather cordiform shape, united on the external side of the tooth, and separated on its internal side. These triangles, or 'hearts,' are each surrounded by their enamel and filled with bony matter, and their separation produces an angular notch partly filled with cortical substance.

When F. Cuvier wrote but one species, *K. Moco*, was known, and this was discovered by Prince Maximilian of Neuwied, and noticed by him under the name of *Cavia rupestris*. The fur is ash-gray mixed with reddish-yellow, blackish above and whitish below. Size, smaller than that of the Guinea-Pig.

This species was found in the rocky places of the interior of Brazil, near Rio San Francisco.

In 1836 Mr. Bennett exhibited to a meeting of the Zoological Society of London a Rodent sent home among the animals collected by Captain Phillip Parker King, R.N., during his survey of the Strait of Magalhaens, and presented by him to the Society, which Mr. Bennett regarded as a second species of *Kerodon*, and for which he proposed the name of *K. Kingii*. It was chiefly distinguishable from that discovered by Prince Maximilian by its more uniform colour. Excepting a slight dash of white behind the ear, and a longer line of the same colour marking the edge of each branch of the lower jaw, the animal is entirely gray; the upper surface being distinguished from the under by a greater depth of tint, and by the intermixture of a free grizzling of yellow and black. The crowns of the molar teeth, as in the typical species, consist of bone surrounded by two triangles of enamel, the bases of which are connected by a short line of enamel passing from one to the other, all the lines being slender and sharply defined.

This species was found at Port Desire, on the eastern coast of Patagonia. ('Zool. Proc.,' 1835.)

Mr. Waterhouse refers the genus *Kerodon* to *Cavia*. [HYSTRICIDÆ.]

KEROLITE, a Mineral, consisting of a hydrous silicate of alumina and magnesia, which occurs massive and reniform. Structure lamellar or compact. Colour white, yellow, or green; streak white. Fracture conchoidal. Hardness 2·0 to 2·25. Lustre vitreous or resinous. Transparent, translucent. Specific gravity 2·0 to 2·2. Feels greasy, but does not adhere to the tongue. It is found at Frankenstein in Silesia, and at Zöblitz in Saxony, and also in New York and New Jersey, United States. The following is an analysis by Pfaff:—

Silica	37·95
Alumina	12·18
Magnesia	16·02
Water	31·00
	97·15

KESTREL. [FALCONIDÆ.]

KEUPER, in Geology, the German term for the upper portion of the New Red-Sandstone formation. It is supposed by some geologists that certain sandstones in Warwickshire, Worcestershire, and other parts of England, correspond to this group of strata. Remains of reptiles are said to have been found in it near Warwick.

KHAYA, a genus of Plants of the natural family of *Cedrelaceæ*, which is often made a tribe of the *Meliaceæ*. *Khaya* contains only a single species, *K. Senegalensis*, which has been well figured in the 'Flore de Senegambie,' i. t. 32. It forms one of the largest and handsomest of the trees which are found along the banks of the Gambia and in the valleys near Cape Verd. It attains a height of from 80 to 100 feet, and is also one of the most common of the trees of the forest, being called Cail by the negroes, and Cail-Cedra by Europeans. The wood is of fine quality, reddish-coloured like that of mahogany, which belongs to the same natural family. The bark is remarkable for its bitterness and febrifuge properties, and is taken by the negroes in the form of infusion and decoction, as a cure for the fevers so prevalent in their country.

KIANG. [EQUIDÆ.]

KIDNEYS are two glands lying in the lumbar region, on each side of the spinal column. They are composed of numberless and delicate tubular ramifications, on whose walls there is a fine network of capillary arteries and veins, and which are all collected into one mass of a firm fleshy consistence, inclosed in a fibrous capsule.

The ureter, through which the urine secreted by the kidney is conveyed to the bladder, dilates at its extremity into a wide pouch, the pelvis of the kidney, which is divided into several portions called calyces. Into each calyx a nipple-like process, or papilla, projects, at whose extremity there are several minute orifices, each opening into a very fine canal, which, as it is continued into the substance of the kidney, ramifies and becomes tortuous. On all these canals, or tubuli uriniferi, minute bloodvessels ramify, and secrete the urine, which is conveyed from the tubuli into the calyces, and from them through the pelvis and the ureter into the bladder.

The papillæ, and the conical bodies called pyramids, of which they are the extremities, being chiefly composed of the excretory canals, are nearly white, and of a firm dense structure; but as the tubuli ramify, their branches separate in a somewhat radiating manner, and the bloodvessels filling the intermediate spaces between them give to all the exterior part of the kidneys a deep red-colour, and a softer and more fleshy consistence. Hence the kidney is generally described as divided into a cortical, or vascular, and a medullary or tubular portion.

The general structure of the kidney may be best shown by making a section from its convex border into the pelvis. The surface of each part then presents several whitish conical bodies, the pyramids, whose rounded apices, the papillæ, project into corresponding tubular calyces, and whose bases are surrounded by the vascular cortical substance. In the latter no distinct arrangement of vessels can be seen, but there are scattered irregularly through it minute granular bodies called the acini, or corpuscles of Malpighi, which are composed of delicate tortuous arteries.

In the early embryo of *Mammalia* each papilla, with the tubules opening on it and its bloodvessels, forms a separate body; but during growth the several renculi are united into one mass, their original separation being however indicated by the more or less deeply lobulated form of the organ in various animals, and occasionally in man. [URINARY SYSTEM; URINE.]

KILLAS, the local name of a group of rocks in Cornwall, ranked by geologists with the Clay-Slate, or Grauwacke Slate of other countries. The term is perhaps most properly applied to denote fissile argillaceous rocks, such as are usually called clay-slate; but it is often extended to other earthy compounds allied to these by geological position. (Conybeare, 'Ann. Phil.,' new series, vol. vi.) Near granite the Killas is supposed by many geologists to undergo great alterations of character, to become 'metamorphic,' so as to assume more or less of the characters of pyrogenous rocks. In these 'altered' rocks lies a great part of the mineral wealth of Cornwall; tin and copper veins abound in them, as well as in the contiguous granite, to whose influence their mineral characters are ascribed. Dr. Borlase, in his work 'On the Geology of Cornwall,' assigns to these rocks the title of *Cornubianite*.

KILLBRICKENITE. [ANTIMONY.]

KILLENITE, a Mineral which occurs both crystallised and massive. The crystals are imperfect: the primary form appears to be a rhombic prism. The cleavage is parallel to the lateral faces and short diagonal. Fracture uneven. Structure lamellar. Colour greenish and brownish-yellow. Streak yellowish-white. Lustre glimmering, dull, vitreous. Translucent. Opaque. Specific gravity 2·698. Hardness 4·0; scratched by the knife. Frangible.

It occurs in granite veins at Killeny near Dublin, and is stated by Dr. Thomson to consist of—

Silica	49·03
Alumina	30·60
Potash	6·72
Oxide of Iron	2·27
Water	10·00
	——98·67

By the blow-pipe it becomes white, swells up, and fuses into a colourless enamel.

KING-CRAB. [LIMULUS.]

KING-FISH. [LAMPRIS.]

KINGFISHERS. [HALCYONIDÆ.]

KINGLET. [REGULUS.]

KINGSCLERE, a village in Hampshire, remarkable for the exhibition of the Greensaud Formation in the midst of the elevated chalk downs, on the line of an anticlinal axis passing east and west. The anticlinal axis passes through the middle of a valley (hence called a 'valley of elevation') in which the greensand appears; and it might seem on a first view that the discontinuity of the chalk was simply owing to elevation and fracture, but by considering the areas and slopes of the strata, in plans and sections on a true scale, it will immediately appear that a considerable mass of chalk must have been removed by denudation. For the knowledge of this interesting 'valley of elevation' we are indebted to Dr. Buckland. ('Geol. Trans.,' 2nd series, vol. ii.) Sir Charles Lyell has contemplated it in connection with the more extensive denudation of the Weald of Kent and Sussex. (*Principles of Geology.*)

KINGSTON, a Fish. [SQUALIDÆ.]

KINIXYS. [CHELONIA.]

KINKAJOU. [VIVERRIDÆ.]

KINO. [PTEROCARPUS.]

KINOSTERNON. [CHELONIA.]

KIRWANITE, a Mineral consisting of silicate of iron, &c. It occurs filling cavities in a kind of basaltic rock. The texture is fibrous, fibres diverging from a centre and forming brushes. The colour is dark olive-green. Opaque. Hardness 2·0. Specific gravity 2·941. It is found on the north-east coast of Ireland. The following analysis is by R. D. Thomson:—

Silica	40·50
Protoxide of Iron	23·91
Lime	19·78
Alumina	11·41
Water	4·35
	——99·95

KITE. [FALCONIDÆ.]

KITE. [RHOMBUS.]

KITTA. [CORVINÆ.]

KITTIWAKE. [LARIDÆ.]

KLEY, a Fish. [MORRHUA.]

KLIPPSPRINGER. [ANTILOPEÆ.]

KNAPPIA, a genus of Plants belonging to the natural order *Gramineæ*. It has an inflorescence, with a somewhat one-sided raceme. The flowers solitary; glumes not keeled, and blunt. It has 2 paleæ, which are scarious, very hairy, obtuse, unequal, and without awns. There is but one species of *Knappia*—

K. agrostidea, an elegant but very small grass, with a small fibrous root, having numerous stems and short rough leaves. The spikes are slender, consisting of from 5 to 10 mostly sessile alternate spikelets. It is found in sandy maritime pastures, but is a rare grass.

(Babington, *Manual of British Botany.*)

KNAP-WEED. [CENTAUREA.]

KNAUTIA (named after Christopher Knaut, a German botanist), a genus of Plants belonging to the natural order *Dipsaceæ*. The inner calyx is cup-shaped, with radiant teeth, the outer one forming a thickened margin to the germen. It has a 4-fid corolla, a fruit with 4 sides and 8 little depressions, the receptacle with spinous scales shorter than the involucre.

K. arvensis, the Field Scabious, has its lower leaves simple, the stem-leaves pinnatifid, the inner calyx with 8 or 16 somewhat-awned teeth. The stem rises from 2 to 3 feet in height, is slightly branched, and with but few leaves. The flowers are purple, in large convex long-stalked heads. This is the only British species of this genus. There are a few species of *Knautia* natives of Europe.

(Babington, *Manual of British Botany*; Don, *Dichlamydeous Plants.*)

KNEBELITE. [MANGANESE.]

KNOT. [SCOLOPACIDÆ.]

KNOT-GRASS. [POLYGONUM.]

KNOTWORTS. [ILLECEBRACEÆ.]

KNOWLTONIA, a genus of Plants belonging to the natural order *Ranunculaceæ*. It has 5 sepals, from 5 to 15 petals, with the margins naked. The stamens and ovaries numerous; many 1-seeded succulent fruits, not pointed by the style, which is deciduous. The species are 1-seeded perennial herbs, with greenish-yellow flowers.

K. vesicatoria is a plant which has the appearance of an umbelliferous perennial. It has biternate leaves, the segments somewhat cordate, rigid, and smooth, the lateral obliquely truncate at the base. The umbels are nearly simple, and few-flowered. The leaves are used as vesicants in the Cape of Good Hope. There are four other species, natives of the Cape of Good Hope, where these plants grow in abundance. They will thrive well in a mixture of loam and peat, and may be increased either by dividing the root or by seed.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica.*)

KOALA. [MARSUPIATA.]

KOBELLITE, a Mineral resembling sulphuret of antimony, but is more brilliant. The structure is radiated, crystalline. Streak and powder black. Specific gravity 6·29 to 6·32. It is found in the cobalt-mine at Huena in Sweden. Analysis by Setterberg :—

Sulphuret of Lead	46·36
Sulphuret of Bismuth	33·18
Sulphuret of Antimony	12·70
Sulphuret of Iron	4·72
Sulphuret of Copper	1·08
Gangue	1·45
	99·49

KOBRE'SIA, a genus of Plants belonging to the natural order *Cyperaceæ*. It has the spikes aggregate; the lower flower pistiliferous, the perigone of one scale inclosing the germen and covered by the glume. The upper flower staminiferous without any perianth. There is but one species of this genus, *K. caricina*, which has an erect stem from 6 to 12 inches in height, slender leaves shorter than the stem, from 4 to 5 spikes aggregated at the summit of the stem, and from 6 to 8 flowers. There is often an abortive stamen at the base of the nut. This plant is found throughout Europe and in Great Britain, on moors in Yorkshire, Durham, and Perthshire. (Babington, *Manual of British Botany*.)

KOBUS. [ANTILOPEÆ.]

KOELE'RIA, a genus of Plants belonging to the natural order *Graminaceæ*. It has unequal glumes, the upper one with 2 or 3 ribs, shorter than the spikelet, which is compressed. The outer palea is nerved, keeled, and acuminate; the seed loose, and the styles terminal. There is but one British species of this genus :—

K. cristata has a compact panicle, spiked, oval, and interrupted below, the outer palea 3-ribbed and acute; the leaves narrow, rough at the edges, and ciliated. In dry places the leaves are much shorter than the stem; in damper places elongated, and often nearly as loug as the stem.

(Babington, *Manual of British Botany*.)

KOGIA. [CETACEA.]

KOLLYRITE, a Mineral consisting of a hydrous silicate of alumina, which occurs massive. Colour white. Fracture earthy. Nearly opaque. Lustre somewhat vitreous. Hardness 3·25. Specific gravity 2·06 to 2·11. It is found at Schemnitz in Hungary, and in a lead-mine on the bank of the river Oo, in the Pyreuees. The following analysis is by Berthier :—

Silica	19·0
Alumina	40·5
Water	40·5
	100

KONIGA, a genus of Plants belonging to the natural order *Cruciferæ*. It has an oval compressed pouch, from 1 to 2 seeds in each cell, simple filaments, and 8 hypogynous glands. But one British species of this genus has been discovered, *K. maritima*, which is a procumbent plant, with bipartite hairs, linear-lanceolate acute leaves, oval pointed glabrous pods. It is the *Lobularia* of Koch, and the *Glyce* of Lindley. The flowers are white and sweet-scented. (Babington, *Manual of British Botany*.)

KONIGITE, a Mineral consisting of sulphate of copper which is insoluble. *Krisuvigite* is one of the same species.

KOODO. [ANTILOPEÆ.]

KRAMERIA, a genus of Plants belonging to the natural order *Polygalaceæ*. It has 4 or 5 sepals, irregular, coloured, spreading, deciduous; petals 5 or 4, irregular, smaller than the calyx, the three inner unguiculate; stamens 1, 3, or 4, hypogynous, unequal; ovary 1-celled, or incompletely 2-celled; style terminal; stigma simple; ovules in pairs, suspended. Fruit between hairy and leathery, globose, covered with hooked prickles by abortion, 1-seeded, indehiscent. The species are spreading many-stemmed undershrubs. The leaves alternate, simple, entire, or 3-foliate, spreading; racemes simple, spiked.

K. triandra is found on dry gravelly and sandy hills in Peru, flowering all the year round. It is known by the name of Ratanhy Root. It is a suffruticose plant, with a horizontal very long and branched root, with a thick bark, reddish-brown outside, red inside. It has a procumbent stem, much branched and taper; the branches are from 2 to 3 feet long, when young, silky; leaves alternate, sessile, oblong and obovate, acuminate, entire, hoary on each side; flowers solitary, axillary, and stalked; calyx silky externally, smooth and shining inside, of the colour of lac. The two upper petals are separate, spathulate, the two lateral roundish and concave; the drupe is dry and hairy, barred, with dull red hooks. The extract of the plant is styptic and tonic, and operates powerfully upon tumours, resolving and restoring tone to those parts. When administered internally the extract of Ratanhy is apt to be rejected by the stomach till three or four doses have been taken. It is best to take it in the form of pills. It is commonly used in Peru as tooth-powder.

(Lindley, *Flora Medica*.)

KRAMERIACEÆ. [POLYGALACEÆ.]

KRAURITE. [IRON.]

KRISUVIGITE. [KONIGITE.]

KROKYDOLITE, a Mineral containing silica and iron. It occurs asbestiform, fibrous, and compact. Colour lavender or indigo blue. Streak lavender blue or leek green. Lustre silky. Opaque. The fibrous variety is flexible and elastic. It is found on the Orange River in Southern Africa. The following is an analysis of the fibrous variety by Stromeyer :—

Silica	51·64
Protoxide of Iron	34·38
Soda	7·11
Magnesia	2·62
Oxide of Manganese	0·02
Lime	0·05
Water	4·01
	99·83

KUPFERINDIG (*Indigo Copper*, *Blue Copper*), a Mineral which occurs in spheroidal masses, presenting superficial indications of crystallisation. Colour dark blue. Fracture uneven. Hardness about 2·0. Lustre faintly resinous, Opaque. Specific gravity 3·8. It is found at Sangerhausen in Thuringia, and also in the volcanic rocks of Vesuvius, in black or greenish blue incrustations. Its analysis by Walchner affords—

Sulphur	32·64
Copper	64·77
Iron	0·46
Lead	1·04
	98·91

KUPFERSCHAUM, a Mineral containing arsenate of copper, which occurs crystallised. Primary form a right rhombic prism. Occurs in rhomboidal plates, which present perfect cleavage parallel to the faces of the rhomb; generally in small aggregated and diverging fibrous groups of a pale apple-green or verdigris-greeu colour. Streak paler. Hardness 1·0 to 1·5. Lustre pearly on the faces of the rhomb. Translucent. Flexible in thin laminæ. Specific gravity 3·0 to 3·2. It is found at Matlock in Derbyshire, in the Bannat, at Lebether in Hungary, in Siberia, the Tyrol, and at Saalfeld in Thuringia. Its analysis by Von Kobell affords—

Arsenic Acid	25·01
Oxide of Copper	43·88
Carbonate of Lime	13·65
Water	17·46
	100

KYANITE (*Cyanite*, *Disthene*, *Sappare*). This Mineral occurs crystallised and massive. Its primary form is a doubly oblique prism. The cleavage is parallel to the faces of the primary form. Fracture uneven. Hardness of the sharp portions sufficient to scratch glass. Colour white, yellow, and various shades of blue and green. Streak white. Lustre vitreous, pearly. Transparent; translucent. Specific gravity 3·6.

By the blow-pipe it is infusible, aud merely becomes white even in a very strong fire; with borax it readily dissolves into a colourless transparent glass. The following are analyses by Laugier and Arfwedson :—

	Laugier.	Arfwedson.
Silica	38·50	34·33
Alumina	55·50	64·89
Lime	0·50	...
Oxide of Iron	2·75	...
Water and Loss	2·75	...
	100	99·22

It is found in Switzerland, in Scotland, and many other parts of Europe, and also in North and South America.

L

LA'BEO (Cuvier), a genus of Fishes belonging to the family *Cyprinidæ*. The species of this genus resemble the true Carps in having the dorsal fin long, but they do not possess the strong spine of the anal and dorsal fins. The lips are very thick and fleshy, and more or less crenulated. There are no cirri. An illustration of this genus will be found in the *Cyprinus Niloticus* of Geoffroy St. Hilaire. ('Poissons du Nil,' pl. xi. f. 2.) The *Cyprinus fimbriatus* of Bloch, 'Schn.,' p. 441, sp. 24, and the *Catostomus cyprinus* of Lesueur, also belong to the genus *Labeo*, which has no representative in the Europeau seas.

LABIA. [FORFICULIDÆ.]

LABIATÆ. [LAMIACEÆ.]

LABIDOURA. [FORFICULIDÆ.]

LABIDUS. [MUTILLIDÆ.]

LABLAB, a name, it is said, of Egyptian origin, which has been adopted by botanists to designate a genus of Papilionaceous *Leguminosæ* of the tribe *Phaseoleæ*. This genus, like *Dolichos*, from which it has been separated, is a twisting climber, with leaves composed of three large leaflets. The flowers are in racemes, and either white or purple-coloured. The legumes are large, scimitar-shaped, flat, and compressed, tubercularly muricated along the sutures, and having the seeds separated from one another by transverse partitions. It is on account of these seeds and legumes that the species are valued and cultivated in hot countries such as India, Egypt, and the West India Islands, as well as in China. In India *L. vulgaris* and *L. cultratus* are chiefly cultivated in the rainy season in gardens, and may be considered the analogues of the French and kidney beans of European gardens.

LABRADORITE (*Labrador Felspar*, *Glaucolite*), a Mineral which occurs in rolled or imbedded crystalline masses. Its cleavage is parallel to the planes of a doubly-oblique prism. Fracture uneven, conchoidal. Hardness 5·5 to 6·5. It scratches phosphate of lime, and is scratched by quartz. Colour white, gray; richly iridescent. Lustre vitreous. Translucent. Specific gravity 2·69 to 2·76.

When powdered and heated in muriatic acid it gelatinises. On charcoal before the blow-pipe it fuses into a compact glass, with a brilliant fracture.

It is found on the coast of Labrador, and in Devonshire imbedded in a trap rock. It is probably a variety of *Albite*.

The following is an analysis of the mineral from Labrador:—

Silica	55·75
Alumina	26·50
Lime	11·00
Soda	4·00
Oxide of Iron	1·25
Water	0·50
	99

LABRAX (Cuvier), a genus of Fishes of the section *Acanthopterygii* and family *Percidæ*. The fishes of this genus are closely allied to the true Perches, but may be distinguished by the opercular bones being covered with scales, the absence of denticulations on the suborbital and interopercular bones, the operculum being terminated by two spines, and likewise by the tongue being almost entirely covered with minute and closely-set teeth. There are two dorsal fins.

L. Lupus (Cuvier), a fish commonly known in this country by the name of the Basse, and sometimes called the Sea-Dace, is abundant in the Mediterranean; its flesh being excellent food, it has been long known, and was called by the Romans *Lupus*, and by the Greeks *Labrax*.

Head of Basse (*Labrax Lupus*).

The Basse is not unfrequently met with on our own shores: it is generally from about 12 to 18 inches in length, but sometimes attains a much larger size. The upper parts of the head and body are dusky blue, passing into silvery white on the sides and belly; the fins are pale-brown. In form it very much resembles the perch, and, like that fish, it has two distinct dorsal fins, the rays of the first being spinous, and those of the second being flexible: the scales are of moderate size.

L. lineatus of Cuvier and Valenciennes, the Rock-Fish or Striped Basse of the United States, also belongs to the present genus, and indeed very closely resembles *L. Lupus* in form, but attains a larger size, and is adorned with seven or eight longitudinal black lines on a silvery ground-colour. There is also a second American species of Basse, the *L. mucronatus* of Cuvier and Valenciennes, which differs from the former in having no black lines on the sides of the body, and in being of a smaller size and deeper and shorter form.

LA'BRIDÆ (Labroides, Cuvier), according to Cuvier's 'Règne Animal,' a family of Fishes of the order *Acanthopterygii*. The fishes belonging to this family are of an oblong form, covered with scales, usually of large size, formed of simple laminæ, and with the external or posterior margin smooth; they have a single dorsal fin supported in front by spinous rays, each of which is generally furnished with a membranous appendage; the jaws are covered by thick fleshy lips; two upper pharyngeals are attached to the cranium, and, together with a large lower pharyngeal, are armed with teeth, which are large and rounded, sometimes pointed or laminated, and generally very strong. The intestinal canal is without cœca, or when these appendages are present they are of small size, and there is a simple and strong natatory bladder. The following are the genera contained in this family:—

Labrus proper, the characters of which are—opercula and preopercula without spines or dentations; cheek and operculum covered with scales; lateral line straight, or nearly so. Of this genus, the species of which are called Wrasses, we have several examples on the British coast.

L. maculatus, Bloch, the Ballan Wrasse, is not unfrequently met with on various parts of our coast; it is about 18 inches long, of a red colour above, pale-orange beneath, and adorned with bluish-green oval spots; the fins and tail are green, with a few red spots, the dorsal fin is spotted at the base. The length of the head compared to the whole length of the fish is as one to four, and the depth of the body is equal to the length of the head. The fin-rays are—dorsal, 20 + 11; pectoral, 15; ventral, 1 + 5; anal, 3 + 9; caudal, 13. Besides this species Mr. Yarrell describes, in his 'History of British Fishes,' the following:—*L. lineatus*, the Green-Streaked Wrasse; *L. variegatus* (Gmel., Linn.), the Blue-Striped Wrasse; *L. vetula* (Bloch), the Sea-Wife; *L. carneus* (Bloch), the Red Wrasse; *L. comber* (Gmel., Linn.), the Comber-Wrasse.

Ballan Wrasse (*Labrus maculatus*).

Cheilinus, Lacép.—The species of this genus differ only from the true *Labri* in having the lateral line interrupted opposite the end of the dorsal fin, and commencing again a little below the break. The scales on the tail are large, and extend on the fin. These fishes inhabit the Indian Ocean, and are very beautiful in colouring.

Lachnolaimus, Cuv., may be thus characterised:—Anterior spines of the dorsal fin with long flexible filaments; pharyngeals furnished with a villous membrane, with rounded flat teeth on the hinder part. The known species are from America.

Julis, Cuv., is distinguished from *Labrus* proper by the head being entirely smooth and without scales, and the lateral line being suddenly bent opposite the end of the dorsal fin.

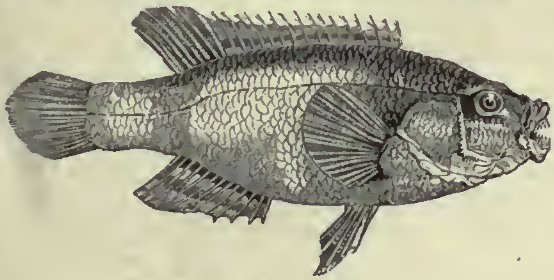
Julis Mediterranea, Risso (*J. vulgaris*, Cuv.), the Rainbow-Wrasse, has been caught off the British coast; but it appears here to be scarce, though a well-known fish in the Mediterranean. It is of a slender and elongated form, and remarkable for the elegant distribution of its colours, which change according to the light and position: on each side of the body is a broad dentated stripe, extending from the head nearly to the tail, of a silvery and fulvous colour. The fin-rays are—dorsal, 9 + 13; anal, 2 + 13; caudal, 13; pectoral, 12; and ventral, 1 + 5. A specimen described by Donovan, which exceeded seven inches in length, was caught off the coast of Cornwall, and is the only recorded instance of the occurrence of the species on the British coast.

Rainbow Wrasse (*Julis Mediterranea*).

The species of the genus *Anampses* of Cuvier differ from those of the genus *Julis* in having two flat teeth in each jaw, which project and curve outwards.

The genus *Crenilabrus* of Cuvier has the general characters of *Labrus* proper, but the margin of the pre-operculum is dentated.

Crenilabrus Tinca, Flem., called the Gilt-Head, Connor, &c., is found on many parts of our coast, and indeed is one of the commonest species of the family *Labridæ* we possess; it is from 8 to 10 inches in length; the upper parts are marked with alternate red and bluish longitudinal lines; below the lateral line the colour is bluish-green, spotted with dull red; head brownish-red, with undulating lines of an azure-blue colour; dorsal, caudal, and ventral fins bluish-green, spotted, and lined with red; pectorals pale and immaculate; greatest depth of the body very nearly one-third of the entire length.



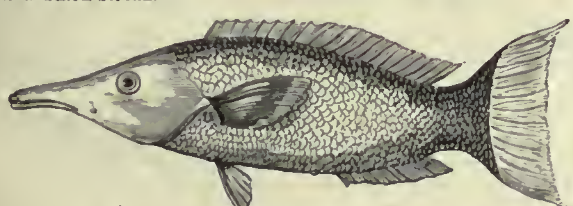
Gilt-Head (*Crenilabrus Tinca*).

The works on British fishes contain three other species of the present genus. The Goldsinny (*C. cornubicus*, Risso), the Gibbous Wrasse (*C. gibbus*, Flem.), and the Scale-Rayed Wrasse (*C. luscus*, Yarrell). [Crenilabrus.]

In the genus *Coricus*, Cuvier, we find the same characters as in *Crenilabrus*; but the mouth is protractile, though not quite in so great a degree as in the next genus, *Epibulus* (Cuvier), where the species have the power of extending the mouth to a great degree: in the fishes of the last-mentioned genus the head and body are covered with large scales, which extend both on the caudal and anal fins; the lateral line is interrupted, and there are two long conical teeth in each jaw, behind which the teeth are comparatively small and blunt. The only species known (*Epibulus insidiator*) inhabits the Indian Ocean. *Clepticus* (Cuvier), which is the next genus in succession, has for its distinguishing characters—the snout small and cylindrical, which may be suddenly protruded like that of *Epibulus*, but which is not so long as the head: the teeth are minute, the body oblong, and the head obtuse; the lateral line is continuous, and the dorsal and anal fins are almost entirely enveloped by scales. But one species is known (the *C. genizara*, Cuvier), and this is from the Antilles.

In the genus *Gomphosus* (Lacépède) the muzzle is remarkably long and slender, owing to the prolongation of the maxillary bones; the head is smooth, as in *Julis*. The species inhabit the Indian Ocean.

Gomphosus viridis, Bennett ('Fishes of Ceylon'), is found off the coast of Ceylon, and is of a dark green colour: the pectoral fin is marked with a black streak.



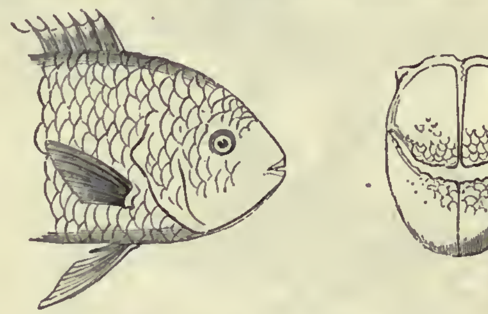
Gomphosus viridis.

Xyrichthys (Cuvier).—The fishes of this genus are of a compressed form, and have the profile of the head high and nearly vertical: the body is covered with large scales; the lateral line is interrupted; the jaws are furnished with a range of conical teeth, of which those in the centre are the longest; the pharynx is beset with hemispherical teeth. The compressed form and almost vertical profile of the head caused the older authors to arrange these fishes with the *Coryphænæ*. The *Xyrichthys novacula* (*Coryphæna novacula*, Linn.), or Razor-Fish of the Mediterranean, affords an example of this genus: it is of a red colour, irregularly striped with blue.

Chromis, Cuvier.—With the thick lips, protractile intermaxillaries, pharyngeal bones, filaments to the dorsal spines, and the general appearance of a *Labrus*, these fishes have the teeth in both jaws and on the pharyngeals slender and thickly set, or, as Cuvier describes them, 'en carde,' but in front of these there is a range of conical teeth. The vertical fins are filamentous. The ventral fins are often prolonged into long filaments. The lateral line is interrupted. A small species of this genus, which is of a chestnut-brown colour, is common in the Mediterranean; it is the *Sparus chromis*, Linn. Another species is found in the Nile, the *Labrus Niloticus*, Hassels, &c. The genus *Cychla* (Bloch, Schn.) differs from *Chromis* in having the body more elongated, and in having the whole of the teeth very slender and thickly set, like the pile on velvet, and forming a broad band: it contains numerous species. The genus *Pseliops* (Cuvier) differs from *Chromis* in having the head compressed, the eyes placed near to each other, and the ventral fins much elongated.

Malacanthus, Cuvier.—In this genus there are the general characters of *Labrus*; the maxillary teeth are nearly the same, but the pharyngeal teeth are 'en carde,' as in *Chromis*. The body is elongated, the lateral line continuous, the operculum is produced posteriorly into a little spine, and the long dorsal fin has but a small number of slender and flexible spines in front. One species is found in the Antilles, which is of a yellowish colour with irregular transverse violet stripes, and has a crescent-shaped tail: it is the *Coryphæna Plumieri* of Lacépède.

Scarus, Linn.—The species of this genus, commonly known by the name of Parrot-Fishes, are remarkable for the convex and rounded form of the jaws, which are beset with several series of scale-like teeth, which are so soldered together, that they usually appear to form solid masses of enamel: these teeth succeed each other from behind forwards; those at the base, being the most recent in formation, in time replace those above, and themselves form the cutting edge. When alive, the fleshy lips nearly cover the teeth. In general form and in the large scales with which the body is covered the Parrot-Fishes resemble the true *Labri*; their pharyngeals, like them, are furnished with teeth, but they consist of transverse laminæ.



Head of a Parrot-Fish (*Scarus*), and the jaws, natural size.

These fishes are chiefly confined to the seas of hot climates, and are of very brilliant colours, which last circumstance, combined with a fancied resemblance between the mouth and the beak of a parrot, has given rise to the name of Parrot-Fishes. Some of them have a crescent-shaped tail, and of these there are a few in which the forehead is very gibbous; in others, the tail is truncated. Cuvier has separated from the Parrot-Fishes, under the generic name *Calliodon*, those species in which the lateral teeth of the upper jaw are square and pointed, and in which there is an interior range of much smaller teeth in the same jaw; and lastly, M. Cuvier has established the genus *Odax* for the reception of those Labroid Fishes which approach the genus *Labrus* in having the lips thick and fleshy, and the lateral line continuous, and the jaws composed like those of *Scarus*, but which are however flat and not gibbous, and are covered by the lips; the pharyngeal teeth are as in *Labrus*. The *Scarus pullus* of Bloch (Schneider) belongs to this genus; the fish is found off the coast of New Zealand, is of a blackish brown colour, and furnished with small scales.

LABROIDES. [Labridæ.]

LABRUS. [Labridæ.]

LABURNUM, the common name of the European trees named by botanists *Cytisus alpinus* and *C. Laburnum*. It is a native of the Alps of Europe, and is well known in gardens for the beauty of its pendulous racemes of beautiful yellow flowers. The seeds of Laburnum contain a poisonous substance called Cytisine; and the wood, which is olive-green, hard, and compact, is occasionally used by the turner for ornamental purposes. [Cytisus.]

LABYRI'NTHODON, a genus of Fossil Reptiles from the New Red-Sandstone strata. (Owen.) [Amphibia.]

LAC. [Coccidæ.]

LACE-BARK TREE. [Daphne.]

LACERTA. [Sauria; Lacertiadæ.]

LACE'RTIADÆ, or LACERTIANS. Under the family name Lacertians Cuvier arranged—

1st. The Monitors and their subdivisions, namely, the Monitors properly so called, including the Ouarans of the Arabs (*Varanus*), &c.; the Dragons (*Crocodilurus* of Spix, *Ada* of Gray), and the Sauvegardes (*Monitor* of Fitzinger and Ameiva).

2nd. The Lizards properly so called.

This second group comprises, according to Cuvier, the genera *Lacerta*, *Algyra*, and *Tachydromus*.

Messrs. Duméril and Bibron make the Varanians, or Sauriens Platynotes (Broad-Backed Saurians), a family which comes immediately after the Geckotians in their 'Erpétologie.' They allow that the Varanians are nearly allied (ont très grands rapports) to the Lacertians, as modified by them, and rest the distinctions of the former family from the latter—1st, on the presence in the latter of polygonal scales which cover the head; 2nd, on the form of the scales of the back and of the belly, and their noncompressed tail; and 3rd, on the form and disposition of the teeth, which are not distant, obtuse, and conical, but placed on the same line, and trenchant at their summit in the antero-posterior direction.

For an account of the systematic arrangement of the Lizards and their congeners, see SAURIA.

LACHESIS. [CROTALIDÆ.]

LACHRYMAL GLANDS. [EYE.]

LACISTEMA'CEÆ, *Lacistemads*, a small and obscure natural order of incomplete Exogenous Plants, containing a few arborescent species, inhabiting the woods of tropical America, in low places. In appearance they resemble the genus *Celtis*; and in structure they approach very nearly to *Urticaceæ*, from which Von Martius first distinguished them. The principal characters on which the order is founded are the dehiscent 3-valved fruit and amentaceous inflorescence. Nothing is known of their properties. There are two genera and six species.

A branch of *Lacistema serrulatum* in flower and fruit. 1, a flower with its calyx; 2, an ovary with the double stamen below it; 3, a ripe fruit.

LACTEALS, a set of absorbent vessels which take their origin in the villi of the intestines, and are the principal means by which the food, in the form of chyle, is conveyed into the blood. [ABSORBENT SYSTEM; DIGESTION; CHYLE; INTESTINES.]

LACTU'CA, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Liguliforæ*, the tribe *Cichoraceæ*, and the sub-tribe *Lactuceæ* of De Candolle. It has a cylindrical imbricated involucre, with the scales membranous at the margin, and few-flowered; the receptacle naked; the achenium compressed, wingless, with a long filiform beak; the pappus hair-like in several rows.

L. virosa, Acrid Lettuce, has leaves with a prickly keel, horizontal, oblong, auricled, and clasping, mucronate, dentate or sinuated, the beak white, equalling the fruit, which is black. This plant is found on hedges, old walls, and the skirts of fields throughout Europe. It yields a milky juice, which when procured and dried has the name Lactucaricum. This substance is also procured from the Garden Lettuce (*L. sativa*), and in the 'London Pharmacopœia' the *L. sativa* is the only plant recognised for supplying this substance. Dr. Christison remarks:—"The London College however, and many cultivators, are wrong in restricting themselves to the garden lettuce for the preparation of lactucaricum. From information communicated to me several years ago by Mr. Duncan, chemist and druggist in this city (Edinburgh), who has often made lactucaricum on a large scale, it appears that the *L. virosa* yields a much larger quantity, and that the produce is of a superior quality. Nor is there any reason for dreading the narcotic properties of the wild lettuce, the scientific name of which has given rise to an exaggerated notion of its activity. The results obtained by Mr. Duncan have been since confirmed by those of Schultz in Germany, who found that a single plant of the garden lettuce yields only 17 grains of lactucaricum on an average, while a plant of wild lettuce yields no less than 56 grains." Mr. Duncan has made the observation also that, "although the milkiness of the juice increases till the very close of the time of flowering, namely in the wild-lettuce till the month of October in this climate, the value of the lactucaricum is deteriorated after the middle of the period of inflorescence; for subsequently, while the juice becomes thicker, a material decrease takes place in the proportion of bitter extract contained in it." For an account of *L. sativa* and its uses as a salad see LETTUCE, in ARTS AND SC. DIV. This plant appears to have been cultivated amongst the Greeks, and also used in medicine. It is the Θρίδαξ of Dioscorides (ii. 165); also of Theophrastus. Several varieties of the Garden Lettuce were used both among the Greeks and Romans as salads.

L. Scariola, Prickly Lettuce, has the leaves with a prickly keel, perpendicular, arrow-shaped at the base and clasping, sinuate, the beak white, equalling the pale fruit. It is found plentifully in waste places in many parts of Europe, but is a rare plant in Great Britain. It has a stem from 2 to 5 feet high, leafy and panicled. Its juice is not so acrid as that of *L. virosa*, but possesses the same properties. It is found on the higher hills of Greece, and is probably the Θρίδαξ ἀγρία and Θριδακίνη of Dioscorides. The Θριδακίνη of Theophrastus (i. 8 and vii. 3) and of Galen (lib. 2), according to Fraas, is the *L. coriacea* of Schultz.

There are two other British species of lettuce: *L. saligna*, with a white elongated beak, twice as long as the fruit, the upper leaves entire, acuminate; and *L. muralis*, with the beak much shorter than the fruit.

(Babington, *Manual of British Botany*; Fraas, *Synopsis Plantarum Floræ Classicæ*; Christison, *Dispensatory*.)

LACTUCA'RICUM is a substance obtained from the *Lactuca virosa*, being the inspissated milky juice of the plant, and which is at first white, but afterwards by exposure to the air and sun concretes and becomes brownish. The juice of the leaves only should be collected before the flowering has begun. Puncturing the leaves is the best mode of procuring it.

Other plants are often mistaken for it, as *Lactuca sativa*, *L. augustana*, *L. quercina*, *L. Scariola*, *Sonchus oleraceus*, and *Dipsacus sylvestris*.

According to Klink, Lactucaricum contains lactucic acid. It yields by distillation its odour and taste to water, which thus acquires some of the virtues of the plant. The inspissated concrete juice is said to resemble opium in its action, but is much feebler. In pulmonary diseases it is sedative. The common Garden Lettuce (*Lactuca sativa*) also possesses sedative properties, and eaten towards bed-time has been said to procure rest in cases of morbid vigilance, or to allay pains of the stomach. [LACTUCA.]

LACUNA. [LITTORINIDÆ.]

LA'DANUM, sometimes written *Labdanum*, but incorrectly, as it is the Λήδανον of the Greeks and the Ladun of the Arabs. It is first mentioned by Herodotus (iii. 112) as procured in Arabia, and used by the Arabs for fumigation. The word is not Greek, but an Arabic word with a Greek termination; the Greeks also used the word Λῆδος to indicate the shrub which produced the Ladanum. This gum-resin is produced by several species of *Cistus*, the Κίστος of Dioscorides, though the name and description are often confounded with those of the Κισσός, or *Hedera*. *C. ladaniferus*, *C. Creticus*, *C. laurifolius*, and *C. Ledon*, Lam., are usually mentioned as the species which are indigenous in the Grecian Islands, in Spain, Italy, and the south of France. That obtained from the Levant is the most celebrated. The juice exudes upon the leaves and branches of these shrubs, and is collected, according to Tournefort, by means of an instrument resembling a rake, with leather thongs instead of teeth, which is drawn over the plant; and as the juice adheres to the thongs, it is afterwards separated. Ladanum is also described by Dioscorides as being collected from the beards of goats which had been feeding on the leaves of *Cistus*. (Compare Herodot., iii. 112.) It is now seldom employed for any purpose, as it is with difficulty obtained of a sufficient degree of purity from the adulterations to which it is subjected; one analysis yielding 72 parts of ferruginous sand, and another 86 of resin, out of 100 parts. The purest kind, seen only in the places where it is produced, is described as blackish, homogeneous, and tenacious, easily softening under the fingers, and even sticking to them; having a grayish fracture, which however becomes black by exposure to the air; rather a bitter taste, and a very agreeable smell from the presence of a volatile oil. It was formerly employed as a stimulant, more recently as an expectorant, and is esteemed even in the present day by the Turks as a perfume, and used for fumigation.

LADY-BIRD. [TRIMERA.]

LADY-FERN. [ASPIDIUM.]

LADY'S-SLIPPER. [CYPRIPEDIUM.]

LADY'S SMOCK. [CARDAMINE.]

LÆMANCTUS. [IGUANIDÆ.]

LÆMODI'PODA, Latreille's fourth order of the *Crustacea*, placed by him between the *Amphipoda* and the *Isopoda*. He describes them as being the only forms among the *Malacostraca* with sessile eyes (*Edriophthalmia*) whose posterior extremity does not present distinct branchiæ, and which have hardly any tail, the two last feet being inserted at that end, or the segment to which they are attached being followed by not more than one or two other joints, which are very small. They are also, he states, the only ones in which the two anterior feet (which agree with the second jaw-feet) make a part of the head.

The *Lœmodipoda* of Latreille have all four setaceous antennæ carried upon a peduncle of three joints, mandibles without palps, a vesicular body at the base of four pair of the feet at least, beginning with the second or third pair, reckoning those of the head. The body, which is most frequently filiform or linear, is composed (reckoning the head) of from eight to nine joints, with some small appendages, in form of tubercles, at its posterior and inferior extremity. The feet are terminated by a strong hook. The four anterior feet, of which the second are the greatest, are always terminated by a monodactylous claw. In many the four succeeding feet are shortened, less articulated, without any hook at the end, or rudimentary, and not at all fit for ordinary use.

The females carry their eggs under the second and third segments of the body, in a pouch formed by approximated scales.

The *Lœmodipoda* are all marine, and Savigny considers them as approaching the *Pycnogonidœ*, and making, with that form, the passage from the *Crustacea* to the *Arachnia*.

Latreille brought the forms under one genus, *Cyamus*, with the following sub-divisions and sub-generic appellations.

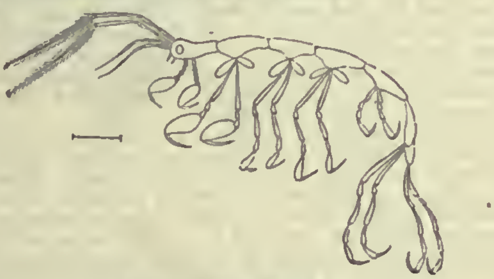
1. *Filiformia* (Latr.).

Body long and very slender, or linear, with longitudinal segments; feet similarly elongated and slight; stem of the antennæ composed of many small joints.

Leptomera, Latr. (*Proto*, Leach).—Feet fourteen (reckoning the two annexed to the head), complete, and in a continuous series. (Latr.)

In the *Leptomerœ* (*Gammarus pedatus*, Mull., 'Zool. Dan.') all the feet, with the exception of the two anterior ones, have a vesicular body at their base. In the *Proto* of Leach (*Cancer pedatus*, Montague, 'Trans. Linn. Soc.,' ii.) these appendages are peculiar to the second feet and the four succeeding ones.

Leptomera pedata may be given as an example.



Leptomera pedata, magnified.

Naupredia, Latr.—Feet ten, in a continued series; the second and two succeeding pairs have a vesicular body at their base.

The species are found on the coasts of Europe, France, &c.

Caprella, Lam.—Feet ten, but in an interrupted series, commencing with the second segment (inclusive), and not reckoning the head. This segment and the following one have each two vesicular bodies, and are totally deprived of feet.

The species are found in the northern and temperate European oceans.

The *Lœmodipoda* of this section keep among the marine plants and sponges, and walk like caterpillars, turn frequently with rapidity on themselves, or set up their bodies, vibrating their antennæ at the same time. In swimming they curve the extremity of the body.

2. *Ovalia* (Latr.).

In this subdivision the body is oval, with transverse segments. The stem of the antennæ appears to be inarticulated. The feet are short, or have but little length; those of the second and third segments are imperfect, and terminated by a long cylindrical joint without hooks; at their base they have an elongated vesicular body. These *Lœmodipoda* form the sub-genus.

3. *Cyamus*, Latr. (*Larunda*, Leach.)

M. Latreille states that he has seen three species, all of which live on *Cetacea*, and the most known of which, *Cyamus Ceti* (*Oniscus Ceti*, Linn.; *Squilla*, Degeer; *Pycnogonum*, Fabr. and Sav.), is found also on the Mackerel. The fishermen term it the Whale-Louse (Pou de la Baleine). Another species, very analogous to the first, was brought back by Delalande from his voyage to the Cape of Good Hope. The third and much the smallest is found on the Cetaceans of the East Indian seas. (Latr.)

Cyamus Ceti, magnified.

M. Desmarest gives the *Lœmodipoda* the same position as M. Latreille, and divides them also into two sections. The first, consisting of *Leptomera*, Latr. and Lam. (*Proto*, Leach; *Caprella*, Lam.); the second of *Cyamus* (*Cyamus*, Latr. Lam.; *Panope*, Leach; *Larunda*, Leach).

M. Desmarest remarks that M. Latreille never saw the *Leptomerœ* themselves, and that he has separated them from *Caprella* and *Proto* from published figures only.

M. Milne-Edwards makes his Legion of Edriophthalmians comprise the *Amphipoda*, *Isopoda*, and *Lœmipoda*.

LAGANA. [Echinidæ.]

LAGENA'RIA (from 'lagena,' a bottle), a genus of Plants belonging to the natural order *Cucurbitaceœ*. The flowers are monœcious, the calyx campanulate, with subulate segments shorter than the tube. The corolla is white, with obovate petals spreading below the edge of the calyx. It has five triadelphous stamens, the fifth one distinct; three subsessile granulated stigmas, obovate compressed seeds, tumid at the margin, 2-lobed at the apex.

L. vulgaris, Common Bottle-Gourd, is a musky-scented plant, and clothed with a soft down. It has a climbing stem, with tendrils from 3- to 4-cleft. The flowers are stellated, spreading, and in clusters; the fruit in shape like a bottle, when ripe of a pale-yellow colour, sometimes six feet in length. When dried it becomes hard, and is used to contain water; it is then of a pale bay-colour. In its wild state this plant produces a poisonous fruit, and Dr. Royle states that a very intelligent native doctor informed him that cases of poisoning have occurred from eating the bitter pulp in the district where it grows. Some sailors also are said to have died from drinking beer that had been standing in a flask made from one of those gourds.

These injurious effects seem however to be removed by cooking, for Don says that the poor people among the Arabians eat it boiled with vinegar, or fill the shells with rice and meat, and so make a kind of pudding of it. The pulp of the fruit is often employed in poultices: it is bitter and purgative, and may be used instead of colocynth. This species grows abundantly in Egypt and Arabia; the Arabians call it Charrah; it thrives wherever the mountains are covered with a fit soil. There are three other species enumerated by Don growing in Guinea and the East Indies.

L. idolatrica is held in great veneration by the Hindoos in their religious ceremonies.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica.*)

LAGENORHYNCHUS. [Cetacea.]

LAGERSTRŒ'MIA, a genus of Plants of the natural family of *Lythraceœ*, which extends from the Malayan Archipelago into China and Japan, as well as along the foot of the Himalayan Mountains to the northern parts of India. The genus was named by Linnæus in honour of Lagerstrœm, who was director of the Swedish East India Company and imported many interesting plants from India and China. The species are few in number, but most of them highly ornamental in nature. *L. Reginœ* especially forms a small tree and is conspicuous from its large rose-coloured flowers, of which the petals, standing out on rather long claws, more fully display the varied outline of its undulated limb. The bark and leaves are accounted purgative and hydragogue, the seeds narcotic. *L. Indica* and *L. parviflora* are small and shrub-like, and suited to our hot-houses, but all require moisture in the season of flowering.

LAGIDIUM. [Chinchillidæ.]

LAGOMYS. [Leporidæ.]

LAGOPUS. [Tetraonidæ.]

LAGO'STOMYS, or LAGOSTOMUS, a genus of *Mammalia* belonging to the order *Rodentia* and the family *Chinchillidœ*. *L. trichodactylus* is the Viscacha, or Biscacho. [Chinchillidæ.] The accompanying figure was taken from a specimen in the Zoological Gardens Regent's Park.

Viscacha, or Bischaco (*Lagostomys trichodactylus*).

LA'GOTHRIX, M. Geoffroy's name for a genus of South American Monkeys, thus characterised:—

Dental Formula:—Incisors, $\frac{4}{4}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{6-6}{6-6}$ = 36.

Facial angle about 50°; muzzle projecting; head round; extremities proportioned to the body; anterior hands provided with a thumb; tail strongly prehensile, and having a part of its extremity naked below; hair strong and curly.

Two species are recorded, *L. Humboldtii* and *L. canus*.

The first of these, or the Caparro, was found by Humboldt and Bonpland in the hut of an Indian, who had captured it in an excursion to the westward. Size about 2 feet 2 inches without the tail. Head round and very large. Hair long, strong, and uniform gray, the tips black. Face naked and black; mouth beset with long stiff bristles. Tail rather longer than the body, prehensile, naked at the extremity. Habits gregarious; frequently seen raised on the hinder extremities.

It was found on the Rio Guaviare, one of the tributary rivers of the Orinoco.

The other species has shorter hair, and is of the size of the Sapajousal (*Cebus Capucinus*, Desm., *Simia Capucina*, Linn.).

It is a native of Brazil.

Dr. Gray places the form in his family *Sariguidæ*, and in the second sub-family of it, namely, *Atelina*.

Mr. Swainson arranges it in the family *Cebidæ*, between *Mycetes* and *Ateles*.

LAGOTIS. [CHINCHILLIDÆ.]

LAGRIIDÆ (*Lagriariæ*, Latreille), a family of Coleopterous Insects of the section *Heteromera*, the characters of which are:—Elytra soft; head and thorax considerably narrower than the elytra, the latter almost cylindrical, ovate or quadrate, and truncated; antennæ inserted near an emargination of the eyes, either filiform or insensibly larger towards the apex, the terminal joint being longer than the preceding, especially in the males; palpi thickened at the tip; terminal joint of the maxillary palpi of the form of a reversed triangle; femora oval and clavate; tibiæ long and slender; those of the anterior legs often curved; penultimate joint of the tarsi bilobed and the claws simple. The genus *Lagria* (Fab.), contains those species in which the antennæ are gradually thickened towards the apex, and have the last joint ovate; the fore part of the head is but little produced, but behind is prolonged and slightly rounded; the thorax is almost cylindrical or square.

One species of this genus exists in England, the *Lagria hirta*, an insect not unfrequently found in hedges and woods, and apparently most abundant on the white thorn. It is about 4-12ths of an inch in length, of an oval form, with a narrow head and thorax; these, as well as the body beneath, the antennæ, and the legs, are black; the elytra are dirty yellow, soft, and pubescent. The body of the males is rather narrower than that of the females, and the antennæ are longer.

The genus *Statyra* (Latreille) also belongs to the present family, and consists of species which have the body more elongated than those of *Lagria* proper; the antennæ are filiform, and consist of almost cylindrical joints, the last of which is very long and pointed; the head is considerably produced in front of the eyes, and is abruptly narrowed behind; the thorax is longer than broad, somewhat ovate, but truncated before and behind; the elytra are acutely terminated.

Lagria hirta.

The line *a* denotes the natural size; *b*, the antenna; *c*, the tarsus of the fore and middle pair of legs; *d*, the tarsus of the posterior pair of legs.

LAGURUS (from λαγὼς, a hare, and οὐρά, a tail), a genus of Plants belonging to the natural order *Gramineæ*. It has a spiked panicle, 1-flowered, scarious glumes ending in a long fringed seta. The outer paleæ end in two long setæ and with a dorsal geniculated twisted awn.

L. ovatus is the only species, and has a stem from 4 to 12 inches in height. The leaves are broad and lanceolate, the spikes ovate and pubescent. It is found in sandy places in Guernsey and on the continent of Europe.

(Babington, *Manual of British Botany*; Koch, *Flora Germanica*.)

LAITH. [MERLANGUS.]

LALO. [ADANSONIA.]

LAMA. [LLAMA.]

LAMANTIN. [CETACEA.]

LAMBRUS, Leach's name for a genus of Brachyurous Crustaceous Decapods.

LAMB'S LETTUCE. [VALERIANELLA.]

LAMELLARIA. [VELUTINIDÆ.]

LAMELLIBRANCHIA'TA, De Blainville's third order of *Acephalophora* (Acéphales Testacés of Cuvier).

De Blainville makes this order consist of the following families:—1st, *Ostracea* (Oysters, &c.); 2nd, *Subostracea* (*Spondylus*, &c.); 3rd, *Margaritacea* (*Vulsella*, *Malleus*, &c.); 4th, *Mytilacea* (Mussels and Pinnas); 5th, *Polyodonta*, or *Arcacea*; 6th, *Submytilacea* (*Anodon*, *Unio*, *Cardita*); 7th, *Chamacea*; 8th, *Conchacea*; 9th, *Pyloridea*; 10th, *Adesmacea* (*Pholas*, *Teredo*, *Fistulana*, &c.).

M. Rang separates the order into two divisions:—

I. *Monomyaria.*

Families:—1st, Ostracés, Cuvier (*Ostreadæ*); 2nd, Pectinides, Lam. (*Pectinidæ*); 3rd, Malléacés, Lam. (*Malleidæ*); 4th, Aviculés (*Aviculidæ*).

II. *Dimyaria.*

Families:—5th, Arcacés (*Arcadæ*); 6th, Mytilacés (*Mytilidæ*); 7th, Submytilacés (*Submytilidæ*: fresh-water, *Anodon*, *Unio*, &c.; Naiades of Lamarck and Lea: marine, *Cardita*, *Cypricardia*, &c.); 8th, *Chamacea* (*Chamadæ*); 9th, *Conchacea*; 10th, *Pyloridea*; 11th, Tubicolés, Lam. (*Aspergillum*, *Clavagella*, &c.). [CONCHIFERA; MOLLÚSCA.]

LAMELLICORNES (Latreille), one of the sections of the order *Coleoptera*. The insects of this section have five joints to all the tarsi. The antennæ are inserted in a small hollow in front of the eyes, short, usually composed of nine or ten joints, the last of which are large and flat, and open like a fan. [COLEOPTERA.] The number of these lamellated joints varies, but there are generally three. The clypeus is usually very large, and the labrum is small and hidden beneath the clypeus. The anterior tibiæ are dentated externally, and the posterior tibiæ are often more or less denticulated. The mandibles of some of the species are membranous.

The larva [COLEOPTERA] is soft, of a cylindrical form, or nearly so, and has a large vertical head. There are six small legs attached to the thoracic segments. The body is always bent. When about to assume the pupa state the larvæ inclose themselves in an oval case formed of particles of earth, rotten wood, or other surrounding substances, which are cemented by a glutinous matter. Some of them live in the ground, and feed upon the roots of plants, and others live in decayed animal and vegetable substances, upon which they feed. The perfect insects also feed upon these substances (many of them are found in dung); others feed upon the leaves of plants, or on the flowers.

Latreille divides the Lamellicornes into two great tribes, Scarabaides and Lucanides. [SCARABAIDÆ; LUCANIDÆ.]

LAMELLIROSTRES, Cuvier's name for the great family of the *Anatidæ*. [DUCKS.]

LAMIA'CEÆ, or LABIA'TÆ, *Labiates*, a very extensive and important natural order of Exogenous Plants, with irregular unsymmetrical monopetalous flowers, and a 4-lobed ovary, changing to 4 seed-like monospermous fruits. It is technically allied so nearly to *Boraginaceæ* as to differ apparently in little except having regular flowers; but in nature it belongs to a different series of vegetation. The leaves of *Lamiaceæ* are uniformly opposite, and their stems square or nearly so, and in the greater part of the order the flowers are disposed in short opposite clusters axillary to leaves, and appearing in consequence as if in whorls.

The species are generally aromatic and tonic, a property that is in most cases owing to the secretion of a volatile oil in little cysts or glands occupying the leafy organs. The aromatic qualities are familiar to us in the Sage, Marjoram, Thyme, Basil, and similar plants, commonly cultivated for the service of the kitchen, as condiments; of Lavender, so much valued for its peculiar fragrance; of Mint and Peppermint, well known for their stimulating power, and of many others. Betony, Ground Ivy, Horehound, and others are examples of the bitter tonic qualities of such plants; Rosemary appears to have the specific property of stiffening the hair and encouraging its growth; its oil is that which gives the green colour to bear's grease and such pomatums; and Cat-Thyme (*Teucrium marum*) and Cat-Mint (*Nepeta Cataria*) seem to be genuine feline aphrodisiacs.

Plants of this order are distributed over all the warmer and temperate parts of the world, generally being herbaceous, and never exceeding the size of small bushes. Mr. Bentham has given an elaborate view of their geographical distribution, from which it appears that out of 1714 species 1030 belong to the Eastern hemisphere, and 649 to the Western; 8 only are Arctic; 80 inhabit the temperate parts of Europe, 190 Spain, 149 the Himalayan Mountains, and only 157 the Equinoctial regions of both the Old and New World, and those are chiefly mountain plants.

Linnæus distributed the genera of *Lamiaceæ* through his *Didynamia*, *Gymnospermia*, and *Diandria Monogynia*. Writers on the natural system have devised much better modes of arrangement; the most perfect and recent is that of Mr. Bentham ('Labiatarum Genera et Species,' London, 1832-36, 8vo.)

There are 125 genera and 2350 species of this order.

Leaf and flowers of *Salvia pratensis*.

1, the ovary, upon the four lobes of which a part of the character of this order depends.

The British genera of this order are numerous. They are divided by Babington into the following tribes:—

I. *Menthoideæ.*—Corolla bell-shaped, nearly regular; stamens distant, straight, diverging upwards.

1. *Mentha.* 2. *Lycopus.*

II. *Monardeæ.*—Corolla 2-lipped; stamens 2, fertile, parallel under the lip of the corolla.

3. *Salvia.*

III. *Satureiineæ.*—Corolla 2-lipped; stamens 4, distant; cells of anthers separate, divergent, connective, dilated.

4. *Origanum.* 6. *Calamintha.*
5. *Thymus.*

IV. *Melissineæ.*—Corolla 2-lipped; stamens distant; anther cells connected above.

7. *Melissa.*

V. *Scutellarieæ.*—Stamens approximating, parallel under the upper lip of the corolla; calyx 2-lipped, closed in fruit.

8. *Scutellaria.* 9. *Prunella.*

VI. *Nepeteæ.*—Stamens approximating, parallel under the upper lip of the corolla, 2 inferior shortest; calyx tubular.

10. *Nepeta.*

VII. *Stachydeæ.*—Stamens approximating, parallel under the upper lip of the corolla, 2 inferior longest; calyx tubular, or bell-shaped, spreading in fruit.

11. *Melittis.* 15. *Stachys.*
12. *Lamium.* 16. *Ballota.*
13. *Leonurus.* 17. *Marrubium.*
14. *Galeopsis.*

VIII. *Ajugoideæ.*—Upper lip of corolla very short, or split and deeply bifid.

18. *Teucrium.* 19. *Ajuga.*

The genera are described under their respective names.

LAMINARIA. [ALGÆ.]

LAMINARITES. Brongniart, classing Fossil *Fuci* according to the analogy they offer to recent tribes, uses this term for one species found in the secondary strata of Aix, near La Rochelle.

LA'MIUM, a genus of Plants belonging to the natural order *Labiatæ*. It has a 2-lipped corolla, the upper lip arched, lower lip trifid. The lateral lobes minute, tooth-like, or obsolete, rarely elongated. The anthers approach in pairs, and forming a cross, burst longitudinally. The calyx is 5-toothed and bell-shaped, the teeth nearly equal. This genus includes the Dead, Blind, and Dumb Nettles of our peasants, so called from their resemblance to the *Urticæ* in many points, except their stings.

L. amplexicaule has roundish cordate obtuse leaves, the lower ones stalked, the upper ones sessile and clasping. The teeth of the calyx are longer than the tube, at length connivent; the lateral lobes of the lower lip of the corolla toothless; the nuts small, and of an obovate-oblong shape. It is found in sandy and chalky fields in Great Britain, the north of Africa, and Middle Asia.

L. intermedium has reniform, cordate, obtuse leaves, and is distinguished by the teeth of the calyx being longer than their tube, hispid, and always spreading. The lateral lobes of the lower lip of the corolla with a short tooth; the nuts twice as large as those of the former species, and of an oblong shape. This species is common in Scotland, Sweden, and the north of Germany.

L. purpureum has a pale purple corolla, spotted with red, the lateral lobes of the lower lip having two teeth. The nuts oblong, or about twice as broad as long. It is found in Great Britain and Sweden, where, according to Linnæus, it is boiled and eaten. It was formerly used in medicine, but is not now prescribed.

L. incisum has but one tooth in the lateral lobes of the lower lip of the corolla. It is a British plant, and is likewise found in France, Germany, and Sweden.

L. album is distinguished by having the calyx-teeth as long as the tube, all separated by acute angles, the upper one distant from the others. The corolla has three teeth, and is large and white. It was once used medicinally, but is now disregarded. Like *L. purpureum*, this species is eaten in Sweden as a pot-herb. It is found in Great Britain and the southern parts of Europe.

L. maculatum has the calyx-teeth longer than their tube, the three upper ones separated from the others by broad obtuse angles; the lateral lobes of the lower lip of the corolla with one tooth. It is found in Great Britain and on the continent of Europe.

L. striatum has deeply-cut ovate leaves, the corolla three times as large as the calyx, which is glabrous. It is a native of Greece in waste places, and is supposed by Fraas to be the Λευκὰς ὀρεινή of Dioscorides (iii. 103).

There are several other species of *Lamium*, growing chiefly in the southern parts of Europe. They are not worth cultivation for ornament, but will easily grow in any soil or situation, and are to be propagated either by division or by seed.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Fraas, *Synopsis Plantarum Floræ Classicæ*.)

LAMNA, a genus of Squaloid Fishes. Fossil in the Chalk, London Clay, &c., and recent. [SQUALIDÆ.]

LAMPERN. [PETROMYZON.]

LAMPREY. [PETROMYZON.]

LAMPRIS, a genus of Fishes belonging to the family *Scomberidæ*. It has an oval body greatly compressed; small scales; a single elevated and elongated dorsal fin; sides of the tail carinated; teeth wanting; branchiostegous rays 7.

L. guttatus, the Opah, or King-Fish, has been taken on the British coasts. It is a very rare fish, and as beautiful as rare. The upper part of the back and sides are of a rich green, reflecting both purple and gold in different lights, passing into yellowish-green below; above and beneath the lateral line are various round yellowish white spots, from which the fish received the name of Luna. The irides are scarlet; all the fins bright vermilion. It has been remarked, on account of these showy colours, that the Opah looks like one of Neptune's lords dressed for a court-day.

This fish was formerly referred to the genus *Zeus*, and called *Z. Luna* and *Z. imperialis*.

LAMPROTILA. [HALCYONIDÆ.]

LAMPROTORNIS. [STURNIDÆ.]

LAMPY'RIDÆ (*Lampyris*, Linn.), a family of Coleopterous Insects of the section *Malacodermi*. The insects of this family have five joints to all the tarsi; flexible elytra; the body usually elongated and somewhat depressed. The thorax projects more or less over the head; the mandibles are usually small, and terminated in a sharp point; the penultimate joint of the tarsi is always bilobed; the claws are simple, and the antennæ are approximated at the base.

The family *Lampyridæ* contains the following genera, and some others of minor importance.

Lycus, the distinguishing characters of which are—fore part of head prolonged into a snout; antennæ serrated; elytra most commonly dilated in the middle or towards their posterior part. One of the species of this genus is found in England, the *Lycus minutus*, Fab.; it is about a quarter of an inch in length, and of a black colour, with the exception of the elytra, which are brilliant red and have raised striæ.

Omalisus, Geoff.—Antennæ simple, the second and third joints much shorter than the following; head not sensibly prolonged in front; joints of the tarsi elongated and nearly cylindrical; the penultimate joint heart-shaped; elytra tolerably firm.

O. suturalis resembles in colouring and size the insect last described; the suture however is black. It inhabits France.

Lampyris.—Head not produced in front, hidden beneath the thorax; eyes in the male sex very large; antennæ short; females apterous. To this genus belongs the Glow-Worm (*Lampyris noctiluca*, Latr.). This insect is rather more than half an inch in length, of a blackish colour, the thorax is margined with dusky-red, the legs and the edges of the segments of the body of the same colour. The female resembles the male, but is quite destitute of wings, and the terminal segments of the abdomen beneath are yellowish; the thorax is semicircular; the body is very soft, of an oblong form, pointed at the extremity, and composed of 10 segments. The male Glow-Worm is said to emit the phosphorescent light in a slight degree, but it is chiefly the females from which the brilliant light proceeds which we so often see on banks, beneath hedges, and in various other situations. This light proceeds from the under part of the abdomen and near the tip, and it appears that the animal has the power of varying its intensity. Glow-Worms will live, we are informed by Latreille, a long time in vacuo, and in different kinds of gases, the nitrous acid, muriatic and sulphurous gases excepted, for in these they soon expire. When placed in hydrogen gas they sometimes detonate. If the luminous portion of the abdomen be removed, it retains its luminous property for some time, and when apparently extinct it may be reproduced by softening the matter with water. The insects emit a brilliant light if immersed in warm water, but in cold water it is extinguished. The females being apterous, and consequently restricted in their powers of locomotion, and the insect being nocturnal, it is supposed that the light emitted by the female is for the purpose of attracting the other sex. The larvæ have been kept alive for a considerable time, by the writer of this article, during which they lived upon snails, killing those of the largest size; sometimes they would seize a snail whilst crawling, and when the animal retired within its shell, they would still keep their hold, and allow themselves to be carried into the shell with the snail, and although they became enveloped in the mucous secretion, it very seldom appeared to adhere to their bodies. Upon being touched or disturbed in any way they emitted the phosphoric light, but not to so great degree as the perfect insect.

LAMPYRIS. [LAMPYRIDÆ.]

LANARKITE, a Mineral consisting of sulphato-carbonate of lead. It occurs in long slender crystals, single or aggregated into fibrous masses. The primary form is an oblique rhombic prism. Colour greenish, yellowish, or grayish. Streak white. Hardness 2·0 to 2·5. Lustre nearly resinous, but pearly on the cleavage planes. Transparent, translucent. Specific gravity 6·8 to 7. It is found at Lead Hills in Scotland. A massive variety has been met with in Siberia. The following is its analysis by Brooke:—

Sulphate of Lead	53·1
Carbonate of Lead	46·9
	——100

LANCELET. [BRANCHIOSTOMA.]

LANCE'OLA, a genus of *Crustacea* established by Mr. Say on a single species, *Lanceola pelagica*, two females of which only he appears to have seen taken on the coast of America in the Gulf Stream. M. Desmarest is of opinion that the genus belongs to the *Amphipoda* from its vesicular oblong branchiæ, to the number of ten, placed at the internal base of the feet, except those of the first and seventh pairs, and that it especially approaches *Phronima* in its caudal appendages, which consist of three pairs of lanceolate styles, which are double and supported by depressed linear peduncles annexed to the sides by three rings which compose the tail. Its mouth, provided with two triarticulate filiform palps and bifid jaw-feet, bears analogy to that of the *Cloportes*. Its general form is that of the genus *Praniza* (which M. Desmarest considers to be an Isopod); its antennæ, composed of four joints, have the last joint not divided, and the inferior antennæ are the longest. The superior antennæ have their base hidden. The eyes are elongated; the front is concave; the feet are 14 in number, and simple; the two first pairs are compressed, and the sixth is the longest. The head is short and transverse. The body is soft, and covered with membranous integuments; the tail is depressed, narrower than the body, and its terminal segment is attenuated between the posterior caudal styles.

LAND-CRAB. [GECARCINUS.]

LANDAKIA. [DRACONINA.]

LANGSDORFIA. [RHIZANTHEÆ.]

LANIADÆ, a family of Birds including the Shrikes, or Butcher-Birds (*Lanius*, Linn.).

Linnæus places his genus *Lanius* at the end of his first order, *Accipitres*, immediately following the Owls (*Strix*). The *Picæ* form the succeeding order.

Cuvier makes the Pies-Grièches (*Lanius*, Linn.) the first great genus of his *Dentirostres*, his second order; the Oiseaux de Proie (*Accipitres*, Linn.) being his first.

Vigors observes that in the characters of the notched, depressed, and angular bill, and the strong hairs or vibrissæ that surround its base, as well as in their manners, the *Muscicapidæ* partially correspond with the *Laniadæ*, from the earlier families of which they chiefly differ in their inferior power and robustness. Entering among the *Laniadæ* by the genus *Tyrannus* (Cuv.), which unites them with the preceding *Muscicapidæ*, and from which he would separate it chiefly on account of the strength of the bill, wherein the character of a Shrike is more conspicuous than that of a Flycatcher, Vigors proceeds by means of *Psaris* (Cuv.) and *Artamus* (Vieill.) to *Dicrurus* (Vieill.), the Fork-Tailed Shrikes of the Old World, where the base of the bill is still depressed and wide, as in the groups just quoted, but the apex gradually more compressed. Hence, he remarks, we are led by some intervening forms to the still more compressed bills of *Sparactes* (Ill.) and the true *Lanius* of authors, which by its short, compressed, and strongly-dentated bill exhibits the type of the family. "Here," continues the author, "we are met by some conterminous groups, among which *Falcunculus* (Vieill.) is conspicuous; and hence we descend by intermediate gradations to the more lengthened and slender-billed *Vanga* (Cuv.), together with *Prionops*, *Laniarius*, and *Thamnophilus* of M. Vieillot, which bring us in contact with the Thrushes. The extremes of the family will be found in the *Graucalus* and *Ceblepyris* of M. Cuvier, which by their bills, in some degree depressed at the base, lead back to *Tyrannus* and the other broad-billed groups which commence the family. This last-mentioned genus, *Ceblepyris*, has latterly been arranged among the Thrushes; but I feel inclined rather to leave it in its original station among the Shrikes, from the peculiarity of its tail-coverts, which form themselves into a kind of puffed-out cluster on the back. This character seems to prevail among the *Laniadæ* more generally and in a greater degree than in other birds: in one species of the family, the Puff-Backed Shrike of Africa, now rendered so familiar to our cabinets from our connection with the Cape, this singular protuberance is carried to so great an extent as to form an apparently artificial appendage to the back. In the genus before us this peculiarity seems even still further developed in the well-known conformation of the same tail-coverts, their shafts being elongated and projected beyond the webs in stiff and sharpened points. On looking to the general affinity which the extremes of this family bear to the *Musicapidæ*, and through them to the Fissirostral Birds of the last preceding tribe, we may perceive the character of feeding on the wing carried on to the *Tyranni*, the fork-tailed *Dicruri*, and more particularly to the *Artami*, or the Pie-Grièches Hirondelles of the continental writers; while the depressed bill of the same Fissirostral tribe is partially preserved in the groups just mentioned, together with that of *Ceblepyris*, which meets them at the opposite extreme of the circle of affinity." [MERULIDÆ; MUSCICAPIDÆ.]

In allusion to the rapacious habits of the *Laniadæ*, Mr. Swainson observes, that the comparisons which have been drawn between them and the Falcons are no less true in fact than beautiful in analogy, remarking that many of the *Falconidæ* sit on a tree for hours watching for such little birds as come within reach of a sudden swoop, when those birds of prey pounce on the quarry, seize it in their talons, bear it to their roost, and devour it piecemeal. These, he adds, are precisely the manners of the true Shrike; yet with all this, the structure of the Falcons and Shrikes, and their more intimate relations, are so different that they cannot be classed in the same order, though they illustrate that system of symbolic relationship termed analogy, which, in Mr. Swainson's opinion, pervades creation; but the two groups are, he remarks, in nowise connected, and there is consequently no affinity between them. The following, according to him, are the very decided external characters of the typical groups:—

The short and strong bill is abruptly hooked at the end, and the notch is so deep as to form a small tooth, more or less prominent, on each side. This projection, Mr. Swainson remarks, is analogous to the teeth of quadrupeds, so far as it enables the bird to take a firm grasp of its food, and is used to divide it into pieces: the claws also, as instruments of capture, are peculiarly fine and sharp in the typical group, and this character pervades more or less the whole family. The mode of darting suddenly on their prey (rather than hunting or searching for it) is most prevalent in those groups which are nearest related to the Flycatchers, whose general weakness however confines their depredations to the smaller insects—larger and more powerful tribes being the food of the typical Shrikes.

Mr. Swainson arranges the *Laniadæ* in five divisions or sub-families:—1, The *Tyranninæ*, or Tyrant-Shrikes; 2, the *Ceblepyrinæ*, or Caterpillar-Shrikes; 3, the *Dicrurinæ*, or Drongo-Shrikes; 4, the *Thamnophilinæ*, or Bush-Shrikes; and 5, the *Laniancæ*, or True Shrikes. According to Mr. Swainson's views the first three of these sub-families constitute the aberrant circle, or that in which the character of the Shrike is least conspicuous. The fourth is the subtypical; and in the fifth the laniue structure is most perfectly developed.

Tyranninæ.

Sub-Family Character.—Bill very straight, short, depressed its whole length; the culmen not arched, but the tip abruptly hooked. Nostrils and rictus defended by bristles. Feet short, small, and slender; lateral toes equal, or nearly so; claws long, slender, fully curved, and very acute.

Locality.—America only.

Genera.—*Ptilogonys*, Sw.; *Chrysolophus*, Sw.; *Saurophagus*, Sw., with its sub-genus *Megastoma*, Sw.; *Tyrannus*, Vieill., with its sub-genus *Milvulus*, Sw.; and *Tyrannula*, Sw.

Mr. Swainson observes that the connection between the family of Shrikes and that of the Flycatchers (*Muscicapidæ*) by means of the

Tyranninæ is so perfect that it is difficult at present to determine where one terminates and the other commences. The Water-Chats of Brazil pass by such imperceptible degrees into the lesser Tyrant-Shrikes (*Tyrannula*), that although an observer on the spot might, he remarks, draw a distinction, an ornithologist acquainted only with dried skins is at a loss to distinguish their remote ramifications. "The Water-Chats (*Fluvicolinæ*)," says Mr. Swainson in continuation, "which seem to connect the Tyrant-Shrikes to the Flycatching family, or the *Muscicapidæ*, like very many other tribes, have their plumage black and white variously blended, but without any mixture of green. The Lesser Tyrants (*Tyrannula*), on the contrary, are all of an olive-coloured plumage; that colour, in short, which is most adapted for concealment among foliage, and therefore suited to their manner of life: between these however we find some curious birds, which borrow the habits of both groups. The species called by Latham White-Headed Tody, for instance, is black and white: its general resort is on the sides of marshes, where it perches npon the reeds, and darts on passing insects in the same manner as a true Tyrant-Shrike; this we have ourselves repeatedly witnessed. Azara says that it likewise chases insects upon the ground; so that we have thus in this one bird the manners of both groups exemplified. Whether this, or the *Tyrannula ambulans* of Brazil, which lives on the ground like a lark, constitutes a generic type in this division is at present uncertain. The Lesser Tyrants (*Tyrannulæ*) are spread over the whole of America, where they represent the true Flycatcher (*Muscicapa*) of the Old World: both have nearly the same manners; and so closely do they resemble each other that they can only be distinguished by their feet, tail, and wings. From these we may pass to the True or Greater Tyrants, by a little sub-generic group (*Milvulus*, Sw.) having very long forked tails. The habits of the typical Tyrants intimately resemble those of the lesser, but they feed upon larger insects more suited to their own size: some imitate the Kingfishers, by diving in the water; and they will even prey upon small reptiles. The species, which are numerous, swarm in tropical America, where they are everywhere seen, perched upon naked branches, and uttering at short intervals a sharp and monotonous cry. The Tyrants are bold and quarrelsome birds, particularly during the season of incubation; the male will not then suffer any birds to come near its nest, and becomes so infuriated against snch unconscious intruders that it will attack both hawks and eagles, with a determination not to be resisted, until they are fairly driven away."

Ceblepyrinæ.

Sub-Family Character.—Bill broad at the base, but destitute of long bristles. Rictus nearly smooth. Wings pointed; the three first quills graduated. Feathers on the rump very thick, and apparently spinous. Tail with the centre emarginated, and the sides rounded. Feet short; lateral toes unequal.

Locality.—Warm latitudes of the Old World.

Genera.—*Ceblepyris*, Cuv.; *Oxynotus*, Sw.; *Campephaga*, Vieill., with its sub-genus *Phœnicornis*, Sw.; and *Erucivora*, Sw.

Mr. Swainson is of opinion that the passage from the Tyrant-Shrikes to the *Ceblepyrinæ* is sufficiently marked by tho Mexican genus *Ptiliogonys*, which brings them very close together. The *Ceblepyrinæ* are confined to the Old World; but, according to that author, not a single species had yot been found in Europe. They live upon soft caterpillars, for which they search among the foliage of high trees, as Le Vaillant, who first called attention to the group, pointed out. Mr. Swainson remarks that nearly all the species are distinguished by the feathers on the back, which are very thick set; and when the hand is passed over them in a direction towards the head they feel as if intermixed with little sharp spines concealed beneath the surface. This singular construction, he adds, is seen also in the Trogons, and, in a less degree, in the families of Orioles and Cuckoos. The genus *Phœnicornis*, in his opinion, unites this division to the Tyrants.

Dicrurinæ.

Sub-Family Character.—Bill compressed towards the ond; the culmen gradually arched and bent over the lower mandible. Feet short. Tail lengthened, generally forked. Wings long, and more or less pointed.

Locality.—The warm latitudes of the Old World.

Genera.—*Tephrodornis*, Sw.; *Melasoma*, Sw.; *Ocypterus*, Cuv., with its sub-genus *Analcipus*, Sw.; and *Dicrurus*, Vieill.

Mr. Swainson holds that wo are led to the *Dicrurinæ*, or Drongo-Shrikes of Le Vaillant, by those caterpillar-catchers (*Erucivora*, Sw.) which have only a few acute feathers on their back; or that the genus *Oxynotus* may possibly effect this junction. The Drongos, he states, are fly-catching birds, having their bill both compressed and depressed, and the mouth furnished with very stiff long bristles. "These," says Mr. Swainson, in continuation, "are entirely unknown in America, where they seem to be represented by the Fork-Tailed Tyrants (*Milvulus*, Sw.): like them they have the tail, almost universally, long and forked; and they associato, as do the American birds, in flocks, something like Swallows, pnrsuing insects upon the wing in every directiou. Bees appear to be a favourite food with these birds, as they are likewise with the King-Tyrant of North America (*Tyrannus intrepidus*). Some aro ornamented with littlo recurved crests in front of the head; others have the neck-feathers pointed, and of a rich metallic hue; most have the tail remarkably developed; and nearly all are of a uniform glossy black colour: hence it becomes very difficult to distinguish the species, which in truth are much more numerous than has been generally imagined. In the genus *Analcipus* we first havo a few bright colours. Only three species, natives of Madagascar and the Indian Islands, have yet been discovered; they lead us to the Swift-Shrikes (*Ocypterus*, Cuv.), so named from their very long wings; but in *Tephrodornis* these members again become like those of the Drongos. This latter genus is very remarkable; for, by the bristly nature and the incurved direction of the frontal feathers, we have a clear representation of *Chætoblemma*, and all those bristle-fronted birds which are analogical to *Prionops* and *Dasycephala*."

Mr. Swainson remarks with regard to these three groups, which form, according to him, the aberrant sub-families of the *Laniadæ*, that the approximation of the *Dicrurinæ* to the *Tyranninæ* has been thought so strong and so decisive that one ornithologist supposes they actually pass into each other; and he thinks that this union is not only highly probable, but what we should naturally expect; in which case the three aberrant groups would form their own circle.

Thamnophilinæ.

Sub-Family Character.—Lateral toes unequal; the outer connected to the first joint of the middle toe. Claws broad, and not very acute. Bill lengthened, abruptly hooked at its tip; the tooth prominent.

Genera.—*Thamnophilus*, Vieill.; *Malaconotus*, Sw.; *Prionops*, Vieill.; *Colluricincla*, Vig.

Mr. Swainson remarks that the habits of the *Thamnophilinæ*, or Bush-Shrikes, are strikingly opposed to those of the aberrant divisions, as he terms them. The Bush-Shrikes, he tells us, live among thick trees, bushes, and underwood, where they are perpetually prowling about after insects and young and sickly birds, and are great destroyers of eggs. They neither seize their prey with their claws, nor do they dart at it on the wing; the former therefore are thick and rather blunt, and the wings are so short as to indicate very feeble flight. Tho bill, which is the capturing instrument, is always stout, much more lengthened than in the True Shrikes, and very abruptly hooked at the end, which is armed with a strong tooth.

Only one species of *Prionops* (*P. plumatus*), according to the same author, was known until lately, and that is common in Senegal, where it is said to search for terrestrial insects in humid situations beneath the surface: it has a peculiar crest of rigid feathers falling back on the head, but also reversed over the base of the bill, and completely protecting the nostrils and the sides of the mouth. Mr. Swainson looks upon this bird as forming the point of union between the Bush-Shrikes and the Forked-Tailed Shrikes, or *Dicrurinæ*, the singular structure above-noticed being partially developed in the genus *Tephrodornis.*

Thamnophilus, which Mr. Swainson regards as strictly typical, shows, he observes, the perfectiou of that particular structure which distiuguishes the Bush-Shrikes. The bill is very powerful; and although many of the species far exceed a thrush in size, others are not much larger than a wren. The group is stated to be confined to the hotter latitudes of America, where the species are very numerous. Though the plumage is thick, the texture of the feathers is very soft and lax. The colours are sombre, but often elegantly varied with dark bands and white spots. Mr. Swainson looks upon the genus *Malaconotus* as representing these birds in Africa; and he observes that, although they were long confounded with them, their distinctions are very decisive, the African group being distinguished for the gaiety and brightness of their plumage; the brightest crimson, combined with glossy black or clear green, with orange or yellow, decorating most of the species. Others however have the sombre colours of the American group, but they are never banded: and a few so nearly approach the *Lanianæ* that it is very difficult to distinguish them otherwise than by the great inequality of their lateral toes, the inner one being always much shorter than the outer, and the latter often so connected to the middlo toe that the feet are partially syndactyle. The Australian genus *Collurisoma* (*Colluricincla ?*) he thinks, probably represents the tenuirostral type.

Lanianæ.

Sub-Family Character.—Lateral toes equal and free. Claws slender, acute. Bill generally short, with the tooth very prominent.

Genera.—*Lanius*, Linn.; *Telophonus*, Sw.; *Chætoblemma*, Sw.; *Nilaus*, Sw.; and *Falcunculus*, Vieill.

Mr. Swainson is of opinion that the precise passage between the *Thamnophilinæ* and the *Lanianæ* seems to be effected by the geuus *Chætoblemma*, a remarkable form discovered in South Africa by Mr. Burchell. This, Mr. Swainson observes, is the only short-billed Shriko that has the frontal feathers stiff and directed forwards upon the baso of the bill: in that respect, as well as in the length of its wings, it presents, in his opiniou, a curious analogy to *Prionops* among the Bush-Shrikes.

The samo author remarks that as the genus *Lanius* is pre-eminently typical, not ouly of its own family, but of the whole tribo of *Dentirostres*, or toothed-billed birds, every country in the world possesses examples of it: even in Australia the True Shrikes are, he states, represented by a peculiar type, tho *Falcunculus frontalis*, which however, instead of watching for its prey, and devouring birds or grasshoppers, by impaling them upon thorns, and feeding on them at leisure, like the True Shrikes, climbs among the branches of trees and devours the hard-coated beetles which lurk beneath. Here, he observes, is a bird having the form of a Shrike and the habits of a Woodpecker. This Australian Shrike, as being the scansorial type of the *Lanianæ*, becomes, in Mr. Swainson's opinion, the representative of the Titmice, and has the crest and nearly the same coloured plumage as the genus *Parus*. This analogy, according to his views, is further indicated by the great size of the hind toe, which is so unusually large, as at once to evince the climbing habits of the bird, as affirmed by Lewin. Nor is this, in his opinion, the only analogy indicated by the colours of this species; for in the Bentivi Tyrant (*Saurophagus sulphuratus*, Sw.), he sees a bird in all its most striking peculiarities of plumage coloured like the *Falcunculus cristatus*, with this difference only, that in one the back is olive-brown and in the other olive-green. "Now," continues Mr. Swainson, "it is precisely at this point where, according to our theory, the circle of the Shrike family is closed; and thus these two genera will stand in juxtaposition. Certain however it is that of all the Tyrants, the Bentivi is that which most resembles a True Shrike; not so much perhaps by its general structure as by its living upon reptiles, and even carrion, and thus becoming, like the shrikes, both insectivorous and carnivorous."

Of the two other genera comprised in this sub-family, *Telophonus* and *Nilaus*, the former, according to the same author, bears such a strong resemblance to the typical genus *Lanius*, as well as to *Malaconotus*, that, without a knowledge of the true characters of these three groups, an ornithologist may be much perplexed in detecting their essential differences. "The genus *Lanius*," says Mr. Swainson, "as already mentioned, is chiefly known in its outward appearance by its short and strongly toothed bill: but there is another character equally important, which all writers have hitherto overlooked—this is to be found in the equal length of the lateral toes and the acuteness of the claws. Now this structure of foot is also found, with a diminution hardly perceptible, in *Telophonus;* but then the bill is lengthened, so as to give these birds at the first glance an appearance of being *Malaconoti*. This union of characters is just what we should expect in such birds as were to represent the Bush-Shrikes in the circle of *Lanianæ;* for although the bill is moderately lengthened in *T. collaris*, and remarkably so in *T. longirostris*, still the culmen is regularly curved, and not abruptly hooked at the end, as in *Malaconotus*. We have no remaining doubt, in short, of the immediate union of *Telophonus* with the pre-eminently typical genus *Lanius*, this union being effected by the Corvine Shrikes in one division, and the *T. leucogrammicus* in the other. The second type is *Nilaus*, at present composed but of one species: it has the bill much like that of a True Shrike, but considerably attenuated; and the general organisation of the bird is weaker than in any other genus. This, we think, is the tenuirostral type of the circle; if so, it will consequently stand between *Chætoblemma* and *Falcunculus*. We have already shown in what respect this latter genus may be viewed as uniting the whole of the shrikes into one circular family; but as we have ventured so far as to trace out the smaller circle of the *Lanianæ*, the ornithologist may well inquire in what manner *Falcunculus* can be actually united to *Lanius*, seeing that its outward structure, no less than its scansorial habits, are so different. Now this union is effected by a singular bird of Brazil, long bandied about (to translate an expressive French phrase) in systems, from the Tanager family to the old genus *Lanius*, and then again to *Thamnophilus:* its structure was so peculiar, that some years ago we placed it as the type of a supposed genus, under the name of *Cyclaris:* a more minute analysis however of this sub-family, and more especially the recent discovery of *Chætoblemma* among the unexamined birds of our friend Mr. Burchell, has quite satisfied us that this is not one of the prominent types of the *Lanianæ*, but only an aberrant species of *Falcunculus;* we therefore cancel the name of *Cyclaris*, and propose for this bird the name of *Falcunculus Guianensis*."

The following is Mr. Swainson's table of analogies of this family:—

Tribes of Perchers.	Analogies.	Sub-Families of Shrikes.
Dentirostres	Bill short, toothed; seize their prey with their foot	*Lanianæ*.
Conirostres	Bill lengthened; compressed feet, strong robust . . .	*Thamnophilinæ*.
Scansores . .	Feet very short, hind toe lengthend .	*Dicrurinæ*.
Tenuirostres	Bill weak, mouth smooth; feed only on soft substances	*Ceblepyrinæ*.
Fissirostres .	Bill broad; feed upon the wing . .	*Tyranninæ*.

"Every one," observes Mr. Swainson, "must have perceived the resemblance, both in form and habits, between the True Shrikes and the Falcons, and that *Lanius*, which is the first division or genus, is typical of the whole family. The skulking thievish propensities of the Bush-Shrikes (*Thamnophilinæ*), and the jays (which belong to the *Conirostres*), in plundering the nests and destroying the eggs of other birds, is thus explained; since it is seen by the above table, that these two groups mutually represent each other. The very great development of the tail in nearly all the Drongo-Shrikes (*Dicrurinæ*) is also one of the most remarkable distinctions of gallinaceous birds and of the scansorial tribe, which latter is eminently characterised by the peculiar length of the hind-toe and by the tail-feathers ending in fine points: all these characters are found in the Drongos, but in no other shrikes. The soft and tender food of the Caterpillar-Catchers (*Ceblepyrinæ*) evinces that even the *Tenuirostres*—a tribe living chiefly upon juices—may be represented by insectivorous shrikes; while the great depression of the bill which has caused the Tyrants (*Tyranninæ*) to be confounded with the Flycatchers, their constant habit of capturing their prey upon the wing, and the recorded fact that more than one species dives in the water, all remind us of the fissirostral swallows and the aquatic order of *Natatores*."

Before dismissing his account of this family, Mr. Swainson makes the following remarks upon the genera *Vanga* and *Platylophus*—two modern genera, he observes, that appear to enter within its limits, but whose true situation he suspects is very different. "The name of *Vanga*," says Mr. Swainson, "was given by Buffon to a singular and very rare bird of Madagascar, as big as a jay, but with a long abruptly hooked bill like a *Thamnophilus*. It has been usual to place this genus, as well as that of *Platylophus*, in the same group: but when we find that even M. Cuvier joins them with the large Bush-Shrikes, and several of the African *Malaconoti*, in his genus *Vanga*, we immediately perceive that a group so composed is entirely artificial. The resemblance between *V. destructor* and the smaller species of *Barita*—which latter are obviously crows—is so perfect, that a suspicion has always existed in our mind that both belonged to the corvine family. As we have seen, in the genus *Falcunculus*, an Australian shrike assume all the manners of a woodpecker, may not *Vanga, Barrita* (*Barita*), &c., by analogy of reasoning, be true crows, disguised under the economy and much of the structure of shrikes? Again, does the *Vangæ* (*Vanga*) of Australia and that of Madagascar belong to the same genus, or even to the same natural group? The only specimen of this latter bird known to exist in collections is in the Paris Museum, but in too injured a state to allow of this question being answered. On the other hand we happen to know, from unquestionable testimony, that the *V. destructor* of Australia kills and eats small birds, in the same manner as the European species; and that it is actually called a Butcher-Bird by the colonists. Yet this, after all, seems to us only a relation of analogy, just as in the case of *Mniotilta*, which, although it climbs like a *Certhia*, is merely a representation of those scansorial birds, and truly belongs, by affinity, to the circle of warblers. Since our last observations upon *Vanga* were published, we have been fortunate in procuring two or three species, which so connect the Australian *Vangæ* with *Barrita* (*Barita*), that we no longer hesitate to place them all in the corvine family (*Corvidæ*); where also we now arrange *Platylophus*, since it certainly has a greater resemblance to *Vanga destructor* than to any of the Soft-Backed Shrikes (*Malaconoti*). This alteration does not however interfere with anything we have said regarding *Platylophus* being a rasorial type: as such it remains, but merely fills that station in another circle. *Platylophus*, in short, has all the outward aspect of a jay, combined with that of a shrike; while its remarkable crest indicates to which of the primary types of nature we should refer it." ('Classification of Birds;' see also 'Zoological Journal,' vols. i. and ii.; and 'Fauna Boreali-Americana,' vol. ii.)

Prince C. L. Bonaparte, in his 'Specchio Comparativo' (1827), places the genus *Lanius* between the genera *Vireo* and *Turdus*. In his 'Geographical and Comparative List of the Birds of Europe and North America' (1838), the Prince arranges the *Lanidæ* between the *Muscicapidæ* (its last sub-family being *Vireoninæ*) and the *Corvidæ*. In this arrangement the family consists of the sub-family *Laninæ*, which is composed of the genera *Lanius*, Linn., and *Enneoctonus*, Boie (*Lanius*, Vig.).

Mr. G. R. Gray makes the *Laniadæ* (his fifth family of the tribe *Dentirostres*) consist of but two sub-families—the *Lanianæ* and the *Thamnophilinæ*.

Lanianæ.—Genera, *Keroula*, J. E. Gray; *Corvinella*, Less.; *Lanius*, Linn.; *Collurio*, Briss.; *Eurocephalus*, Smith; *Oreoica*, Gould; *Falcunculus*, Vieill.; *Cyclarhis*, Sw.; *Laniellus*, Sw.; *Telophorus*, Sw.; *Nilaus*, Sw.; *Nopothera*, Mull.; *Prionops*, Vieill.; *Colluriocincla*, Vig. and Horsf.

Thamnophilinæ.—Genera, *Thamnophilus*, Vieill.; *Cymoilaimus*, G. R. Gray; *Pityriasis*, Less.; *Vanga*, Buff.; *Laniarius*, Vieill.; *Dryoscopus*, Boie; *Chaunotus*, G. R. Gray; *Cracticus*, Vieill.

The *Dicrurinæ* are placed by Mr. G. R. Gray as the last sub-family (the 6th) of the *Ampelidæ;* and the *Tyranninæ* occupy a position as the third sub-family in the family *Muscicapidæ*.

The *Laniadæ* in this author's arrangement come between the families *Ampelidæ* and *Corvidæ* (the first family of his tribe *Conirostres*. ('List of the Genera of Birds.' 1840.)

The European species of *Laniadæ* are *Lanii excubitor, meridionalis, minor, collurio*, and *rufus*, the two last belonging to the genus *Enneoctonus*, Boie.

We proceed to illustrate this family with the typical genus

Lanius.—Bill very short, strongly hooked; the tooth very prominent; wings moderate, somewhat pointed; tail rounded or slightly graduated; lateral toes free and equal; claws acute. (Sw.)

Lanius Excubitor, Linn., the Butcher-Bird, may be taken as an example.

Old Male.—Head, nape, and back, fine bright ash; a large black band passing beneath the eyes and covering the orifices of the ears; lower part pure white; wings short, black; origin of the quills and extremity of the secondaries pure white; two external tail-feathers white; the third black towards the centre, the fourth terminated by a great white space, and the fifth by a less extensive space; the two middle ones entirely black; bill and feet deep black. Length 9 or 10 inches.

The Young Male resembles the female.

Female.—Upper parts less bright ash; lower parts whitish, each breast-feather terminated by a crescent of bright ash; less white at the extremity of the secondaries, and more black on the origin of the tail-feathers.

Head and Foot of Butcher-Bird (*Lanius Excubitor*).

Varieties.—1. Nearly perfect white, only the black parts are lightly shadowed out by deep ash.

2. More or less variegated with white. (Temm.)

This is the *Castrica palombina* and Averla Maggiore of the Italians; the Pie-Grièche Grise and Pie-Grisatre of the French; Torn-Skade of the Danes; Warfogel of the Swedes; Klavert of the Norwegians; the Berg-Aelster, Grossere Neuntoder, and Gemeine Würger, of the Germans; Greater Butcher-Bird or Mattagess of Willughby; Mountain Magpie, Murdering Pie, Great Gray Shrike, Shreek, and Shrike, of the British; and Cigydd Mawr of the Welsh.

In England this species is only an occasional visitor, nor are we aware of any instance of its having bred here. "The Gray Shrike," says Mr. Yarrell, "has been obtained in several southern and western counties. In Surrey, Sussex, Wiltshire, Dorsetshire, Devonshire, Worcestershire, and Cheshire; and I am informed by Mr. Thompson of Belfast, that it has occurred in one or two instances in the North of Ireland. A specimen shot near Belfast is in the collection of Dr. J. D. Marshall. North of London, it has been killed in Suffolk, Cambridgeshire, Norfolk, Yorkshire, Cumberland, Northumberland, and Durham. No Shrikes appear to have been seen either in the islands of Orkney or Shetland; but the Gray Shrike is included among the birds of Denmark, Norway, Sweden, Lapland, Russia, and Germany. In Holland it is rare; but it is rather a common bird in France, and remains there throughout the year, frequenting woods in summer and open plains in winter. It is an inhabitant also of Spain, Portugal, and Italy." ('British Birds.') Prince C. L. Bonaparte notes it as common near Rome in winter. ('Specchio Comparativo.')

"This Bird," writes Willughby, "in the north of England is called Wierangle, a name, it seems, common to us with the Germans, who (as Gesner witnesseth), about Strasburg, Frankfort, and elsewhere, call it Werkangel or Warkangel, perchance (saith he) as it were Wurchangel, which literally rendered signifies a 'suffocating angel.' In other parts of Germany it is called Neghen-Doer, that is, Ninekiller (Enneactonos), because it kills nine birds before it ceases, or every day nine. Our falconers call it the Mattagess, a name borrowed from the Savoyards, which is by Aldrovandus interpreted a Murthering Pie." Dr. Brookes writes the northern name differently, "Called in Yorkshire and Derbyshire the Were-Angel." The food of this species, which haunts bushes, the skirts of woods and plantations, consists of mice, field-mice, frogs, small birds, lizards, and beetles. "Although," says Willughby, "it doth most commonly feed upon insects, yet doth it often set upon and kill not only small birds, as finches, wrens, &c., but (which Turner affirms himself to have seen) even thrushes themselves: whence it is wont by our falconers to be reclaimed, and made for to fly small birds."

Mr. Yarrell states that the Gray Shrike feeds upon mice, shrews, small birds, frogs, lizards, and large insects. In the 'Portraits des Oyseaux' (1557), where, by the way, it is called Falconello, the bird is represented upon a field-mouse, with the following quatrain beneath its likeness:—

> "Ceste Pie est la moindre de corsage:
> Au demeurant, elle vit de Souris,
> Rats, et Mulots, qui sont par elle pris
> Parmy les champs, gastans bled et fourrage."

So that it seems to have been considered a useful bird in France. It derives its name of Butcher-Bird from its habit of suspending its prey, after it has deprived it of life, upon thorns, and so hanging it up, as a butcher does his meat, upon its sylvan shambles. Mr. Yarrell quotes part of a letter from Mr. Doubleday of Epping, who states that an old bird of this species, taken near Norwich, in October, 1835, lived in his possession twelve months. It became very tame, and would readily take its food from its master's hands. When a bird was given to it, it invariably broke the skull, and generally ate the head first. It sometimes held the bird in its claws, and pulled it to pieces in the manner of hawks; but seemed to prefer forcing part of it through the wires, then pulling at it. It always hung what it could not eat up on the sides of the cage. It would often eat three small birds in a day. In the spring it was very noisy, one of its notes a little resembling the cry of the kestrel.

In the 'Booke of Falconrie or Hawkinge' (London, 1611), we find the Matagesse immediately following 'the Sparrowhawke;' and at the end of 'A generall division of hawks and birdes of prey, after the opinion of one Francesco Sforzino Vyncentino, an Italian gentleman falconer,' we have the following account 'of the Matagasse:'—

"Though the matagasse bee a hawke of none account or price, neyther with us in any use; yet neverthelesse, for that in my division I made recitall of her name, according to the French author, from whence I collected sundries of these points and documents appertaining to falconrie, I think it not beside my purpose briefly to describe heere unto you, though I must needs confesse, that where the hawke is of so slender value, the definition or rather description of her nature and name, must be thought of no great regard;" and then the Matagasse is described.

"Her feeding," continues Turberville, the writer of 'The Booke,' "is upon rattes, squirrells, and lisards, and sometime upon certaine birds she doth use to prey, whome she doth intrappe and deceive by flight, for this is her devise. She will stand at pearch upon some tree or poste, and there make an exceeding lamentable crye and exclamation, such as birdes are wonte to doe being wronged, or in hazarde of mischiefe, and all to make other fowles believe and thinke that she is very much distressed, and standes needefull of ayde, whereupon the credulous sellie birdes do flocke together presently at her call and voice, at what time if any happen to approach neare her, she out of hand ceazeth on them, and devoureth them (ungratefull subtill fowle!) in requital of their simplicity and pains. These hawkes are in no accompt with us, but poor simple fellows and peasants sometimes do make them to the fiste, and being reclaimed after their unskillful manner, do beare them hooded, as falconers doe their other kinde of hawkes whom they make to greater purposes. Heere I ende of this hawke, because I neither accompt her worthe the name of a hawke, in whom there resteth no valour or hardiness, ne yet deserving to have any more written of her propertie and nature, more than that she was in mine author specified as a member of my division, and there reputed in the number of long-winged hawkes. For truely it is not the property of any other hawke, by such devise and cowardly will to come by their prey, but they love to winne it by main force of winges at random, as the round-winged hawkes doe, or by free stooping, as the hawkes of the tower doe most commonly use, as the falcon, gerfalcon, sacre, merlyn, and such like, which doe lie upon their wing, roving in the ayre, and ruffe the fowle, or kill it at the encounter."

With reference to the art which the Matagasse is here said to practise in order to entrap other birds, a device attributed to the Butcher-Bird by other authors, the communication of a writer in 'The Naturalist' becomes interesting. He states that his first acquaintance with this bird was occasioned by hearing notes not entirely familiar to him, though they much resembled those of the Stonechat. Following the sound, he soon discovered the utterer; and, while listening, to his surprise, the original notes were discarded, and others adopted of a softer and more melodious character, never however prolonged to anything like a continuous song.

Sir John Sebright, in his interesting 'Observations upon Hawking,' when treating of Passage Hawks, states that the Slight Falcons (*Falco gentilis*) which are brought to this country in the spring, to be used in flying herons, are caught in the preceding autumn and winter on the heaths near Falconsweard, as they pass towards the south and east. These hawks are taken, he tells us, by placing in a favourable situation a small bow net, so arranged as to be drawn over quickly by a long string that is attached to it. A pigeon of a light colour is tied on the ground as a bait; and the falconer is concealed, at a convenient distance, in a hut made of turf, to which the string reaches. A Butcher-Bird (*Lanius Excubitor*), "that is, the Warder Butcher-Bird, from the look-out that he keeps for the falcon, is tied on the ground near the hut, and two pieces of turf are so set up as to serve him, as well for a place of shelter from the weather, as of retreat from the falcon. The falconer employs himself in some sedentary occupation, relying upon the vigilance of the butcher-bird to warn him of the approach of a hawk. This he never fails to do, by screaming loudly when he perceives his enemy at a distance, and by running under the turf when the hawk draws near. The falconer is thus prepared to pull the net the moment that the falcon has pounced upon the pigeon."

The nest is generally built on trees, and is framed of grass-stalks, roots, and moss, with a lining of down or wool. The eggs, from four to six, or, according to Temminck, from five to seven, are bluish or grayish-white, spotted on the larger end with light-brown and ash.

Butcher-Bird (*Lanius Excubitor*).

In captivity, Bechstein states that, if the bird be captured when it is old, mice, birds, or living insects may be thrown to it, taking care to leave it quite alone, for as long as any one is present it will touch nothing; but as soon as it has once begun to feed freely, it will eat fresh meat, and even become accustomed to the universal paste. An ounce of meat at least is eaten at a meal, and there should be a forked branch or crossed sticks in its cage, across the angles of which it throws the mouse or any other prey, and then darting on it behind from the opposite side of the cage, devours every morsel. The same author states that it may be easily taken if a nest of young birds crying from hunger be suspended to lime-twigs, and that in autumn and winter it will sometimes dart on birds in cages which are outside the window. Bechstein further remarks, that, like the Nutcracker, it can imitate the different notes, but not the songs of birds. Nothing is more agreeable, according to him, than its own warbling, which much resembles the whistling of the Gray Parrot: its throat at the time being expanded like that of the Green Frog. He adds, that it is a great pity that the bird only sings during the pairing season, which is from March to May, and even then often spoils the beautiful melody of its song with some harsh discordant notes.

LANIOGERUS. [NUDIBRANCHIATA.]

LANNER. [FALCONIDÆ.]

LA'NSIUM, a genus of Plants belonging to the natural order *Meliaceæ*, established by the late Dr. Jack, and formed of the *Lansium* of Rumph., 1, p. 151, t. 54, which is the *Lansai* of Marsden's 'Sumatra,' pl. v. p. 101, and the Langsal or Lanseh of the natives of the Malay Islands. This forms one of the highly-esteemed fruits peculiar to the Malayan Archipelago, or what was termed India Aquosa by old writers, though unnoticed in many works where we might expect to find it fully described. The genus is characterised by—Calyx deeply 5-parted; corolla 5-petalled, petals roundish. The tube formed by the union of the stamens is subglobose, with its mouth nearly entire, having the 10 anthers included within it. Ovary 5-celled, cells with 1-2 ovules; style short, columnar; stigma flat, 5-rayed; berry cortical, 5-celled, 5-seeded, with one or two cells only perfecting their seed; seeds enveloped in a semitransparent pulpy tunic or aril, exalbuminous; cotyledons unequal, peltate, the short radicle being inserted into their centre. The Lanseh forms a moderate-sized tree with tomentose branches. Leaves alternate, pinnate; leaflets 7 to 9, alternate, short-pedicelled, elliptic-oblong, very smooth; the young leaves are pubescent on the under surface; stipules none; racemes springing from the trunk and naked branches, at first suberect, afterwards drooping by the weight of the fruit. The fruit is of an agreeable taste, according to Marsden, though the skin contains a colouring juice, extremely bitter, and which is apt to taint the fruit if not opened with care.

The Ayer-Ayer is another fruit so nearly resembling the Lanseh in most particulars that Dr. Jack, hesitating to rank it as a species, mentions it as a permanent and well-marked variety under the name var. *β. L. aqueum*. The fruit of the Ayer-Ayer is rounder, and the pulp more watery, and dissolves more completely in the mouth than the Lanseh. Both are highly esteemed by the Malays, and are equally agreeable to the European palate. The juicy envelope of the seeds is the part eaten, and the taste is cooling and pleasant. ('Linnæan Transactions,' xiv. p. 114.)

LANTA'NA, a genus of Plants belonging to the natural order *Verbenaceæ*, named from one of the old names of *Viburnum*, which some of the species somewhat resemble in habit. They are often stated to be confined to America, but a species is found in Arabia, and two in India. They form small or moderate-sized shrubs, often with rugose aromatic leaves, and a somewhat peculiar odour in the clustered flowers, which are either pink, yellow, white, or changeable. Piso states that three species, which are confounded together in Brazil under the name *Camara*, are there used for making medicated baths for diseases of the skin. Martius states that the flowers of some species are employed for making demulcent drinks in catarrhal affections. *L. macrophylla* is employed in infusions as a stimulant, and *L. pseudo-Thea* as a substitute for tea.

LANTERN-FLY. [FULGORA.]

LAOMEDEA, a genus of *Polypifera*, established by Lamouroux to include species ranked by previous writers as belonging to *Sertularia*. [SERTULARIDÆ.]

LAPIS-LAZULI. [LAZULITE.]

LAPLYSIA. [TECTIBRANCHIATA.]

LAPPA, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Tubuliflorœ*, the tribe *Senecionideæ*, and the sub-tribe *Carduineæ*. It has an equal and many-flowered homogamous head, a globose involucre, with imbricated coriaceous scales. The receptacle is rather fleshy, flat, and with stiff fringes; the corollas are 5-cleft, regular, and with a 10-nerved tube; the stamens have papillose filaments, with anthers terminating in filiform appendages; the fruit is oblong, laterally compressed, smooth, and transversely wrinkled.

L. minor has a tapering fleshy root, an erect stem, 3 feet or more in height, solid, leafy, round, and with many wide-spreading branches; the leaves are stalked, broad, heart-shaped, and, being 3-ribbed at the base, somewhat hoary and downy beneath; the florets are axillary, with their anthers and stigmas purple. When in flower the involucre readily breaks from the stalk, and is known in the country by the name of a Bur. It adheres to the coats of animals and the hair and clothing of those who pass by, and it is almost impossible to become free from it without breaking the scales asunder and scattering the fruit. The root is reckoned tonic, aperient, and diuretic. It has had some reputation in the form of a decoction in rheumatism and diseases of the skin. Sir Robert Walpole recommends it as a remedy in gout, and some have used it as an excellent substitute for sarsaparilla. The fruit is bitter and slightly acid, and has been prescribed as a diuretic. It grows in waste places throughout Europe and the west of Asia.

L. major and *L. tomentosa* are species which are found in Germany and Switzerland, but are not used in the arts or in medicine.

(Lindley, *Flora Medica;* Koch, *Synopsis Floræ Germanicæ.*)

LA'PSANA, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Liguliflorœ*, the tribe *Achoraceæ*, and the sub-tribe *Lampsanæ*. There is but one British species of this genus—

L. communis, Nipple-Wort. It has dentate or lobed stalked leaves, the lower leaves lyrate; the involucres glabrous and angular; the stem panicled. The stem is from one to three feet in height, branched above, with yellow small-headed florets. It is found in waste uncultivated land, and derives its common name from its reputation in village medicine as a soothing application to inflamed nipples, and is used in many of our provinces as an external application in wounds and ulcerations.

L. fœtida is a species of this genus which grows in Switzerland and the regions of the Alps.

(Babington, *Manual of British Botany;* Koch, *Synopsis Floræ Germanicæ.*)

LAPWING. [CHARADRIADÆ.]

LARCH. [ABIES.]

LARDIZA'BALA, a genus of Plants belonging to the natural order *Menispermaceæ*, and named by Ruiz and Pavon after Michael Lardizala, of Uribe, a Spanish naturalist. It has diœcious and polygamous flowers. The sepals and petals disposed in a ternary order in 2 or 3 series. The stamens 6, monadelphous; berries 3- or 6-celled, the cells many-seeded. The pulp of the fruit sweet and eatable. It has leaves 2-3 ternate; the leaflets oblong, acute, unequal at the base, a little toothed; two large unequally cordate bracts situated at the base of the peduncle. This plant is a twining shrub, a native of Chili in woods at Concepcion, also in Peru about Arauco. It has an eatable fruit, which is gathered and sold in the markets of Chili and Peru. The pulp of the fruit is sweet and grateful to the taste. It is called in Peru Aguil-boguil and Guilbogui; and in Chili by that of Coquilvochi. *L. triternata* and *L. trifoliata* are climbing plants, natives of Chili and Peru, but their fruits are not eaten. (Don, *Dichlamydeous Plants.*)

LARDIZABALACEÆ, *Lardizabalads*, a small natural order of Plants, containing 7 genera and 15 species. The species are twining smooth shrubs with alternate compound leaves, without stipules. Racemes solitary or clustered; flowers coloured white, lilac, purple, or deep yellow, sometimes fragrant. The sepals of the male plant are 3 or 6 in 2 rows, deciduous; petals 6 in 2 rows, opposite the sepals, the inner ones smaller, or gland-like, or absent. Stamens 6, opposite the petals; filaments united into a tube, or even distinct; anthers turned outwards, rarely inwards, 2-celled, opening by a longitudinal slit. The female flowers as before, but larger, with 6 very imperfect stamens. Carpels distinct, 3, rarely 6 or 9, 1-celled, with a short style and a single stigma. Two of the genera inhabit the cooler parts of South America, the remainder are from the temperate parts of China. *Burasaia* is the only tropical form. These plants appear to be harmless. Some of them are eaten by the natives of Japan and India.

LARDIZABALADS. [LARDIZABALACEÆ.]

LARIDÆ, the name given by Leach to the family of Birds vernacularly known as Sea-Gulls, Sea-Mews, or Gulls, belonging to Mr. Vigors's fifth order *Natatores*.

Willughby, in his 'Ornithology,' under his section (vi.) 'Of Sea-Gulls, called in Latine *Lari*,' says in his first chapter of that section entitled 'Of Gulls in General'—"Gulls are a whole-footed fowl, with an indifferent long, narrow, sharp-pointed bill, a little crooked at the end; oblong nostrils; long and strong wings; short legs; small feet (for they do not swim much); a light body, but invested with many and thick-set feathers; a carrion carkass, the fat that is sticking to the skin (as in other birds); much upon the wing, very clamorous, hungry, and piscivorous.

"These we divide into two kinds:—1st, the greater, which have tails composed of feathers of equal length, and an angular prominency or knob on the lower chap of the bill underneath to strengthen it, that they may more strongly hold fishes; 2nd, the lesser, which have a forked tail, and no knob on the bill (or, he adds in a marginal note, 'but a very small one'). Both kinds may be divided into pied or particoloured, and gray or brown."

Willughby places the Gulls between the 'Douckers, or Loons, called in Latine *Colymbi*,' and the 'whole-footed birds with broad bills,' the first members of which are 'the Goose-kind,' commencing with the Swan.

Ray's 'Synopsis' places the Gulls between the *Colymbi* and the 'Aves Palmipedes rostro in extremo adunco, non serrato,' *Avis Diomedea* (Albatross), Shearwater, Puffinus, &c.; and he describes them as "Palmipede Birds, with a narrow, sharp, but not hooked (adunco) bill, long-winged, and much given to flight (volaticæ), called *Lari*, in English Guls or Sea-Mews, and in some places Sea-Cobs," with the following definition:—"The marks of Gulls are a strong, oblong, narrow, and acute bill, which is a little curved at the extremity, but in the smaller species straighter; nostrils oblong; wings oblong and strong; feet small; body very light, clothed with many and thick feathers; and to be clamourous, much on the wing, hungry, and piscivorous."

He divides the Gulls into three sections, namely:—

1. The Three-Toed Gulls, 'Lari tridactyli, seu postico digito carentes;'
2. Four-Toed Gulls, 'Lari tetradactyli, seu postico digito donati, and
3. Fork-Tailed Gulls, 'Lari minores, caudâ forcipatâ' (Terns, &c.).

Brisson placed in his twenty-third order (consisting of birds with four toes, the three anterior joined together by membranes and the posterior separate, and with a toothless bill), the Gulls, Petrels, Puffins, Terns, Sea-Skimmer, or *Rhyncopsalia* (*Rhynchops*, Linn.). &c.

The second division of the third order (*Anseres*) of Linnæus consists of those web-footed water-fowl which have an edentulous bill, and the following are the genera of that order:—*Rhynchops*, *Diomedea*, *Alca*, *Procellaria*, *Pelecanus*, *Larus*, *Sterna*, and *Colymbus*.

M. Lacépède's second sub-class of birds consists of those which have the lower part of the leg denuded of feathers, or many toes united by a large membrane. The first division of this sub-class comprises those birds which have three anterior toes, and one toe or none behind. In the first sub-division, the first order (the twenty-second reckoning from the beginning), consisting of palmiped water-birds with a hooked beak, we find *Diomedea* and *Procellaria*, among other genera; and in the third (twenty-third reckoning from the beginning) are placed, also among other genera, *Rhynchops*. In the fourth (twenty-fifth reckoning from the beginning), with a straight and slender bill, we have the genus *Sterna*; and, in the next but one (twenty-seventh), bill tumid (bec renflé), we have the genus *Larus*, the intervening genus being *Recurvirostra* (Avosets).

M. Duméril's third family (twenty-second in the series), consists of the long-winged *Palmipedes*, and includes *Rhynchops*, the Terns, the Avosets, the Petrels, the Albatrosses, and the Sea-Mews.

In the method of M. Meyer, we find the first sub-order (*Conirostres*) of his eleventh order, *Natatores*, comprising among other genera those of *Sterna*, *Larus*, and *Lestris*.

The Long-Winged *Natatores* (Longipennes) of Illiger consist of the genera *Rhynchops*, *Sterna*, *Larus*, and *Lestris*; and his *Natatores* with tubular nostrils (*Tubinares*), of *Procellaria*, *Haladroma*, *Pachyptila*, and *Diomedea*.

Cuvier's Long-Winged *Palmipedes* comprise the Petrels, Albatrosses, Gulls, Terns, and *Rhynchops*.

The fourth family (Pelagians) of M. Vieillot's first tribe (Teleopodes) of the order *Natatores* consist of *Stercoraria*, the Gulls, Terns, and *Rhynchops*.

M. Temminck places the whole of the *Palmipedes* in one order.

M. De Blainville's *Natatores* consist of the Macropteres (Gulls), the Syphonorhiniens (Petrels), the Cryptorhiniens (Pelicans), and the Colymhiens. In his method as developed by M. Lherminier, the Gulls (*Larus*) and the Petrels (*Procellaria*) are placed in his first sub-class, or Normal Birds.

Mr. Vigors ('Natural Affinities that connect the Orders and Families of Birds,' 'Linn. Trans.,' vol. xiv.) states that *Phaëton*, a genus belonging to the immediately preceding family (*Pelecanidæ*), bears a considerable resemblance in general appearance and habits to *Sterna*, belonging to the succeeding family of *Laridæ*, the structure of their foot alone effecting a separation between them. Even here however, he remarks, we may observe the gradation that exists between the feet of the two families; the web that unites the toes of the Tropic-Bird, as well as of the Frigate-Bird, being but half the size of that of the *Pelecanidæ* in general; and thus their foot preserves a connection with that of the Terns, where the same membrane is equally contracted. "We thus," continues Mr. Vigors, "enter the family of *Laridæ* by means of *Sterna*, with which *Rhynchops* (Linn.) most intimately accords in habits and external characters, notwithstanding the dissimilitude of the bill. The *Sterna Anglica*, or Gull-Billed Tern of Colonel Montagu, conducts us from these genera to the groups which compose the Linnæan *Larus*, now justly subdivided into two genera, the *Lestris* (Ill.), and *Larus* of authors. From this group we are led to the genera *Diomedea* (Linn.) and *Haladroma* (Ill.), which are characterised by the absence of the hind toe, by means of the species *Larus tridactylus* (Lath.), where, though the hind toe is not absolutely deficient, as might be inferred from the specific name, there appears but the rudiment of one, or rather a stump without a nail. The last-mentioned genus, *Haladroma*, originally belonged to the *Procellaria* (Linn.), and was separated from it by its tridactyle foot. Even in this character however it forms a passage from *Larus* to the groups that compose the genuine *Procellaria*, all of which are distinguished by the singular peculiarity of having no true hind toe, but a nail adhering to the tarsus in its place. We thus arrive at the Petrels, separated into the groups of the *Procellaria* (Auct.), *Pachyptila* (Ill.), *Puffinus* (Ray), and the section denominated by M. Temminck Les Petrels Herondelles. These two latter groups appear to lead us back to the Terns, or Sea-Swallows, from whence we started. The whole of this family, which corresponds with the *Longipennes* of M. Cuvier, is distinctly characterised by the strength and expansiveness of their wings, with the aid of which they traverse immeasurable tracts of the ocean in search of their food, and support their flight at considerable distances from land, seldom having recourse to their powers of swimming. We may thus discern the gradual succession by which the characters peculiar to the order descend from the typical groups that swim and dive well and frequently, but make little use of their wings for flight, to the present groups, which are accustomed to fly much, but seldom employ their powers of swimming, and never dive. The family of *Laridæ* may thus be observed to stand at the very extremity of the order; and it assumes, as I have already observed, in conjunction with the other extreme groups, much of the habits of the land birds. A portion of the group before us, the Petrels, seem even to employ their feet in their own element as if on land, walking as it were on the surface of the waters. We have thus arrived at the termination of the last family of the order, and have to look for its connection with the first. This link is immediately supplied by the before-mentioned genus, *Pachyptila*, in which the bill, broad and depressed at the base, assumes the character of that of the *Anatidæ*. There is indeed a considerable approximation and interchange of character between the two groups. The bill of some species of *Anser* may be observed to become gradually less broad and more compressed, so as to bring them closely to the Petrels; while again the web that connects their toes is equally curtailed in extent, until in one species, the Semipalmated Goose of Dr. Latham, figured in the supplement to his 'Synopsis,' we may observe no greater web than may be seen among many of the *Sternæ*. On the other hand, the same membrane is so extended in some of the Petrels, as to equal the most dilated web observable among the *Anates*. We may also add that the divisions of the *Procellariæ*, as they approach the *Anatidæ*, become gradually more nocturnal in their habits, and thus adopt a character common to a great portion of the latter family. Here then in the fifth and last order of birds we perceive the families of which it is composed following each other in a regular series of affinities, which returns into itself with a continuity similar to that which has been equally apparent in every other great department of the class."

M. Latreille places the Gulls, Puffins, Pelecanoides, Petrels, Albatrosses, Terns, Noddies, *Pachyptila*, and *Rhynchops*, in his third family (*Longipennes*), of his seventh order (*Palmipedes*), belonging, with the Échassiers (*Grallatores*), to his second section, Aquatic Birds.

Prince C. L. Bonaparte, in his 'Tabella Analitica de' Generi' ('Specchio Comparativo'), makes the *Longipennes* the first family of his order *Anseres*. He divides the family into two sections:—1, 'Narici senza margine rilevato,' consisting of the genera *Rhynchops*, *Sterna*, *Larus*, and *Lestris*; 2, 'Narici tubulose,' containing the genera *Procellaria* and *Diomedea*.

M. Lesson, in his 'Projet,' makes the *Palmipedes* (*Natatores*) his eighth order, being the third of his second section, Aquatic Birds. In the 'Table Méthodique,' at the end of his 'Manuel,' his fourth family of *Palmipedes* is named *Laridæ*, and consists of the genera

Sterna, Rhynchops, Larus, Stercorarius, Diomedea, Haladroma, Procellaria, Pachyptila, Puffinus, and *Thalassidroma*. The family is ranged by M. Lesson between the *Pelecanidæ* and the *Anatidæ*, which form his last family.

Mr. Eyton, in his 'Catalogue of British Birds,' enumerates the following genera and sub-genera as constituting the family of *Longipennata*:— Genus, *Procellaria*, Linn.: sub-genera, *Puffinus*, Ray; *Fulmarus*, Stephens; *Thalassidroma*, Leach. Genus *Lestris*, Temm.; genus *Larus*, Linn.: sub-genera, *Rissa*, Leach; *Larus*, Stephens: *Chroicocephalus*, Eyton; *Xema*, Leach; *Sterna*, Linn.; and *Anous*, Leach.

Mr. Swainson, who refers to Mr. Vigors's arrangement above noticed, speaks of the *Laridæ* as constituting a much more numerous family than either of the three *Colymbidæ, Alcidæ* (*Alcadæ*), or *Pelicanidæ* (*Pelecanidæ*) previously adverted to by him. The structure of the *Laridæ* too he considers to be more perfect in a general sense, although inferior in that particular construction which constitutes the perfection of the order, namely, the power of swimming and diving. The wings, he remarks, are very long; and the feet, although webbed, enable these birds to walk about with perfect ease on the shore in search of food; the hind toe is very small, sometimes wanting; but the legs are nearly as long as in some of the Wading Birds, of which he considers them to be the representatives. The bill he notices as being slender, much compressed, and as gradually but not abruptly bent. After referring to their gregarious and omnivorous habits, their tolerable facility of swimming, their inability to dive, and their great power of flight, Mr. Swainson notices the genera in the following order, and expresses his views in the following terms:—

"The Terns, or Sea-Swallows (*Sterna*), constitute the fissirostral type; they have remarkably long wings and slender bills; the tail is forked; and the plumage generally is a of a delicate pearl-white, with more or less black upon the head: the species are numerous, and occur in both hemispheres. The extraordinary genus *Rhynchops*, or Skimmer, although possessing much of the general habits of the terns, is eminently distinguished by the singular form of its bill, the upper mandible of which is considerably shorter than the under, and appears as if one-third of the length had been broken off: three species have been described, to which we add a fourth: they skim over the surface of the ocean with great swiftness, and scoop up small marine insects and other animals. The True or Typical Gulls (*Larus*) are a numerous race, dispersed in every clime, and so closely resembling each other in plumage, that many of the species are even now but imperfectly understood; they bear a close resemblance in general appearance to the terns, but the bill is stronger, and the upper mandible much more curved towards the end: many are of large size; and all are voracious devourers of fish, and of every marine animal, dead or alive, which is cast upon the shore; they particularly abound in northern latitudes, but seem to range over the whole world of waters. The Parasitic Gulls (*Lestris*) are the raptorial representative, and are almost confined to cold regions; they are known by their stronger conformation, their different shaped bill, and the rough scales upon their feet; these birds, like the frigate cormorants, derive their chief supply of food by robbing their more feeble congeners; they pursue the largest gulls, and make them disgorge or relinquish their hard-earned game. The black-toed and the arctic gulls belong to this group, and both are occasionally seen on the northern shores of Britain. The genus *Diomedia* (*Diomedea*) includes the well-known and gigantic albatrosses, the most powerful and bulky of the whole family; they are oceanic birds, living almost constantly out at sea, but are more particularly abundant in the Pacific Ocean: we have no examples in Britain, or indeed in Europe: the extent of their outspread wings is enormous, yet their flight, except in stormy weather, is by no means lofty; like all the rapacious birds of the ocean, they are most veracious, and their flesh is rank and repulsive. The genus *Haladroma* comprises such of the albatrosses as have the bill more resembling that of the petrels, while they agree with the former in being destitute of a hind toe; but only one or two species have as yet been clearly ascertained. The True Petrels (*Procellaria*) have the lower mandible truncated; we have a native example of this genus in the Fulmar (*P. glacialis*), but nearly all the rest inhabit the antarctic regions; they are continually out at sea, even in the most violent storms; Cuvier mentions that their French name of Petit Pierre is derived from their habits of walking on the water by the help of their wings. The Shear-Water Petrel and some others have been separated under the very objectionable name of *Puffinus*, from the different construction of their nostrils and of the lower mandible: there is one species, the English Puffin (*P. Anglorum*, Tem.), which appears to be confined to the northern coasts of Scotland. The genus *Thalassidroma*, Vig., differs from the other petrels, by having the legs longer and the bill somewhat shorter: it is composed of those small birds well known to sailors by the vulgar name of Mother Cary's Chickens. We may here also mention the sub-genus *Pachyptila*, as being that form which, of all this family, shows the nearest approach to the *Anatidæ*, with which we commenced the circle: the bill retains the general form of the petrels, but the base is considerably dilated, and its inner margins are found to be furnished with teeth-like laminæ. The most aberrant type of the *Laridæ* appears to be the genus *Dromas* of Paykull, a long-legged bird analogous to the flamingos: this we have never yet seen, but Temminck and others consider it has an affinity with the terns. The circle of the *Laridæ*, no less than that of the natatorial order, has now been traced, and we can only regret that our limited space prevents us from laying before the reader some of the very many analogies by which this arrangement is confirmed."

In the 'Synopsis' at the end of the same volume, Mr. Swainson makes the Gulls a sub-family under the name of *Laridæ*, with this definition: "Feet lengthened, formed both for walking and swimming;" the sub-family consists of the following genera and sub-genera:—*Sterna* (Terns), including *Sterna*, Linn.; *Thalassites*, Sw.; *Phaeton*, Linn.; *Rhynchops*, Linn.; and *Gavia*, Brisson; *Larus*, Linn. (Gulls); *Lestris*, Ill. (Jager); *Diomedea*, Linn. (Petrels), including *Procellaria, Diomedea*, Linn. (Albatross); *Haladroma*, Ill.; *Thalassidroma*, Vig.; *Pachyptila*, Ill.; and *Dromas*, Paykull.

Having given a general sketch of the views of authors respecting this extensive family, we shall here confine ourselves to the Gulls only, including in that term the genera *Xema*, of Leach; *Larus*, of Linnæus; and *Lestris*, of Temminck.

Xema (Leach).—Bill short, slender, straight, laterally compressed, its tip bent down; the lower mandible somewhat angulated beneath; nostrils very slender, linear; legs slender; tibiæ naked on the lower part; tail forked. (Gould.) Length about 14 inches.

X. ridibundus (*Larus ridibundus*, Linn.). Summer plumage.—Bill naked, skin round the eye, legs and feet, lively-red; head and throad deep-brown, between chocolate-colour and black; shoulders and back gray; outer edges of the quills (with the exception of that of the first, which is black) white, extremities of all but the first black, slightly tipped with white; rump, tail, and under surface, white.

Winter plumage like summer plumage, saving the head, which is gradually changed from the deep colour above-mentioned to pure white, by a process which Mr. Yarrell has proved to be different from moulting. ('Trans. Zool. Soc.,' vol. i. p. 13.)

Young of the Year.—Colour of bill and tarsi more obscure; top of the head and ear-coverts mottled with brown, which is also the colour of the back and shoulders, each feather having a lighter margin; tail broadly edged with black. (Gould.)

Xema ridibundus (adult in summer plumage, and young of the year). Gould.

This bird is the Mouette Rieuse ou à Capuchon Brun of the French; Gabblano cinerizio col Rostro e colli Piedi rossi, Gaimonc, and Corvo Bianco, of the Italians; Laughing Gull, Pewit, or Blackcap, Sea-Crow, and Mire-Crow, of the English; Yr Wilan Benddu of the Welsh.

The old birds in their complete winter plumage are, *Larus cinerarius*, Gmel.; *L. procellosus*, Bechst.; La Petite Mouette Cendrée, Briss.; Die alte Lachmeve im Winter Kleide, Leisler, &c.; Kleine Zeemeeuw, Sepp.; Gabbiano Cenerino, and Gabbiano Moretta, 'Stor degl. Ucc.;' and Red-Legged Gull of Latham.

In the summer or nuptial plumage the bird is *Larus ridibundus*, Linn., Gmel.; Mouette Rieuse à Pattes Rouges, Briss.; La Mouette Rieuse, Buff.; Schwarzköpfige Meve, Bechst., &c.; Bruinkop Meeuw, Sepp.; Gabbiano Moretta, 'Stor. degl. Ucc.;' and Black-Headed Gull of Latham.

The young of the year are *Sterna obscura*, Brown Tern, and Brown Gull of Latham.

The young in their moult and in winter are, *Larus erythropus*, Gmel.; La Petite Mouette Grise, Briss.; *Larus canescens*, Bechst.; Red-Legged Gull, Penn. 'Arct. Zool.;' Brown-Headed Gull and Red-Legged Gull variety, Latham. (Temm.)

The food of this species consists principally of insects, worms, spawn, and fry, and small fishes. In habits it resembles generally the other Gulls, but it walks better. The nest, contrary to the nidification of the other Gulls, which generally form their nests on the ledges of rocks near the sea, is placed, as is the case with other *Xemæ*, in low situations, such as meadows in the neighbourhood of the sea or æstuaries, among the herbage on the ground. The eggs, which vary much, are generally of a deepish olive, sprinkled with large brown and blackish spots.

They inhabit rivers, salt lakes, and fresh-waters; in winter only on the shores of the sea; a bird of passage in Germany and France; very abundant in Holland at all seasons of the year. (Temminck.) Mr. Selby says that in Britain they are very regular in their migratory movements (for such their departure to and from the sea-coast may properly be termed), and that their return in spring may, in some cases, be calculated upon almost to a day.

Selby speaks of the eggs of this bird as being well flavoured, free from fishy taste, and, when boiled hard, as not easily distinguishable from those of the Lapwing, for which they are sometimes substituted.

The young, he adds, are also eaten, although not held in such high estimation as they formerly were, when great numbers were annually taken and fattened for the table, and when the Gullery (or summer resort of the species) produced a revenue of from 50*l.* to 80*l.* to the proprietor. These are the See-Gulles of the ancient great festivals. In the Household Book of the fifth Earl of Northumberland, begun in 1512, these See-Gulles are among the delicacies for the principal feasts or his lordship's own 'mecs,' and they are charged at one penny or three-halfpence each.

In Willughby's time the price was higher. He mentions a colony of these birds "which yearly build and breed at Norbury in Staffordshire, in an island in the middle of a great pool in the grounds of Mr. Skrimshew, distant at least thirty miles from the sea. About the beginning of March hither they come; about the end of April they build. They lay three, four, or five eggs, of a dirty green colour spotted with dark brown, two inches long, of an ounce and a half weight, blunter at one end. The first down of the young is ash-coloured and spotted with black; the first feathers on the back after they are fledged are black. When the young are almost come to their full growth, those entrusted by the lord of the soil drive them from off the island through the pool into nets set on the banks to take them. When they have taken them they feed them with the entrails of beasts, and when they are fat sell them for fourpence or fivepence a piece. They yearly take about one thousand two hundred young ones, whence may be computed what profit the lord makes of them. About the end of July they all fly away and leave the island."

Dr. Plott, in his 'Staffordshire,' adds to the history of the birds that bred in Pewit Pool, in the parish above mentioned, that they would breed on no other land than that of the proprietor of that place, and that on the death of the owner they deserted the pool for three years, but only retired to another estate belonging to the next heir. The doctor was fond of the marvellous.

Larus.—Bill of mean length, strong, straight, cultrated, the upper mandible having the tip incurved; symphysis of the upper mandible strongly angulated, and ascending thence to the point. Nostrils placed in the middle of the bill, lateral, oblong, narrow, and pervious. Tongue pointed, with the extreme tip cloven. Wings long, acuminated. Tail even, or slightly forked. Legs placed near the centre of the body, of mean length and strength, with the lower part of the tibiæ naked. Feet of four toes, three before and one behind; the three in front united by a membrane; the hind one short and free. (Gould.)

L. marinus, Linn.; Goëland Noir Manteau of the French; Great Black-Backed Gull, Great Black and White Gull of Willughby (the provincial name is Cobb); Gwylan rûdd a gywn (Wagel) of the Welsh.

Great Black-Backed Gull (*Larus marinus*). Adult, in winter plumage.

Perfect Winter Plumage of Old Birds.—Summit of the head, region of the eyes, occiput, and nape, white, but all the feathers marked on their middle with a longitudinal stripe of bright brown; front, throat, neck, all the lower parts, back and tail, pure white; top of the back, scapulars, and the whole wing of a deep black, shaded with bluish; quills towards the end of a deep black, all terminated with a large white space; secondary quills and scapulars terminated with white; bill whitish yellow, angle of the lower mandible bright red; naked border round the eyes red; iris brilliant yellow marbled with brown; feet dirty white. Length 26 or 27 inches; females 24 to 25 inches. (Temminck.) Willughby's specimen measured, "from tip to tip of the wings distended," 67 inches.

M. Temminck observes (1820) that in this state the species had never been described. Willughby and Montagu however had each described one (the latter author in his 'Dictionary,' 1802) almost in the perfect state, and it is now beautifully figured in Mr. Gould's great work on 'The Birds of Europe.'

Summer or Nuptial Plumage of Old Birds.—Summit of the head, region of the eyes, occiput and nape, pure white without any brown; naked border round the eyes orange; rest of the plumage as in winter. In this state it is *Larus marinus*, Linn.; Le Goëland Noir Manteau, Buffon; Mantel Meve, Bechst.; Black-Backed Gull, Latham, &c. (Temminck.)

Young of the Year, and those One Year Old.—At this period the bird is *Larus nævius*, Linn.; *L. marinus junior*, Latham; Le Goëland Varié ou Grisard, Buffon; and Wagel Gull, Latham. (Temminck.)

The Young of the Year have the head and the front of the neck grayish-white covered with numerous brown spots, which are largest on the neck; the feathers of the upper parts are blackish-brown in the middle, all bordered and terminated with reddish-white, which colour forms transverse bands on the coverts of the wings; lower parts of a dirty gray, striped with large zigzags and brown spots; feathers of the middle of the tail more black than white, the lateral ones black towards the end, and all bordered and terminated with whitish; quills blackish, a little white on the point; bill deep black; iris and naked circle brown; feet livid brown.

After the First Year to the Age of Two Years.—All these colours change no otherwise than that the blackish-brown and yellow of the middle of the feathers occupy gradually less extent, giving place to pure white, which then surrounds all the feathers; the white begins to predominate over the gray in the lower parts, which have gradually less of the brown spots; the head becomes pure white, and the point and base of the bill assume a livid tint.

At two years, on the autumnal moult, the mantle is defined; it is then blackish, varied with irregular brown and gray spots; the white becomes pure, and only sprinkled with a few spots; the tail is pervaded with black marblings of varied forms; and the bill assumes the red spot with black in the middle,* the rest of that organ being livid white speckled with black.

At the third autumnal moult the plumage is perfect.

The young vary accidentally in having all the plumage grayish-white, with deeper spots, and spots very feebly indicated; the quills whitish. Sick individuals put on these appearances, as well as the greater part of those which are kept in captivity. (Temminck.)

This species is very abundant in the Orcades and Hebrides; common in its double passage on the coasts of Holland, France, and England; lives in the north; never or very accidentally found in the interior or on fresh waters; rather rare in the Mediterranean. (Temminck.) Common in many parts of the north of Europe, but does not appear to extend, at least in any considerable numbers, to very high latitudes, as Captain Sabine, in his 'Memoir of Greenland Birds,' states that it was only once seen in Baffin's Bay, and Sir John Richardson never mentions it. Met with, but by no means plentifully, upon most of our coasts, usually alone or in pairs, and rarely in a flock of more than eight or ten together. (Selby.) America (near Philadelphia), not very rare. (Prince C. L. Bonaparte.) United States. (Audubon.)

Fish, living or dead, fry, carrion, &c., form the food of this species, according to Temminck, who adds that it rarely feeds also on bivalve shell-fish. "It is," says Selby, "of very voracious appetite, and preys upon all kinds of animal substance that may happen to be cast on shore. It also keeps a close watch upon the lesser gulls, whom it drives from any food they may have discovered, appropriating the whole to itself." Montagu notices the damage it does to fishermen by severing and devouring the largest fish from their hooks, if left dry by the ebbing of the tide. Flight slow, but buoyant. Cry strong and hoarse, to be heard from a great distance when the bird is on wing, and most frequent in the spring and breeding season. Very wary; keeping by the shores of the sea, which it only quits accidentally. Nest on the rocks, Temminck says, in the regions of the Arctic Circle. Captain Sir James Ross however, in his 'Last Expedition of Sir John Ross,' does not mention it. Eggs three or four, very deep olive-green, with great and small blackish-brown spots. (Temminck.) Like those of the Herring and Lesser Black-Backed Gulls in colour and markings, but are larger. (Selby.) The author last quoted says that its breeding-stations in Britain are the Steep-Holmes and Lundy Islands in the Bristol Channel, Souliskerry in the Orkneys, the Bass Rock in the Frith of Forth, and one or two other stations upon the Scottish coast. Mr. Gould says that it also breeds in the marshes at the mouth of the Thames, making a nest on the ground of reeds, rushes, and flag-leaves.

* The individual described by Willughby as the Great Black-and-White Gull (*Larus ingens marinus Clusii*), and hereinbefore noticed, seems to have been in this stage of plumage, or rather more varied. Willughby took 'a plaise entire' out of its stomach. He also mentions another (which he supposes was a young one) with the head and neck particoloured of black and white, and the back and wings paler.

Lestris (*Catarractes*, Ray? *Catarracta*, Aldrov.?).—Bill moderate, hard, strong, cylindrical, very compressed, hooked at the point, the upper mandible covered with a cere, the under mandible with an angle on the inferior edge. Nostrils approaching the point of the bill, diagonal, narrow, closed on their posterior part, and pervious. Tarsi long, naked above the knee. Feet having three toes before, entirely palmated; hind toe very small; nails large and hooked. Tail slightly rounded, two middle feathers elongated. Wings, first quill-feather longest. (Gould.)

L. parasiticus. Old of both Sexes in Perfect Plumage.—Front whitish; on the summit of the head a sort of hood of blackish-brown, terminating at the occiput; throat, region below the eyes, all the neck, the breast, the belly, and abdomen, pure white; on the flanks some ash-coloured undulations; lower coverts of the tail, back, wings, and caudal feathers, uniform very deep ashy-brown, graduating into blackish on the end of the quills and tail-feathers; the two long tail-feathers terminated in a loose point (en pointe très-effilée); base of the bill bluish, point black; iris brown; feet deep black. Length 14 or 15 inches; the long feathers exceed from 3 to 5 or 6 inches. (Temm.)

In this state M. Temminck considers it to be *Larus parasiticus*, Linn., Gmel.; *Cataracta parasitica*, Retz; *Stercorarius longicaudus*, Briss.; Le Labbe à Longue Queue, Buff.; Stercoraria di Coda Longa, 'Stor. degl. Ucc.;' Die Polinowe, Lepechin; Struntmeve, Bechst.; Arctic Bird, Edwards; Arctic Gull, Latham.

Middle Age.—All the upper parts spotless ashy-brown; lower parts a shade brighter, equally spotless; interior base of the quills and the upper part only of the caudal feathers pure white, the rest blackish-brown; the two long feathers gradually diminishing towards the end, which is terminated in a very loose point; bill and feet as in individuals with perfect plumage.

In this state the bird is *Larus crepidatus* of the first edition of M. Temminck's 'Manuel;' Le Stercoraire of Brisson; Le Labbe ou le Stercoraire of Buffon, especially Pl. Enl. 991, and more especially Edw., t. 149. (Temm.)

Arctic Gull (*Lestris parasiticus*).

Young of the Year at the Time of their Leaving the Nest.—Top of the head deep gray; sides and upper part of the neck bright gray, sprinkled with brown longitudinal spots; a black spot before the eyes; lower part of the neck, back, scapulars, small and great coverts of the wings umber-brown, each feather being bordered with yellowish-brown, and often with reddish; lower parts irregularly variegated with deep brown and yellowish-brown on a whitish ground; abdomen and tail-coverts striped transversely; quill and tail-feathers blackish, white at their base and internal barbs, all terminated with white; tail rounded only; base of the bill yellowish-green, black towards the point; tarsi bluish-ash; base of the toes and membranes white, the rest black; posterior nail often white. (Temm.)

In this state M. Temminck considers the bird to be *Larus crepidatus*, Gmelin; *Catarracta* (Catharacta) *Cepphus*, Brunnich; Le Labbe ou Stercoraire of authors: Labbe à Courte Queue, Cuv.; and Black-Toed Gull of Latham and Pennant; Yr Wylan Ysgafn of the Welsh.

Mr. Gould, whose figure we have copied, says that he believes the bird in question to be the true *Parasiticus* of Linnæus, Buffon, and Temminck; and although Mr. Gould thinks it probable that the species undergoes variations in plumage similar to those of *Lestris Richardsonii*, he is by no means able, from his own knowledge, to state this to be the case, as in all the specimens which he had opportunities of examining the markings were clear and decided, the birds exhibiting a well-defined, dark-coloured cap on the head, light under parts, and very long middle tail-feathers.

Localities.—Shores of the Baltic, Norway, and Sweden; spreads itself habitually in the interior on lakes and rivers; of periodical or accidental passage in Germany, Holland, France, and Switzerland, where the young only ordinarily are seen: the old rarely wander. (Temminck.) "In its young state, as the Black-Toed Gull (*Larus crepidatus*) of authors, this species," writes Mr. Selby, "is not of unfrequent occurrence, during the autumnal months, upon the northern coast of England, to which it is attracted by the Gulls that follow the shoals of herring on their approach to the shallows for the purpose of depositing their spawn. Like the other Skuas it obtains the greater part of its subsistence by continual warfare on the above-mentioned birds, vigorously pursuing and harassing them till they are compelled to disgorge the food previously swallowed. In this occupation its dark plumage and rapid flight are certain to attract the attention of the spectator: and there are few probably who have visited the coast of Scotland and the northern districts of England who have not witnessed and admired the aërial evolutions of the Teazer, and the distress of its unfortunate objects of attack. It is but very rarely met with beyond the precincts of the Shetland and Orkney Isles in its adult state, and only one instance has occurred within my own observation, namely, on an excursion to the Fern Islands in the month of May, when two of these birds flew ahead of the boat in a northerly direction, and which were perfectly distinguishable by their lengthened and slender middle tail-feathers, and the black and white of their plumage. This Skua does not appear to be a permanent resident in any part of the British dominions, for Low, in his 'Fauna Orcadensis,' describes it as a migratory bird, arriving there and in Shetland in May, and departing in autumn, or as soon as the duties of reproduction have been effected." Mr. Gould says that he has not been able to ascertain whether it breeds among the British Isles, and adds that it is certainly of rare occurrence. Its natural habitat, he thinks, is more confined to the north, namely, the shores of the Baltic Sea, Norway, and the Polar regions. All our Arctic voyagers mention it, down to Captain James Ross inclusive, and it appears to be common in the Polar Seas of Europe and America.

The account given by Mr. Selby above will prepare the reader for the principal source whence this and other Jäger Gulls derive their subsistence, namely, by pursuing and buffeting the peaceable gulls and compelling them to render up the produce of their toils. But they also feed on fish, insects, and worms, and Temminck particularly mentions the *Janthina*, or Oceanic Snail, as forming a part of its sustenance. In truth no animal substances seem to come amiss to it. Mr. Richards, of her Majesty's ship Hecla, saw this bird feeding on the bodies of some young children whose graves of ice had vanished on the thaw, near Igloolik, on the 21st of June 1823.

Temminck says that it nestles not far from the sea-shore. Selby, who states that it breeds upon several of the Orkney and Shetland Isles, and that it is gregarious during that period, informs us that the situations selected are the unfrequented heaths at some distance from the shore, and that the nest is composed of dry grass and mosses. The eggs are two, of a dark oil-green with irregular blotches of liver-brown; and Mr. Selby adds that the bird at this time is very courageous, and, like the Common Skua, attacks every intruder by pouncing and striking at the head with its bill and wings. Occasionally it endeavours, according to the same authority, to divert attention by feigning lameness in the same manner as the Partridge and the Lapwing. In the Appendix to Parry's 'Voyage' (1819-20) this 'Arctic Lestris' is stated to be equally abundant in the islands of the Polar Sea as in Baffin's Bay. Captain Edward Sabine, who drew up the account, states that it is frequently met with inland, seeking its food along the water-courses which occupy the bottom of ravines; differing in this respect from the Pomarine Lestris, which is exclusively a sea-bird.

The following is a list of the British *Laridæ*, according to Yarrell:—

Sterna Caspia, the Caspian Tern.
S. Boysii, the Sandwich Tern.
S. Dougallii, the Roseate Tern.
S. Hirundo, the Common Tern.
S. arctica, the Arctic Tern.
S. leucopareia, the Whiskered Tern.
S. Anglica, the Gull-Billed Tern.
S. minuta, the Lesser Tern.
S. fissipes, the Black Tern.
S. leucoptera, the White-Winged Black Tern.
S. stolida, the Noddy Tern. [STERNA.]
Larus Sabini, Sabine's Gull.
L. minutus, the Little Gull.
L. capistratus, the Masked Gull.
L. ridibundus, the Black-Headed Gull.
L. atricilla, the Laughing Gull.
L. tridactylus, the Kittiwake Gull.
L. eburneus, the Ivory Gull.
L. canus, the Common Gull.
L. Islandicus, the Iceland Gull, or Lesser White-Winged Gull
L. fuscus, the Lesser Black-Backed Gull.
L. argentatus, the Herring Gull.
L. marinus, the Great Black-Backed Gull.
L. glaucus, the Glaucous Gull, or Large White-Winged Gull.
Lestris cataractes, the Common Skua.
L. pomarinus, the Pomerine Skua.
L. Richardsonii, Richardson's Skua.
L. Buffonii, Buffon's Skua.
Procellaria glacialis, the Fulmar Petrel. [PROCELLARIA.]
Puffinus major, the Greater Shearwater.
P. anglorum, the Manx Shearwater. [PUFFINUS.]

Thalassidroma Bulwerii, Bulwer's Petrel.
T. Wilsonii, Wilson's Petrel.
T Leachii, the Forked-Tailed Petrel.
T. pelagica, the Storm Petrel. [THALASSIDROMA.]

LARK. [ALAUDA.]

LARKSPUR. [DELPHINIUM.]

LA'RRIDÆ, a family of Hymenopterous Insects of the section *Fossores*, distinguished by the labrum being either entirely or partially concealed, and the mandibles deeply notched on the inner side near the base. It contains the following genera:—1. *Palarus* (Lat.), in which the antennæ are very short, and are gradually thicker towards the apex: the eyes are closely approximated posteriorly, and inclose the ocelli: the second cubital cell is petiolated. 2. *Tachytes* (Panzer), antennæ filiform, the basal joint slightly incrassated, the rest cylindrical; superior wings with one marginal cell, slightly petiolated and three submarginal cells, the third narrow and oblique; mandibles with a dentate process on the inner side near the base. *T. pompiliformis* is about 2½ lines in length; black, with the basal segments of the abdomen red. It is not an uncommon insect in various parts of England. 3. *Larra*: this genus differs from *Tachytes* (which is *Lyrops* of Illiger) in having no tooth on the inner side of the mandibles at the base; the eyes not being approximated posteriorly, and the metathorax and abdomen being decidedly larger. 4. *Dinetus*: eyes converging posteriorly; antennæ filiform in the female, with the first joint incrassate, in the male larger, with a deep lateral impression, the four following joints submoniliform, and the five next slightly compressed and convoluted, the remaining three filiform; superior wings, with one appendiculated marginal cell, and three submarginal cells. But one species of this genus has been found in England. 5. *Miscophus* (Jurine) has one marginal cell, which is not petiolated, to the superior wing, and two submarginal cells, the second being petiolated; the antennæ are filiform in both sexes. There is but a slight projection at the base of the mandibles. *M. bicolor* (Junine) is the only species found in England, where it is apparently rare. (Shuckard, *Essay on the Indigenous Fossorial Hymenoptera*.)

LARVA, a term applied to that state in which an insect exists immediately after its exclusion from the egg, and which precedes the pupa state. The animals commonly called Grubs, Maggots, and Caterpillars are larvæ. Grub appears to be a general term analogous to larva; the term Maggot is most generally applied to the larva state of Dipterous Insects; and Caterpillar, in the most common acceptation of the term, is used to designate the larva state of Lepidopterous Insects. These three terms however are used in a very vague manner.

The most striking difference perhaps which exists between the larva and the perfect insect consists in the superior powers of locomotion and consequently better developed skeleton possessed by the latter.

Though larvæ never possess wings, they vary much as regards the development of the locomotive organs, and as these are more or less perfect, so do the larvæ resemble or recede from the insect in its imago state. Hence Messrs. Kirby and Spence divide larvæ into two sections: those which, in general form, more or less resemble the perfect insect; and those which are unlike the perfect insect. The larvæ of both sections moult, or cast their skin, several times during their progress to maturity; the number of moults varies according to the species, and the period intervening between the moults depends upon the length of the insect's existence in the larva state. In these moults, not only is the whole external covering of the insect cast, but even the lining of the intestinal canal and of the tubes of the tracheæ is shed.

The greater portion of the larvæ of the orders rthoptera, *Hemiptera*, and *Homoptera*, excepting that they have no wings, bear a considerable resemblance to the perfect insect, and hence belong to the first of the sections just mentioned. As however the muscles which serve to support and give motion to the wings are attached to the skeleton of the thorax, so, as might be expected, we find this part in the perfect insect more unlike that of the larva perhaps than any other; and again where (as in the imago state of *Scutellera*) a portion of the thorax is greatly produced behind and serves to protect the wings when folded,—the larva, having no wings, does not possess this peculiarity.

Belonging to the second division, in which the larva does not resemble the perfect insect, are the orders *Hymenoptera*, *Coleoptera*, *Neuroptera*, *Lepidoptera*, and *Diptera*.

The larvæ of Hymenopterous Insects are usually of a short ovate form, and short and fleshy substance, devoid of legs or distinct head, and the body lies in a bent position. In the *Tenthredinetæ* (Latreille) however we have a remarkable exception, the larvæ of these insects not only being furnished with six legs attached to the thoracic segments, but also possessing a great number of prolegs. These prolegs are usually sixteen in number, and attached in pairs to the abdominal segments; in some there are but fourteen, and in others only twelve prolegs. The larvæ of the *Tenthredinetæ* very much resemble those of Lepidopterous Insects, but differ in the greater number of their prolegs; the head is large, rounded, flattened in front, and vertical in position; the body is always bent under, and when touched they roll themselves up like the *Iuli*. In the genus *Pamphilius* (Lat.), the larva possesses six thoracic legs, but no prolegs.

The larvæ of the *Coleoptera* are most commonly of an elongate, cylindrical, or slightly depressed form; the thoracic segments are almost always provided with six legs, and there are seldom any prolegs on the abdominal segments. The head is furnished with mandibles, maxillæ, labrum, labium, and antennæ, and very frequently with ocelli. The parts of the mouth and the antennæ however do not resemble those of the perfect insect. The antennæ are usually very small, and composed of but three or four distinct joints. The ocelli of the larva are replaced by compound eyes in the perfect insect. The thoracic segments are often protected by a horny plate on the upper surface: the prothorax, which is usually the largest, is generally so protected. The legs, of which these segments have each a pair, are of moderate size in most larvæ of this order, and composed of a coxa, trochanta, tibia, and tarsus; the last however appears to be represented by a small jointless claw. The body is often soft, but sometimes, like the thorax, protected by horny plates, as in some of the *Carabidæ*, *Silphidæ*, &c. In the *Carabidæ*, *Staphylinidæ*, and indeed many families, it is somewhat depressed. In many of the Heteromerous Insects it is cylindrical, of a coriaceous texture throughout, and the terminal segment is often furnished with horny appendages at the apex, and one or two prolegs beneath. The larvæ of many of the *Elaterides* are also of a coriaceous texture and cylindrical form, and the terminal segment of the abdomen is generally furnished with horny appendages. These appendages are indeed very commonly met with in Coleopterous larvæ. In those species belonging to the sections *Lamellicornes*, *Rhyncophora*, and *Longicornes*, however, we have not met with them, and the body is always of a soft and fleshy texture. The larvæ of the two last-mentioned sections have extremely minute legs.

In the order *Neuroptera* the larvæ very much resemble in general appearance many of those of the order *Coleoptera*: they always possess six thoracic legs, but seldom any prolegs. In the Case-Worms (*Trichoptera*) and some others there are a pair of prolegs attached to a terminal segment of the abdomen.

In the order *Lepidoptera* the larvæ (or caterpillars) are soft and fleshy, and usually of a cylindrical form. They possess 6 thoracic legs and generally ten prolegs. The prolegs vary in number, and are attached in pairs to the under side of the abdominal segments; but none are ever found on the 4th, 5th, 10th, or 11th segments. In the larvæ of the *Geometræ* there are but four prolegs, two of which are attached to the anal segment, and the other two to the ninth. Some of the *Tinnæ* have but two prolegs, and these are anal. In the genus *Apoda* (Haworth) the larvæ have no distinct prolegs, but in their stead a number of small transparent shining tubercles, without claws. "The prolegs of almost all lepidopterous larvæ are furnished with a set of minute, slender, horny hooks, crotchets, or claws of different lengths, somewhat resembling fish-hooks, which either partially or wholly surround the apex like a palisade. By means of these claws, of which there are from 40 to 60 in each proleg, a short and a long one arranged alternately, the insect is enabled to cling to smooth surfaces, to grasp the smallest twigs to which the legs could not possibly adhere; a circumstance which the flexible nature of the prolegs greatly facilitates." "When the sole of the foot is open, the claws with which it is more or less surrounded are turned inwards, and are in a situation to lay hold of any surface; but when the animal wishes to let go its hold it begins to draw in the skin of the sole, and in proportion as this is retracted the claws turn their points outwards, so as not to impede its motion." (Kirby and Spence.)

The larvæ of Dipterous Insects are for the most part soft and fleshy, and without legs; none have true jointed legs: some however have prolegs. The head is usually soft and indistinct, but in certain species the head is somewhat corneous, and of a determinate shape. [INSECTS.]

LARVA'RIA, the name of a group of Tertiary Fossils, proposed by M. Defrance. (Blainville, *Actinologie*, p. 442.)

LARYNX is the organ of the voice; its framework is composed of five cartilages, which are capable of being moved on each other in various directions by muscles, so as to act upon two elastic bands, on which the voice essentially depends, and which are called the vocal ligaments.

The first, the Thyroid Cartilage (*fig.* 1), consists of two plates (a, b) of dense tough fibro-cartilaginous substance, of an irregularly quadrilateral form, which are united at the lower part of their anterior edges (c, c) at an angle of about 60°. The prominence of this angular union is felt in the front of the throat, forming what is called the Pomum Adami, at the sides of and behind which the form of the cartilage may be easily traced out with the fingers. The posterior edge of each plate bears at each angle a process or horn (d, d, e, e), by which the thyroid cartilage is attached by ligaments above to the hyoid bone, and below to the cricoid cartilage.

The Cricoid Cartilage (*fig.* 2) has somewhat the form of a signet ring. It is inclosed within the angle of the thyroid cartilage, beneath whose lower edge the front and narrowest portion (a) of its ring may be felt, with an interval of about a quarter of an inch between them. It has an articulating surface on each side, by which it is moveably connected with the inferior horns of the thyroid cartilage; and two other smooth convex surfaces (b, b) on its upper and posterior edge, by which it is articulated with the two arytenoid cartilages.

The Arytenoid Cartilages have each the form of an irregular triangular pyramid (*fig.* 3). They are placed upon the upper edge of the broad part of the cricoid cartilage, just within the most expanded part of the angle formed by the receding plates of the thyroid. The base (*a*) by which each is articulated with the cricoid is slightly concave, perfectly smooth, and capable of moving to a certain extent in every direction.

Fig. 1.

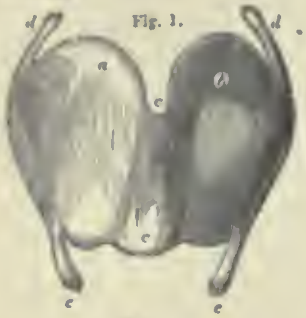


Fig. 4.

Fig. 3.

Fig. 2.

The Epiglottis (*fig.* 4) is of a somewhat ovate form. It is attached by its apex to the angle of union of the plates of the thyroid cartilage, and projects obliquely backwards and upwards over the cricoid and arytenoid cartilages like a shield, guarding them from the contact of foreign bodies passing from the mouth.

These cartilages are connected chiefly by elastic ligament, which is arranged in bands of varying thickness throughout the whole of the larynx, uniting the upper edge of the thyroid cartilage to the os hyoides, and its lower edge to the cricoid cartilage; passing also from the arytenoid cartilages to the epiglottis, and uniting the rings of the trachea and bronchi; affording to all a firm but yielding connection, and endowing them by its elasticity with the power of resounding in accordance with the vibrations originating in the vocal ligaments.

The Vocal Ligaments are two narrow bands of highly-elastic tissue, stretched between the anterior angle of the thyroid and the anterior surfaces of the the arytenoid cartilages. The substance of which they are composed is a yellowish dense fibrous tissue, which is placed in those parts of the body where a permanent elasticity is required, as in the spaces between the laminæ of the vertebræ, the coats of arteries, the rings of the trachea, &c. In *fig.* 5 a profile view of the

Fig. 5.

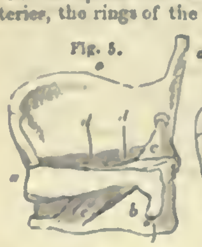


Fig. 7.

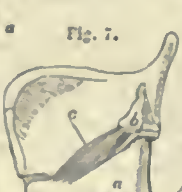
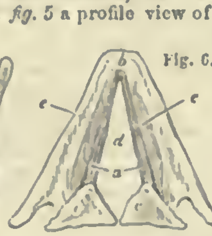


Fig. 6.



right vocal ligament is drawn: *a*, *a*, *a* is the outline of the thyroid cartilage, of which part of the left side is removed; *b* is the cricoid cartilage, and *c* the arytenoid cartilage of the right side; *d*, *d* is the vocal ligament. In *fig.* 6 the view of the vocal ligaments (*a*) is taken as seen from above; they are attached anteriorly to the inside of the thyroid cartilage at *b*, and posteriorly to the front of the arytenoid cartilages (*c*, *c*). Between them is the aperture through which we breathe, the glottis (*d*); it is bounded posteriorly by the inner edges and anterior angles of the arytenoid cartilages; anteriorly by the inner edges of the vocal ligaments. When at rest, as during quiet breathing, the glottis is of a somewhat lanceolate form (*fig.* 11, as outlined by the dots), but when speaking or singing it is very much narrowed (*fig.* 11, the continued lines).

The Muscles acting on the parts of the larynx just described are arranged symmetrically and attached to corresponding points on each side of the larynx; and their names are compounded of those of the cartilages on which they are inserted, as follows:—

The Crico-Thyroideus (*fig.* 8, *a*, *a*, and *fig.* 5, *e*) is attached on each side, at one of its extremities, to the upper edge of the narrow front part of the cricoid cartilage; and at the other, to the lower edge of the thyroid, just before its lower horn. Its fibres are directed upwards and backwards, and its immediate action would therefore be to approximate the adjacent edges of the thyroid and cricoid cartilages. But the thyroid is fixed on each side by a ligament passing from its inferior horn to the side of the broad part of the cricoid (*fig.* 5, *f*), and the crico-thyroid muscle will therefore produce a rotatory motion of the cricoid cartilage around the horizontal axis drawn through *f*. When the anterior edge of the cricoid cartilage is thus raised towards the anterior angle of the thyroid its posterior and upper part will be moved backwards and downwards to a greater distance from the front of the thyroid; and if the arytenoid cartilages be fixed on the top of the cricoid, they will of course move with it in the same direction. The distance between their anterior edges and the angle of the thyroid (*fig.* 5) will thus be increased, and the vocal ligaments (*d*, *d*), which are attached to those points, will be proportionally stretched.

The Thyro-Arytenoidei (*fig.* 6, *c*, *c*) are attached anteriorly by the sides of the angle of the thyroid cartilage to the outer side of, and above, the vocal ligaments, and posteriorly to the anterior angles and outer edges of the arytenoid cartilages. Their simplest action will therefore be to approximate the same points which the preceding muscles render more remote; they will thus shorten and relax the vocal ligaments. Some of their fibres extend on each side for a short distance above and below the vocal ligaments; those below have the power of narrowing the access to the glottis, while those above the ligaments may compress together the sides of the larynx directly over the glottis. Lastly, there are other fibres which are attached to the outer edges of the vocal ligaments themselves.

The Crico-Arytenoidei Postici (*fig.* 9, *b*, *b*) are attached to the posterior surface of the cricoid cartilage (*a*, *a*), and pass obliquely outwards, to be inserted into the outer angle of the arytenoid cartilages. In contracting therefore, if the arytenoid cartilages be moveable, they will draw their anterior angles outwards, and thus increase the width of the glottis; but if the arytenoid cartilages be fixed by other muscles, the crico-arytenoidei postici will merely draw them backwards and stretch the vocal ligaments.

Fig. 8.

Fig. 9.

The Crico-Arytenoidei Laterales (*fig.* 7, *c*) are attached on the one hand to the inner sides of the cricoid cartilage (*a*), and on the other to the outer angles of the arytenoids (*b*); they rotate the latter inwards, so as to approximate their front portions and narrow the anterior part of the glottis.

The Posterior Arytenoid Muscles (*fig.* 9, *c*, *c*) lie behind the arytenoid cartilages, and consist of fibres passing transversely and obliquely from one to the other. They therefore simply approximate these bodies, and narrow or close the back part of the glottis.

The simplest actions of all these muscles in regard to the voice may therefore be thus stated: the crico-thyroidei stretch the vocal ligaments; the thyro-arytenoidei relax them; the crico-arytenoidei postici open the glottis; the crico-arytenoidei laterales and the arytenoidei postici narrow or close it.

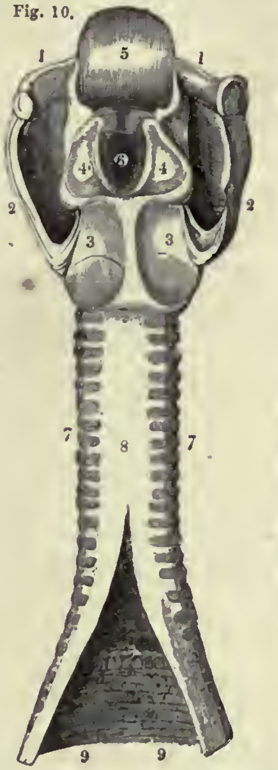
A band of muscular fibres may be also mentioned as passing from the arytenoid cartilages to each side of the epiglottis, and thus serving to draw down the latter so that it may cover the glottis more closely than when left to its own elasticity.

Below, the larynx opens into the trachea (*fig.* 10, 8), which is continued into the chest, and there divides into two branches, the bronchi, whose ramifications and terminations form the air-passages and air-cells of the lungs. The lungs, being exactly contained in the cavity of the chest, are compressed by the contractions of its walls. The walls of the chest are therefore the power by which the air is forced from the lungs through the glottis for the production of the voice, and it is by their more or less powerful contraction that the various degrees of intensity of the same note are produced. The trachea is composed of a series of cartilaginous incomplete rings which are united behind by muscular fibres, and are connected together by longitudinal elastic bands. It is thus capable of variations both of length, breadth, and tension; and of entering into vibrations with the column of air contained in it, and of assisting in communicating those vibrations through its branches to the walls of the chest.

At the upper part of the trachea the windpipe gradually narrows towards the glottis (see view of its section in *fig.* 12); and above the glottis it suddenly dilates, so that the edges of the elastic vocal ligaments stand out from the wall of the larynx, and have space in which they may vibrate freely, like the lips in the mouthpiece of a trumpet. About half an inch higher the passage again contracts, so as to form a narrow recess on each side, directly above the vocal cords. This is called the ventricle of the larynx, and the prominent bands above it are called the false vocal cords, or the upper ligaments of the larynx. They are formed of elastic tissue, like the inferior or true vocal ligaments, but in less quantity, and mixed with fatty tissue, so that they do not vibrate so freely. The walls of the ventricle are capable of being approximated by some of the fibres of the thyro-aryteuoid muscles, which are thinly distributed upon them; and thus the recess may be nearly obliterated, and the upper ligaments brought almost into contact.

The highest part of the larynx is formed by two folds of membrane passing from the arytenoid cartilages to the epiglottis (*fig.* 10), forming an oval aperture which admits of variations of size by the action of the muscles already mentioned. At this aperture the larynx communicates with the upper and most expanded part of the pharynx, the cavities of the mouth and nose, and the frontal and other sinuses which open into the latter. These sinuses are walled round by bone, but the pharynx and its communications with the mouth and nose, as well as the external apertures of the two latter cavities, are in great part muscular, and may be thus subject at will to alterations of form, size, and tension.

Fig. 10.



1, 1, Os hyoides; 2, 2, Thyroid cartilage; 3, 3, Cricoid cartilage; 4, 4, Arytenoid cartilages; 5, Epiglottis; 6, Aperture of communication between glottis and pharynx; 7, 7, Rings of trachea; 8, situation of transverse posterior muscular bands; 9, 9, portion of trachea cut open from behind.

The larynx has been compared to a variety of musical instruments, and it will be seen that in its different parts it unites the principles of several. In its essential vocal apparatus it most nearly resembles the reed-instruments, as the reed-pipes of the organ, the clarionet, &c., or rather a modification of them, in which the vibrating body is not fixed in its dimensions as a metallic tongue, or a reed, but consists of a lamina of elastic membrane, capable of varied degrees of tension, as well as of alterations in its length. No musical instrument has yet been constructed on this principle, unless we consider as such the various kinds of trumpet in which the vibrations are produced by the air impelled against the edges of the lips, rendered more or less tense by the action of their orbicular muscle. The principle has been applied in the formation of artificial larynges by Biot, Cagniard de la Tour, Willis, &c., who have chiefly used caoutchouc membrane; and by Müller and Henle, who have employed besides either the vocal ligaments themselves, or laminæ of the elastic coat of an artery. The most complete examination of the subject is that made by Müller, and published in the first part of the second volume of his 'Physiologie des Menschen.'

It is evident that by adapting to one of the open extremities of a tube two portions of thin elastic membrane, so that their opposite edges leave a narrow space in the middle, through which the air blown into the other end of the tube may pass and excite vibrations, one obtains an imitation of the essential vocal apparatus of the larynx; the trachea being replaced by the tube, the vocal ligaments by the bands of elastic membrane, and the glottis by the space between them, while the parts above the glottis may be imitated by adapting tubes of different sizes and forms above the membranes.

In such an apparatus Mr. Willis found ('Cambridge Philosophical Transactions,' 1832) that in order that two laminæ of elastic membrane inclosing a narrow interval should produce sound, the parts near their edges must be parallel to each other. Applying this law to the case of the larynx, he observes that something more is necessary for speaking or singing than a certain degree of tension of the vocal ligaments, for they are always more or less tense; and even when their tension is increased, and all the cartilages are in the position for producing sound, we may yet breathe quietly, the edges of the vocal ligaments not being parallel.

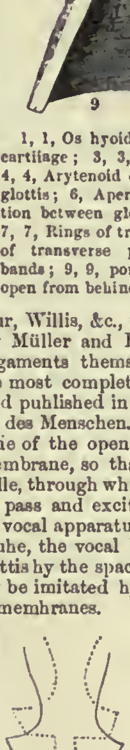


Fig. 12.

Fig. 11.

Fig. 12 represents two vertical transverse sections of the larynx, the continued line indicating the position of its parts when not sounding, the dotted line the same parts in the vocalising position, in which the edges of the ligaments are parallel to each other. Mr. Willis considers it to be one of the functions of the thyro-arytenoid muscle to place the ligaments in this essential position.

When the vocal ligaments are thus placed, the modulations of the notes are effected by the changes in their length and tension; for, like those of other elastic membranes stretched at both ends, they follow in many respects the same laws as cords. [CORD, in ARTS AND SC. DIV.] Thus, the degree of tension being the same, the height of the note is inversely as the length of the membrane; and the length being the same, the height of the note, as expressed by the number of vibrations, is directly as the square root of the power employed in producing the tension. The application of these laws to the vocal ligaments was experimentally proved by Müller. In a part of his experiments on the dead larynx he succeeded in producing the complete scale of notes and half-notes through a range of 2½ octaves, by gradually increasing the tension of the vocal ligaments by weights appended to one of their extremities. The weights produced extension in the same direction in which the crico-thyroid muscles act, when, the arytenoid cartilages being fixed, they throw them backwards with the cricoid as already explained. If instead of stretching the vocal ligaments they were left to their own elasticity, or still more relaxed by artificial means, in imitation of the action of the thyro-arytenoid muscles, still lower notes could be produced.

In the course of these experiments Müller found that the tones of the dead larynx, which in the lower notes closely resembled the chest-notes of the human voice, were very apt, as they ascended in the scale, to assume the characters of the falsetto voice. He was thus led to discover the mode in which the latter class of notes (whose origin had long been the subject of great doubt) is produced. In sounding the chest-notes, and in the common voice of speaking, the whole vocal ligaments vibrate, and with them part of the ventricles, and of the thyro-arytenoid muscles; but in the falsetto notes it is only the thin edges of the ligaments which are thrown into vibrations. He found also that he could prevent the tones of the chest-notes from breaking into those of the falsetto, as he ascended in the scale, by compressing the part of the larynx immediately below the glottis, in imitation of the action of the lower fibres of the thyro-arytenoid muscles.

As in all reed-instruments, the velocity of the current of air exciting the vibrations of the vocal ligaments has an influence on the note produced; thus Müller found that the natural note of the vocal ligaments at a given tension could be raised to its fifth by blowing with increased force. He believes that in singing the same note with varied degrees of force, a compensation is effected by lessening the tension of the ligaments in the same proportion as the velocity of the current is increased; but it seems more probable that the tension of the ligaments is always the same for the same note, while it is the office of the epiglottis to prevent the notes from rising with the increased force of the air. It may effect this on a principle discovered by M. Grenié (Magendie's 'Précis de Physiologie,' i. 253), who found that to remedy the inconvenience arising from the ascent of the note when the current of air blown into a reed organ-pipe was increased, it was sufficient to place within the pipe directly over the reed a supple elastic tongue, which shielded it very nearly in the same manner as the epiglottis covers the vocal ligaments.

Müller found that sounds were most easily produced from the dead larynx when the anterior angles of the arytenoid cartilages were in contact, so that only that part of the glottis was open which is bounded by the vocal ligaments. The tension of the ligaments being fixed, the same note could be produced whether the glottis were widely open or nearly closed; but it is probable that, though not essential, the varying apertures of the glottis are auxiliary to the complete and pure sounds of the different notes; for Magendie (l. c., p. 247) distinctly saw it become narrower as the notes emitted by a dog were higher; and in singing high notes one clearly feels that the air passes through a narrower aperture and with more difficulty than in singing the low notes.

The notes produced at the glottis are subjected to modifications in timbre, strength, and purity, by the parts connected with the larynx both above and below the vocal ligaments. To illustrate this, one need only refer to the difference of tone which may be drawn from a clarionet-reed when it is only attached to the mouth-piece, and when the mouth-piece is fixed on the body of the instrument. This part of the subject has been particularly illustrated by M. Savart, Mr. Wheatstone, and Mr. Bishop. It is well known that in all reed instruments, unless the tube or body be adapted to the reed so as to be capable of the same number of vibrations as it is, there is always a discordance of sounds. If for example the tube be unalterable in length, while the reed is capable of varied modifications of pitch, the sounds will be irregular in intensity, and in some parts of the scale will be totally extinguished. Thus it is that in organs, in each pipe, the tongue and the tube have to be adapted to each other, and that in clarionet-playing much of the perfection of the tone depends on the adaptation of the pressure of the lips on the reed to the length of the tube as determined by the number of holes covered by the fingers. Savart ('Journal de Physiologie,' t. 5) has shown that if the walls of the tube, instead of being fixed in their dimensions like those of reed-instruments, be capable of varying degrees of tension, an extraordinary variety and fulness of notes may be produced; and that the shrill whistle of the bird-call (with which he compared the larynx) is, with the same essential principle for the original formation of sound, converted into a full round tone. In the human body such a tube exists on both sides of the glottis, and is in both parts capable of varieties in tension, size, and form. Thus the trachea may be acted on by its posterior muscles and its elastic bands; and to a far greater extent the parts above the glottis will vary in their condition. In singing an ascending scale of notes, if the finger be placed in the interval between the angle of the thyroid cartilage and the front of the hyoid bone, it will be found that as the notes emitted become higher the interval diminishes and the whole larynx rises. Thus the tube above the glottis is shortened, just as in all wind-instruments the body is shortened by opening the holes at their sides, or by pushing one part of the tube within another. At the same time the lips are drawn in and compressed, the arches of the palate approximated, the uvula tightened, the back of the tongue and soft palate drawn near each other, and the oval aperture into the larynx constricted, all tending together, by a diminution of the size and an increase of the tension, to accord with the diminished length of the tube, that their vibrations may be in correspondence with those of the vocal ligaments. As the voice passes through the descending scale, the opposite changes occur; the vocal ligaments lengthen and are less tense, the larynx descends, the cavity of the mouth is expanded, and all the tissues are relaxed. Hence it is that the singer, when his voice is exerted in its highest notes, feels the greatest fatigue in the parts about the palate and pharynx; while in singing the lower notes he remains unwearied far longer, and at last feels fatigue chiefly in the muscles of the chest.

It is difficult to determine the circumstances on which the differences of the timbre of the voice in different persons depend. The difference between the male and female voices is probably owing to the comparative shortness of the vocal ligaments in the latter. According to Müller their average length in man is 18½ millimetres, in woman only 12¾ millimetres, or nearly as 3 to 2. But to account for the differences of tenor and bass, or of soprano and alto voices, no good evidence has yet been collected. The average compass of the voice is two octaves, but in different parts of the scale in different persons; thus a bass voice commonly has its lowest note four or five notes lower than a tenor, while a tenor has its highest note from four to five notes above the highest note of the bass voice. A soprano voice again has its lowest note at nearly the same part of the scale as the highest note of a bass voice; and thus the whole compass of the human voice, from the lowest of the bass to the highest of the soprano, would be nearly four octaves. The voices of children resemble very nearly those of women, but in males a remarkable change takes place at puberty, when the voice is said to crack; the change from the shrill treble voice of the boy to the fuller and rounder tone of the man is sometimes perfected almost suddenly; but in most cases it is for some time in progress, wavering between the two extremes, deep and manly during quiet enunciation, but when any exertion is used, suddenly starting up again to the shrill tones of boyhood. In old age, the cartilages of the larynx becoming bony, the ligaments hard and unyielding, and its muscles pale and powerless, the voice completely alters; it trembles as if there were not sufficient strength in the muscles to maintain a due tension of the vocal ligaments; it becomes harsh and monotonous, and

> "Turning again towards childish treble,
> Pipes and whistles in the sound."

Much yet remains unknown of the actions of the various parts of the larynx, but enough has been said to prove that it is perhaps the most perfect piece of complex mechanism in existence. Judging of it, as we must do, by comparison with the imperfect contrivances of art, it is not possible that we should be able to discern all the beauties of an instrument which in a space of about six inches by two inches produces a range of notes of between two and three octaves, all of perfect clearness and harmony, and with a tone far superior to any yet known—which is capable at the same time of giving a wide range of expression, and varied degrees of power—of executing difficult and intricate passages with the greatest rapidity and distinctness—and which above all will last for years without need of repair, and is even improved by a judicious use. The larynx fulfils all this, and is besides subservient to other functions of vital importance to the whole body. In breathing for example, its exquisite sensibility is immediately excited by the contact of any foreign substance, or of a deleterious gas, and the glottis is firmly closed by the thyro-arytenoid muscles, to prevent the entrance of the noxious body into the lungs. The same action occurs as we swallow each portion of our food, to prevent any of it passing into the lungs: and if a particle by accident touch the glottis, coughing is excited to ensure its speedy removal. Again, when about to make a violent exertion, a man first draws a full breath, and fixes his chest that he may have a firm support for all the muscles of his limbs; the same little muscles assist in this action by closing the glottis, and thus preventing any portion of the air from being forced from the chest, however great the exertion of the muscles attached to its walls.

LASER, a Gum-Resin highly esteemed among the ancients. It had become rare even in the time of Pliny, but it is described by Dioscorides (lib. iii. c. 84), and still more fully by Theophrastus under the name of Silphion (Σίλφιον, lib. vi. c. 3). In the edition of Bodæus à Stapel a most elaborate dissertation may be seen, in which apparently almost everything that occurs respecting it in ancient authors is brought together. Though the whole plant appears latterly to have been called Silphion, this name was originally that of the root. The stem of the plant is called *μαγύδαρις* by Theophrastus, the leaf *μάσπετον*, the seed *φύλλον*. These names are however differently applied by other authors. Laser was subsequently called Lasaron, and was applied to the juice alone. This was in such high estimation as to have been sold for its weight in gold, having many marvellous properties ascribed to it, but it was probably useful only as a stimulant to some of the functions and as an antispasmodic. The country where it was produced has been clearly laid down as the Cyrenaica Regio, and the physicians of Cyrene, we know, early attained a high reputation. Theophrastus gives a wider extent of distribution along the north of Africa, stating at the same time that the greater portion was collected near the Syrtes. Dioscorides gives Syria, Armenia, Media, and Libya, as the countries whence it was procured. The produce of this plant having been so valuable, it necessarily became a considerable source of revenue, and was represented on the coins of Cyrene; another is represented in the above edition of Theophrastus, with the head of a beardless man on the obverse, while a third is described as figured in Viviani's 'Flora Libyca,' in which the figure is bearded, but in all the plant is exactly the same.

From the descriptions and representations of the plant on those coins there can be no doubt of its being one of the *Umbelliferæ*, and it has successively been thought to be *Laserpitium Siler* and *gummiferum*, *Ligusticum latifolium*, *Ferula tingitana*, &c. But as the natural history of the countries becomes investigated, whence the ancients obtained the substances they have described, these doubts give way to certainties, or very near approximations to the truth. Della Cella, who travelled in the Cyrenaica in 1817, having found an umbelliferous plant on the mountains of Cyrene, and the only one at all resembling the representation on the coins, would appear to have finally determined the question. This plant has been described by Viviani in his 'Flora Libyca,' and named *Thapsia Silphion;* it is very closely allied to *T. garganica* of De Candolle, and a description of it may be seen in Dr. Lindley's 'Flora Medica,' p. 52. The root is said to yield a juice, which, according to the testimony of the natives of the country, is possessed of very valuable medical properties. M. Pacho, who travelled subsequently in the same country, thinks he has found the Laser, or *Laserpitium*, in Cyrenaica and Marmarica, and has called the plant *Laserpitium Derias.* ('Voyage dans la Cyrenaique,' Paris, 1827.)

There appears however to have been from the earliest times two kinds of Laser. Thus Pliny, "Diu jam non aliud ad nos invehitur laser, quam quod in Perside aut Media et Armenia nascitur large, sed multo infra Cyrenaicum." Dioscorides also states some to have been procured from Armenia and Media. Hence it is probable that some similar substance was substituted for the more highly esteemed Cyrenaican juice when this became scarce. There can be very little doubt that Assafœtida was at one time substituted for it, at least since the time of the Arabs, for Avicenna describes his Hulteet, which is assafœtida, as of two kinds, one fœtid, and the other fragrant, the latter from the 'regio Chiruana' in the Latin translation; while Anjidan, which are the seeds of the assafœtida plant, are translated *Laserpitium.* That assafœtida was an article of export from Persia in very early times we know, from seeing it noticed in the Sanscrit 'Amara Kosha,' which is at least of as early a date as the commencement of the Christian era. The juice and seeds of the assafœtida are likewise both used as medicinal substances, and the former esteemed even as a condiment by Asiatic natives. While the root of the Silphium, which grew on Paropamisus with pines, is mentioned by Arrian as affording food to numerous herds of cattle. This has been stated by Mr. Moorcroft to be the case, even in the present day, with another Umbelliferous Plant in the same regions, that is *Prangos pabularia*, which is therefore conjectured by Dr. Royle to be one of the kinds of Silphium. [SILPHIUM.]

LASERPITIUM (the name of the ancient Silphium), a genus of Plants belonging to the natural order *Umbelliferæ.* It has a calyx with a 5-toothed rim; the petals obovate, emarginate, with an inflected lobe; the fruit compressed from the back, or somewhat taper, 8-winged, that is, the half-fruits with five primary filiform ridges, and four winged secondary ones; a vitta in the channel below each secondary ridge. The species are herbaceous plants, with 2-3-pinnate leaves, and entire toothed or cut segments; many-rayed showy umbels; the involucres many-leaved; the flowers white, rarely yellow.

L. glabrum, glabrous Laserwort, has bipinnate leaves, quite glabrous in every part; the leaflets obliquely cordate, here and there mucronate and toothed; leaves of the involucre setaceous; wings of the fruit equal, rather curled. This plant is a native of mountainous districts of Europe in dry and stony places. It attains a height of 1 or 2 feet on the Alps, but in cultivation is a much larger plant. The root is filled with a gum-resin, which is acrid, bitter, and even somewhat caustic. It is said to be a violent purgative. The French call it Turbith aux Montagnes and Faux Turbith.

L. Siler has bipinnate quite glabrous leaves; leaflets lanceolate or oval, quite entire, mucronate, sometimes confluent, and then 3-lobed; the leaves of the involucre and involucels linear-lanceolate, slightly awned, acuminate, the wings of the fruit narrow. It is a native of the mountains of the middle and south of Europe. The root is extremely bitter, and yields an aromatic resinous substance which has been supposed to be the Silphion or Laser of the ancients. [SILPHIUM; LASER.] *L. Siler* is supposed by Fraas to be identical with the Λιγυστικὸν of Dioscorides, 3, 51. Sibthorp found this plant in Greece. *L. gummiferum*, a native of Portugal and Spain, also yields a gum-resin. There are several other species of *Laserpitium* described, and many of them yield a gum-resin, which is one of the secretions of the order to which they belong.

(Lindley, *Flora Medica;* Dou, *Dichlamydeous Plants;* Fraas, *Synopsis Plantarum Floræ Classicæ.*)

LASTREA, a genus of Ferns, belouging to the tribe *Aspidieæ.* It has a reniform indusium attached by the sinus, the veins distinct after leaving the midrib, and not uniting with those of the adjoining pinnule. [ASPIDIUM.]

L. Thelypteris, Marsh Fern, has pinnate fronds, linear-lanceolate; pinnæ slightly downy, but without glands. The lobes are entire, blunt, appearing acute on the fertile fronds from the revolute margins; the rhizome creeping. It is found in marshy and boggy places in Great Britain.

L. Oreopteris, Sweet Mountain-Fern, has pinnate fronds, the pinnæ linear-lanceolate, pinnatifid, glandular beneath, gradually decreasing from about the middle of the frond to near the root; lobes oblong, flat; sori marginal.

L. Filix mas, Male Fern, is known by its subbipinnate fronds, obtuse and serrated pinnules, sori near the central nerve, lateral nerves forked. It is found on woods aud banks in Cumberland and Yorkshire.

L. cristata has linear-lanceolate subbipinnate fronds, short triangular oblong pinnatifid pinnæ; pinnacles serrated, the lowermost lobed, and almost pinnatifid; lateral nerves of the lobes with several branches. It is found in bogs and boggy heaths in Norfolk, Nottinghamshire, and Cheshire.

L. spinulosa has the segments of the fronds serrate, and spinose mucronate; stipes clothed with broad roundish concolorous scales.

L. rigida has its fronds triangular, lanceolate, bipinnate, and glandular; segments of the piunules 2- to 5-toothed, not spinulose; stipes clothed with long-pointed concolorous scales. It is found at Inglebrough, Arnside Knot, and near Settle in Yorkshire.

L. dilatata is distinguished by tho stipes being clothed with long pointed scales, with a dark centre and diaphanous margin; the fronds are arched, often drooping, convex. It is found in woods and on banks in Westmoreland.

L. Fœnisecii has a triangular bipinnate frond; the stipes clothed with long, narrow, laciniated, concolorous scales. It is the *Nephrodium Fœnisecii* of Lowe. The frond is elongate, triangular, concave below. It is sweet-scented, and is found in damp places in Great Britain.

LATA'NIA, a genus of Palms of the tribe *Borassineæ* of Martius, which has been so-called from the uame, Latanier, of one of the species *L. Borbonica*, indigenous in the Isle of Bourbon. The other species, *L. rubra*, a much smaller plant, and remarkable for its red-coloured leaves, is a native of the Mauritius. Both are moderate sized, with all the leaves of a palmate fan shape, the flowers yellow, and the drupes yellowish ooloured. The leaves, like those of other palms, are employed by the natives for covering their huts, as well as for making fans and umbrellas. The leaf-stalks are split and employed for making baskets, sieves, &c. The fleshy part of the fruit is astringent, and the kernel bitter and purgative; and the sap is possessed of remarkable antiscorbutic properties, according to the statement of French authors.

LATHYRUS, a genus of Plants belonging to the natural order *Leguminosæ*, and the tribe *Vicieæ.* It has a campanulate 5-cleft calyx, the two upper lobes the shortest. Stamens diadelphous; style flattened, dilated at the apex, shaggy or downy in front; legume oblong, many-seeded, 2-valved; seeds globose or angular. The species are usually climbing herbaceous plants; the stipules half-sagittate; leaves cirrhose; leaflets 1, 3 pairs; peduncles axillary.

L. Aphaca is a common European field plant. It is a little smooth pale glaucous green aunual, branching from the root into several weak stems, either procumbent or climbing by means of numerous alternate simple tendrils, each of which springs from between a pair of large stipules of a broad arrow-shape, nearly entire. There are no true leaves or leaflets, except that now and then near the root, a pair of an elliptical shape on one or two rudiments of tendrils, very rarely on a real tendril, may be observed, but these soon wither away. The flowers are solitary on long simple stalks, accompanying some of the tendrils, small, drooping, and lemon-coloured. The bracts are in pairs, awl-shaped. The teeth of the calyx long and lanceolate, ribbed. The legume about an inch in length, somewhat cylindrical, smooth, with about six round seeds, which are somewhat narcotic, and produce excessive headache if oaten abundautly in the ripe state. When young and green they may be eaten without inconveuience, like green peas. It is a British species.

L. Cicera is a nativo of Spain. It is a nearly smooth plant, with spreading winged stems; the leaflets 2, linear-oblong; tendrils 3 to 4; stipules half-sagittate, lanceolate, somewhat toothed, ciliated, the length of the petiole, which is not membranous at the edge; peduncles 1-flowered, longer than the stipules; bractlets very small; calycine segments lanceolate, leafy, almost three times as long as the tube; corolla red; legumes broad, oblong, irregularly reticulated, channelled, not winged at the back; seeds 3-cornered, somewhat truncate, brown, and smooth. The seeds are poisonous, and the flour with which they are ground up is rendered unfit for use.

There are 9 British species of this genus mentioned by Babington in addition to *L. Aphaca.*

L. Nissolia is known by its leaf-like petioles, without leaves or tendrils, and with minute stipules.

L. hirsutus has linear-lanceolate leaflets, and globose tubercular seeds.

L. pratensis has many-flowered peduncles, and subulate calyx-teeth; the flowers are of a bright yellow; the hilum small and oblong. It is found in moist meadows and pastures.

L. sylvestris has a winged stem, many-flowered peduncles, the leaves of one pair of linear-lanceolate, or lanceolate leaflets; calyx teeth triangular, subulate; seeds compressed, smooth, and half surrounded by the hilum. The broad-leaved varieties often pass for *L. latifolius.*

L. latifolius is known by the leaves consisting of one pair of elliptical pointed leaflets; the seeds tubercular, rugose, one-third surrounded by the hilum. It is a doubtful native.

L. palustris has the leaves composed of 2 or 3 pairs of linear-lanceolate acute leaflets; the seeds a quarter surrounded by the hilum.

L. maritimus has an angular stem, not winged; the leaves of 3 to 8 pairs of oval leaflets; stipules large, oval, cordate, hastate. It is a rare plant found on pebbly sea shores.

L. macrorhizus is known by its simple winged stem; the leaves having two or three pairs of oblong or lanceolate blunt apiculate leaflets, without tendrils; cylindrical pods. It is the *Orobus tuberosus* of Smith.

L. niger has a branched stem, not winged; the leaves of 3 or 6 pairs of lanceolate or oblong leaflets, without tendrils; stipules linear, subulate, the lower ones arrow-shaped.

(Babington, *Manual;* Lindley, *Flora Medica.*)

LATIALITE. [HAUYNE.]

LATROBITE, a Mineral, which occurs crystallised and massive. Primary form a doubly oblique prism. Cleavage parallel to all the primary planes. Colour pale rose-red or pink. Fracture uneveu. Hardness 5·0 to 6·0. Lustre vitreous. Translucent. Specific gravity 2·72 to 2·80. Found at Amitok Island, Labrador, and in Finland. Analysis by Gmelin:—

Silica	44·65
Alumina	36·81
Lime	8·29
Potash	6·58
Oxide of Manganese	3·16
	99·49

LAUMONITE, a Mineral belonging to the group of Hydrous Silicates of Alumina. It occurs in oblique rhombic prisms. The cleavage is parallel to the acute lateral edge; also massive, with a radiating or divergent structure. The colour is white, passing into yellow or gray. Lustre vitreous. Hardness 3·5 to 4·0. Specific gravity 2·3. It contains—

Silica	48·3
Alumina	22·7
Lime	12·1
Water	16·0
	99·1

It is found exclusively in America. The best specimens are obtained at Peter's Point, Nova Scotia.

LAUNCE. [AMMODYTES.]

LAURA'CEÆ, *Laurels*, a natural order of Apetalous Exogens, consisting entirely of trees and shrubs, inhabiting the warmer parts of the world, and in most cases aromatic, on which account several are mentioned in works on officinal plants. The best known species in Europe is *Laurus nobilis*, the Sweet Bay, a beautiful evergreen, whose fragrant leaves are commonly employed to flavour confectionary. [LAURUS.] Other products of the order are cinnamon and cassia; sassafras, whose bark has great reputation in North America as a powerful sudorific; Pichurim beans, an indifferent substitute for nutmegs; and finally, not to mention other useful substances, camphor, obtained by the Chinese from the *Camphora officinarum* by means of dry distillation. [CAMPHORA.]

In geucral it may be expected that the trees of this order are valuable as aromatics and stimulants, although but a comparatively small number has yet been brought into uso. They are known by the peculiar structure of their flowers, which have no corolla, stamens iu one or several rows, often in part gland-like and sterile, a simple 1-celled superior 1-seeded ovary, and especially by the anthers bursting with recurved valves. [CINNAMOMUM; LAURUS; NECTANDRA; BENZOIN; SASSAFRAS.]

There are 46 genera and 450 species of this natural order. Its position is near *Thymelaceæ* aud *Cassythaceæ.*

LAUREL-CHERRY. [CERASUS.]

LAURUS, a genus of Plants belonging to the natural order *Lauraceæ*, to which indeed it has given its name. It includes as a species one of the most celebrated trees of antiquity, and until recent times some of the most elegant and useful of the vegetable kingdom, as among them were the trees yielding the camphor of Japan, Cinnamon, both of China and of Ceylon, Cassia bark and buds, the Malabathrum leaf of the ancients, with the less known Culilawan and Sintoc barks, as well as the American Persea, Pichurim, and Sassafras. Most of these are however now placed in distinct genera by the latest authors who have paid attention to the subject, as Nees von Esenbeck and Blume.

L. camphorifera of Kæmpfer, now the *Camphora officinarum* of Nees, is a native of Japan and of the province of Fokien in China, and also of the island of Formosa, whence, according to Mr. Reeves, the chief portion of the camphor of commerce is brought to Canton. As the wood is said to be valuable, the root, refuse wood, and smaller branches are cut into chips, covered with a little water, and the camphor separated by sublimation. [CAMPHORA.] It is necessary to distinguish this camphor from that produced in Borneo and Sumatra by *Dipterocarpus*, or *Dryobalanops Camphora*. [DRYOBALANOPS.]

The kinds of cinnamon are not so clearly settled, as there is both a Ceylon and a Chinese cinnamon. The former however is no doubt produced by *Cinnamomum Zeylanicum*, and the latter by the *C. aromaticum* of Nees. This cinnamon is of superior quality, at least some of it, and is preferred by the Chinese to that of Ceylon, and said to be produced in Cochin China chiefly in the dry sandy districts lying north-west of the town of Faifoe, between 15° and 16° N. lat. Mr. Crawfurd ('Embassy to Siam,' p. 478) informs us that there are 10 varieties of it, and that it is not cured, like that of Ceylon, by freeing it from the epidermis. Dr. A. T. Thomson gives this as one of the characters by which cassia may be distinguished from cinnamon. It is possible therefore that some of it may be imported into Europe and sold as cassia, though Mr. Marshall states that the cassia-bark of the shops is only a coarse cinnamon obtained from the thick roots or large branches of the cinnamon tree.

Cassia-Buds, or *Flores Lauri Cassiæ*, are the dried receptacles of some species of this family, by some supposed to be the above *C. aromaticum*; but it has been pointed out by Loureiro, and is named *C. Loureirii* by Nees. It is a native of Cochin China towards Laos, and of Japan. [CASSIA-BUDS.]

It has sometimes been doubted whether the substances we now call Cinnamon and Cassia are exactly the same things as those to which the ancients applied these names. It is very certain that the substances which formed such highly-esteemed articles of commerce must have possessed some remarkable physical and sensible properties not common in products beyond the tropics. The aromatic principle is that which is most conspicuous in the products of the tropical zone, and is found probably in most of the substances which the ancients obtained from the east—at least Dioscorides has described them all together. It would be difficult even with our present knowledge to find any other substances which would equally well answer the ancient descriptions, without going still farther east. The Greek name of cinnamon is *Κιννάμωμον*, which Herodotus says his countrymen learnt from the Phœnicians; and the Hebrew name, we know, is Kinnemon. It is remarkable that the Malay name is Kayu-Manis, which Mr. Marshall says is sometimes pronounced as if written Kaina-Manis. By the Hindoos cinnamon is called Dar-Cheenee, indicating that they obtained it from the Chinese; and Professor Wilson has lately proved that there was commerce by sea with China at a very early period, and, what is still more remarkable, that the navigators were Hindoos.

The Culilawan Bark, often written Culihaban, or Culitlawan, said to be derived from 'kulit,' bark, and 'lawan,' clove, in some measure resembles Cassia. It is one of those which has been known in Europe since the 17th century, but it has been little used in modern times, though Blume describes it as possessed of remarkable properties in curing diseases. Analyzed by M. Schloss, it was found to yield a resin, a volatile oil, and a bitter extractive substance. A volatile oil obtained from it in Amboyna is used as a stimulant, according to Labillardière. It was formerly employed in Europe as an aromatic stimulant, and must be useful in cases where such remedies are indicated. The tree yielding it is a native of Amboyna, and is called Cinnamomum Culilawan by Blume.

L. nobilis of Linnæus, the Laurel, or Sweet Bay, now alone remains in the genus *Laurus*. It is a native of the north of Africa and south of Europe, and of Asia; at least it has been so long naturalised in these countries that it would be difficult to ascertain whence it was originally introduced. It is the *Δάφνη* of the Greeks, and is known to the Arabs by the name Ghar, with Zafne as its Greek synonyme. The berries are even found in Indian bazaars by the name Hubal-Ghar.

It attains a height of 20 or 30 feet, and is cultivated in gardens, not only on account of its elegant appearance, but also for the aromatic fragrance of its leaves, which are evergreen, lanceolate, wavy at the margin, and quite smooth. The flowers are small, four or five clustered together in the axils of the leaves, of a yellowish-white colour, and dotted. The fruit is small, ovate, dark-purple coloured, and a little succulent. It is endowed with aromatic properties as well as the leaves, whence both have long been used in medicine as stimulants and carminatives, as well as a fatty oil expressed from the seed, which however, retaining a portion of the volatile oil, has a fragrant smell. The term 'bachelor' has by some been supposed to be derived from the former practice of crowning candidates for honours with bay-leaves and berries, whence the terms Baccalaureus and Laureate

1, a flowering branch of *Laurus nobilis*; 2, one of the flowers, much magnified; 3, a stamen, with a pair of glands on its filament, and the anther opening by two recurved valves; 4, a seed; 5, a section of the same, exhibiting a minute embryo.

LAVA, in Geology, the most general designation of the mineral substances which are erupted in a melted state from volcanic vents. The situation of volcanoes now extinct may often be recognised by their solidified products, even when the characteristic conical figure of volcanic mounds has been destroyed by time; and it is commonly supposed that 'volcanic rocks' may be distinguished from 'trap rocks,' the effects of heat in ancient geological periods, by some peculiarities of aggregation, which appear due rather to the dissimilar circumstances under which the lava was solidified than to any essential difference in the chemical constitution or mineral components.

Dr. Daubeny presents the following general view of the appearance and heat of lava:—"When observed as near as possible to the point from whence it issues, it is for the most part a semifluid mass of the consistence of honey, but sometimes so liquid as to penetrate the fibre of wood. It soon cools externally, and therefore exhibits a rough unequal surface, but, as it is a bad conductor of heat, the internal mass remains liquid long after the portion exposed to the air has become solidified. The temperature at which it continues fluid is considerable enough to melt glass and silver, and has been found to render a certain mass of lead fluid in four minutes, which, placed on red-hot iron, required double that time to enter into fusion." ('On Volcanoes.')

Lavas vary so much in chemical composition and mineralogical aspect, that it might seem impossible to reduce them to a general rule. Yet as among the older products of heat we distinguish two principal groups depending on the relative abundance of felspar and hornblende (or augite), so among the products of modern volcanoes a similar consideration clears away much of the perplexity which belongs to this subject.

According to Von Buch, almost all lavas are to be viewed as a modification of trachyte, consisting essentially of felspar and united with titaniferous iron, to which they owe their colour and their power of attracting iron; they generally contain glassy felspar; and often inclose augite, leucite, hornblende, mica, olivine, specular iron, and many other minerals, developed by crystallisation from the fused mass. Trachyte, one of the most prevalent of all volcanic products, consists chiefly of felspar (90 per cent.), and includes almost every conceivable modification between porphyry and obsidian.

Basalt, another of the characteristic volcanic rocks, contains, besides much felspar, a considerable admixture of augite or hornblende, and is rich in oxide of iron, sometimes titaniferous.

If lava were wholly felspathic it would consist principally of silica, alumina, and potash, as in column 1, the average of seven analyses of felspar: if wholly hornblendic, as in column 2, which expresses the composition of hornblende from the Vogelsberg, according to Bonsdorff; if wholly augitic, as in column 3, which is the analysis of black augite from Ætna by Vauquelin.

	(1.)	(2.)	(3.)	(4.)
Silica	64·0	42·2	52·0	51·0
Alumina	18·9	13·9	3·3	19·0
Lime	0·8	12·2	13·2	9·5
Magnesia	—	13·7	10·0	—
Potash	13·7	—	—	—
Soda	—	—	—	4·0
Oxide of Iron	0·8	14.6	14·7	14·5
&c.	—	—	6·8	—

The fourth column gives, for comparison, the result of Dr. Kennedy's examination of the compact lava from Catania. Soda, an ingredient of compact felspar, appears more frequent in lavas than potash, which belongs to common felspar: magnesia is not common, its place in the chemical aggregate being probably occupied by oxide of iron. [AUGITE.]

Trachyte is conjectured by Dr. Daubeny to be derived from granite; and some volcanic products present in their chemical composition a remarkable analogy to that of granite. Obsidian, of which a specimen from Hecla yielded to Vauquelin—

Silica	78·0
Alumina	10·0
Potash	6·0
Lime	0·1
Soda	1·6
Oxide of Iron	1·0
	96·7

is by the same writer spoken of as derived from trachyte.

In comparison with this we may place the composition of granite as calculated by Sir Henry de la Beche from its constituents, namely:—

Silica	74·8
Alumina	12·8
Potash	7·5
Lime	0·4
Magnesia	1·0
Oxide of Iron	1·9
&c.	0·3
	98·7

The certainty with which the mineral ingredients of lava can be identified depends principally on the degree of crystallisation which circumstances have permitted, and this on the rate of cooling and pressure to which the melted masses have been subjected. There is in lava every degree of variation, some specimens being of granitic, and others of earthy, compact, resinous, or vitreous texture. Yet in most cases the method of mechanical analysis proposed by Cordier will determine, what very often a lens detects, the real mixture of various minerals in what seems a homogeneous mass. According as felspar or augite predominates, volcanic rocks have been classed, by Cordier and most writers, as trachytic and basaltic. Mr. Scrope ('Journal of the Royal Institution,' vol. xxi.) has proposed an intermediate group to be called graystone. He states that in trachyte, felspar (or its substitute) exists in the proportion of 90 per cent. and upwards, in graystone more than 75 per cent., and in basalt less than 75 per cent. The specific gravity of trachyte is about 2·7, of graystone 3·0, of basalt even 3·5; differences which correspond with their chemical composition. The colours yielded by these rocks, when melted by the blow-pipe, afford a good test for the fine-grained sorts. The glass from trachyte is light-coloured and nearly transparent; graystone gives a darker glass with green or black spots; basalt is changed to a dark green or black enamel. According to conditions of solidification,—in water, in air, or in fissures of the earth,—the minerals which occur in lava are variously distributed so as to give it porphyritic, amygdaloidal, or concretionary characters; and the masses appear compact, porous, cellular, vesicular, cavernous, spumous, or filamentous—and all these circumstances are observable in glass and other products of artificial heat, which are subject to unequal rates of cooling and under different circumstances. [VOLCANO.]

LAVANDULA, a genus of Plants belonging to the natural order *Lamiaceæ*. It has a tubular calyx nearly equal, 13- or rarely 15-ribbed, shortly 5-toothed, with the 4 lower teeth nearly equal, or the 2 lower narrower, the upper either but a little broader than the lateral ones, or expanded into a dilated appendage; the upper lip of the corolla 2-lobed, lower 3-lobed, all the divisions nearly equal, the throat somewhat dilated; stamens didynamous, diclinate.

L. spica is a native of the south of Europe, of which there are two varieties, if not distinct species, termed *L. latifolia* and *L. angustifolia*. The former is also called Spike Lavender, or simply Spike, and the oil which it yields differs considerably from the oil of *L. angustifolia*, or *L. vera*, and is termed oil of spike, or foreign oil of lavender. This sort is much less fragrant, of a deeper green colour than the oil of the true lavender, and is merely used in painting, or to adulterate the genuine oil, which is so extensively employed in the preparation of perfumes.

The flowers of the *L. angustifolia* are the parts employed in medicine. They should be collected before they are expanded, as they are then possessed of a more powerful aromatic odour and a hot bitterish taste. By distillation they yield an oil, which is yellowish, but by rectification becomes nearly white. It has the agreeable strong odour of lavender, and a burning bitterish taste. It is very limpid, but becomes thicker by time. The specific gravity is variable; that of the rectified oil is about 0·872. The freshly-rectified oil of lavender acts on litmus paper, reddening it more powerfully than when a year old. In the cold it deposits a lavender-camphor, or stearopten. It is often adulterated by oil of turpentine and oil of spike. The oil dropped on sugar relieves slight spasms of the stomach; when diffused by alcohol in water it constitutes the spirits of lavender. The compound tincture of lavender is useful in similar cases, and is the best means of covering the disagreeable taste of aloes.

LAVATE'RA (in honour of the two Lavaters), a genus of Plants belonging to the natural order *Malvaceæ*. It has numerous styles, a double calyx, the outer one being 3-leaved, the inner 5-leaved; the capsules orbicular and many-celled; the cells circularly arranged, and 1-seeded.

L. arborea, Tree Mallow, has a wooded stem, the leaves 7-angled, plaited, and downy; the pedicels aggregate, axillary, 1-flowered, and much shorter than the petiole. It is a native of Italy, Spain, Portugal, the north of Africa, and the Canary Islands, on maritime rocks; also in Britain, in the Isle of Wight, on Portland Island, in Cornwall, and Devonshire. It is the Μαλάχη of Theophrastus ('Hist. Pl.,' i. 5; i. 14).

L. Neapolitana has an herbaceous scabrous erect stem, with roundish 7-nerved leaves, and 7 blunt crenated lobes: the pedicels axillary and aggregate, the involucel shorter than the calyx, the lobes of the calyx acuminated. The flowers are blue with obcordate petals. This species is a native of Naples, by the sea-side, and is much cultivated in our own gardens as an ornamental plant.

L. Olbia has a shrubby stem, rather scabrous, from distant fascicles of hairs; the leaves are soft, woolly, 5-lobed, the upper ones 3-lobed, with the middle lobe elongated; the uppermost leaves are oblong, almost undivided, the flowers solitary and sessile. It is a native of Provence, in hedges about D'Hières.

None of the species of *Lavatera* are of any importance or value, excepting as ornamental plants. Many of them are hardy, easily cultivated, and well adapted for shrubberies. The greenhouse and frame species will thrive well in a mixture of loam and peat, or any light soil; they may be planted out during the summer against a south wall, and if protected in the winter by a mat, will generally survive throughout the year. The perennial species grow in any kind of soil, and may be propagated either by dividing the plants at the root or by seeds. The annual and biennial kinds should be sown in the open border during the spring. The species chiefly worth cultivation in gardens are *L. Olbia*, *L. flava*, *L. unguiculata*, *L. Neapolitana*, *L. Cretica*, *L. Lusitanica*, and *L. trimestris*.

(Don, *Dichlamydeous Plants*; Babington, *Manual Brit. Bot.*; Fraas, *Synopsis Plantarum Floræ Classicæ*.)

LAVENDER. [LAVANDULA.]

LAVENDULAN, a Mineral which occurs amorphous. Colour lavender blue. Streak paler blue. Lustre greasy, inclining to vitreous. Hardness 2·5 to 3·0. Occurs at Annaberg in Saxony, with cobalt and iron-ores. Accorning to Plattner, it contains arsenic, and the oxides of cobalt, copper and nickel, and water.

LAVER, a substance sometimes used as food, consists of the fronds of marine plants belonging to the genera *Porphyra* and *Ulva*.

Purple Laver is furnished by *Porphyra laciniata* and *P. vulgaris*, two species common on rocks and stones in the sea on many parts of the British coast. They derive their botanical name from their beautiful purple or violet colour, which is produced entirely by the multitudes of spores, arranged in twos, threes, or fours, with which the whole frond is filled.

Green Laver is the *Ulva latissima*, a very common plant in the sea on rocks and stones, not only in Great Britain, but also on the coasts of India, Australia, the Cape of Good Hope, and South America. According to Lightfoot, the Scottish Islanders ascribe to it anodyne properties, and bind it about the temples to assuage the pain of headache in fevers, and to procure sleep.

In the Western Isles of Scotland, we are informed by the same authority, the inhabitants gather it in the month of March; and after pounding and stewing it with a little water, eat it with pepper, vinegar, and butter; others stew it with leeks and onions. In England Laver is usually stewed and rendered palatable with lemon-juice; to many persons it is however nauseous, and it has been suggested that its introduction to fashionable tables was the sly contrivance of some medical practitioner who wished to prescribe it for the benefit of his scrofulous patients. [ALGÆ.]

(Greville, *Algæ Britannicæ*.)

LAWSO'NIA, a genus of Plants belonging to the natural order *Lythraceæ*, which, consisting of only one or two species, may be found in most Oriental regions in gardens or in field cultivation. The genus is characterised by having a 4-partite calyx, 4 unguiculate petals, 8 stamens, a sessile ovary, the capsule scarcely dehiscent, or rather forming a globular membranaceous 4-celled berry, with several angular seeds in each cell.

It is disputed among botanists whether this genus consists of one or of two species; in the latter case, one species being armed with thorns, was called *L. spinosa*, and the other being without any, was named *L. inermis*, by Linnæus. De Candolle has followed Lamarck in uniting them together under the name *L. alba*, stating that when young the plant is unarmed, but when older becomes thorny from the hardening of the smaller branches.

The natives of North India distinguished the unarmed species by the name Phoolke, or flowering Mhendee. It is a much smaller plant, but flowers most abundantly. The thorny species is called Mhendee; this, besides being a larger plant, contains a greater proportion of colouring matter, and is extensively cultivated in the vicinity of Sidonra, near the north-west bank of the Jumna. The flowers of both are corymbose, white, and powerfully fragrant; the leaves smooth, opposite, oval, lanceolate. To the latter species or variety the Arabic name Hinna or Henna is more especially applied, which, in many of their medical works, as in that of Serapion, is described under that of Al Kanna, where it is interesting to observe he quotes the description by Dioscorides of Κύπρος, as applicable to this plant. This Kupros, or Cyprus, is moreover supposed to be the Copher of Scripture. ('Canticl.,' i. 12). Besides the similarity of name, no plant is more likely to have been alluded to in the above passage, as no other is more highly esteemed or more frequently employed than the Hinna, and it would appear to have been applied to the same purposes from very remote antiquity. All oriental travellers describe the use of this plant by Asiatic women in dyeing their nails and the tips of their fingers, as well as the soles of their feet, of an orange hue with the leaves of the Hinna. It is also used by the men for dyeing their beards, the orange colour being afterwards converted to a deep black by the application of indigo. That this plant was similarly used from very early times is highly probable from the allusions to it by poets, as well as from some of the Egyptian mummies appearing as if the nails had been similarly dyed.

LA'ZULITE, LAPIS LA'ZULI, a Mineral which occurs crystalline and massive. Primary form of the crystal a cube, but occurs in imbedded rhombic dodecahedrons. Cleavage parallel to the planes of the dodecahedron. Fracture uneven. Hardness 5·5 to 6·0. Colour azure and different shades of blue; streak paler blue. Lustre vitreous, translucent, opaque. Specific gravity 2·76 to 2·94. It intumesces before the blow-pipe without fusing. It occurs at Salzberg and in Styria, also in the United States.

Massive variety amorphous, sometimes in grains, imbedded. It fuses on charcoal, when pure, into a white glass. It is brought from Persia and China, and is employed in the manufacture of ultramarine. The following are analyses by Gmelin and Fuchs:—

Gmelin.		Fuchs.	
Silica	49·0	Phosphoric Acid	41·81
Alumina	11·0	Alumina	35·73
Lime	16·0	Magnesia	9·34
Soda and Potash	8·0	Silica	2·10
Oxide of Iron	4·0	Protoxide of Iron	2·64
Magnesia	2·0	Water	6·06
Sulphuric Acid	2·0		
	92·0		97·68

It seems improbable that so different results should be obtained from the same mineral. Dr. Thomson admits the presence of phosphoric acid; the analysis by Fuchs is therefore most probably the correct one.

LEAD. The properties of this metal are, that it has a bluish-gray colour, and is of considerable brilliancy when fresh surfaces are formed by cutting; if it has not been cooled too rapidly, it is so soft, that even when in pieces of considerable thickness it may be easily bent. It soils slightly, and leaves on paper or cloth a mark after friction resembling that of plumbago. Its specific gravity is 11·445, but when impure not greater than 11·352. Lead may be reduced to thin laminæ, but its tenacity is extremely slight; so that a wire about one-tenth of an inch in diameter breaks with a weight of 30 lbs. It fuses at about 612°, and when slowly cooled crystallises in octahedrons. It is not a volatile metal, for in close vessels it may be heated to whiteness without subliming. When exposed to the air it absorbs oxygen and carbonic acid slowly, and acquires a superficial coating of carbonate of lead. In distilled water which has been freed from and kept from the contact of the air, it undergoes no change; but if it be exposed to air and water, it is oxidised and converted into carbonate of lead with considerable rapidity; this carbonate has the appearance of minute shining brilliant scales.

The ores of lead, strictly speaking, are few in number; indeed the only one which can properly be considered as a working ore is the Sulphuret, but there are various combinations of lead occurring in nature, of which we shall give a brief account.

Native lead is of very rare occurrence, and in some cases of very questionable origin. It has been found in small masses in the lava of Madeira, and also in the neighbourhood of Alston in Cumberland; it is in small globular masses, imbedded in galena, or sulphuret of lead, and a slaggy substance, accompanied with blende and crystals of quartz.

Protoxide of Lead: Native Massicot.—This occurs in amorphous masses. Fracture earthy. Brittle. Specific gravity 8·0. Colour yellow. Opaque. Externally dull, internally of a semi-metallic lustre.

It melts readily by the blow-pipe, and, according to Dr. John, it consists of—

Protoxide of Lead	87·382
Carbonic Acid	3·846
Lime and Oxide of Iron	0·481
Silica (ferruginous)	2·404
	94·113

Deutoxide, or *Sesquioxide of Lead: Native Red Lead: Native Minium.*—It occurs amorphous and pulverulent; colour carmine red. Hardness 2·0 to 2·5. Specific gravity variously stated. Dull. By the blow-pipe on charcoal it is reduced to the metallic state. It is supposed to arise from the decomposition of sulphuret of lead and the oxidation of the metal. It occurs in Yorkshire, Suabia, Siberia, and some other places. When used in the arts red lead is artificially prepared.

Chloride of Lead: Cotunnia: Cotunnite.—It occurs in small flat colourless crystals in Cornwall, and at Vesuvius in acicular crystals of an adamantine lustre inclining sometimes to pearly or silky. Specific gravity of the chloride from Vesuvius 1·897.

It fuses by the blow-pipe, and is soluble in a large quantity of water, and, according to Berzelius, consists of—

Chlorine	25·48
Lead	74·52
	100

Di-chloride of Lead: Berzelite.—It occurs in crystalline masses, with a fibrous and radiated structure, on earthy black ore of manganese. Hardness 2·5 to 3·0. Specific gravity 7·0 to 7·1. It is found in the Mendip Hills in Somersetshire. According to Berzelius it consists of—

Lead	83·20
Chlorine	13·77
Carbonic Acid	1·03
Lead	1·46
Water	0·54
	100

Sulphuret of Lead: Galena.—This almost universally diffused ore occurs in attached crystals and massive. Primary form the cube; the cleavage easy, parallel to its faces. Fracture conchoidal. Hardness 2·5 to 2·7. Scratched by carbonate of lime. Colour lead-gray. Lustre metallic. Opaque. Specific gravity 7·568. The massive varieties are amorphous, the structure granular, and compact.

By nitric acid it is converted into white insoluble sulphate of lead. By the blow-pipe on charcoal the sulphur is first dissipated, and then metallic lead is obtained.

In Cornwall and Scotland the veins of this ore traverse primary rocks. In Derbyshire it occurs in veins or beds in transition rocks. It very commonly contains a considerable portion of silver, and is often mixed with small quantities of some other metals. Galena is very commonly associated with calcareous spar and fluor spar, blende, calamine, carbonate and sulphate of barytes, and in Greenland with cryolite and spathose iron.

The deposits of this ore are remarkable for their extent in the United States. They abound in what is called the 'cliff limestone' of the states of Missouri, Illinois, Iowa, and Wisconsin. The lead of commerce is obtained from this ore, and it is often worked for the silver it contains. The following is its analysis by two eminent chemists:—

Dr. Thompson.		Beudant.	
Lead	85·13	Lead	79·6
Sulphur	13·02	Sulphur	13·4
Iron	0·50	Silver	7·0
	98·65		100·0

Seleniuret of Lead, or *Clausthalite.*—It occurs massive. Structure granular. Colour lead-gray; resembles fine-grained sulphuret of lead, but is softer, and rather more blue. Lustre metallic, but rather dull. Opaque. Specific gravity from 7·187 to 7·697. When heated in a tube selenium sublimes; by the blow-pipe on charcoal it burns with a blue flame, and the peculiar odour of selenium. It occurs in the Harz. According to the analysis of Rose, it consists of:—

Selenium	25·59
Lead	74·81
	99·40

The above are the principal native binary compounds of lead. We proceed to notice those which are composed of an acid and oxide of lead, remarking that it is the protoxide only which combines with acids.

Carbonate of Lead: White Lead: Ceruse.—It occurs crystallised and massive. Primary form a right rhombic prism; cleaves parallel to the primary planes. Fracture conchoidal. Hardness 3·0 to 3·5. Brittle. Colour white, yellow, gray, and grayish-black, sometimes tinged green or blue by ores of copper. Lustre on the cleavage planes adamantine, on the fracture surfaces resinous. Translucent, transparent, and doubly refractive. Specific gravity 6·3 to 6·6. Phosphoresces when powdered and thrown on hot coals. Soluble in nitric acid with effervescence. By the blow-pipe on charcoal decrepitates, becomes yellow, and is reduced. Massive varieties amorphous; structure columnar, granular, compact. The following is its analysis by Dr. John :—

Carbonic acid	15·5
Oxide of lead	84·5
	100

It occurs in most lead-mines and is sometimes used as an ore of lead. The white lead which is used in paint is made artificially. *Caledonite* is a compound of the carbonates of lead and copper.

Sulphate of Lead: Anglesite.—Occurs crystallised and massive. Primary form a right rhombic prism. Cleaves parallel to the primary planes. Fracture conchoidal. Hardness 2·5 to 3·0. Colourless generally, but has sometimes shades of yellow, green, gray, brown, and black. Lustre nearly adamantine. Transparent, translucent. Specific gravity 6·23 to 6·31. It occurs in Anglesey, Cornwall, the Harz, &c. The following is an analysis by Klaproth;—

Sulphuric Acid	24·8
Oxide of Lead	71·0
Water	2·0
	97·8

Dioxylite is a compound of carbonate and sulphate of lead, so also *Leadhillite.*

Phosphate of Lead: Pyromorphite.—The primary form is a rhomboid. It commonly occurs in hexagonal prisms, and cleaves parallel to its planes, and to the truncations on its terminal edges. Fracture imperfect, conchoidal, uneven. Hardness 3·5 to 4·0. Colour various shades of green, yellow, brown, and gray. Lustre resinous. Transparent, translucent. Specific gravity 6·911 to 7·098. It occurs also botryoidal and reniform. It occurs in most lead-mines, especially in those of Saxony and the United States. The following is an analysis by Wöhler.

Phosphoric Acid	15·72
Oxide of Lead	82·30
Muriatic Acid	1·98
	100

Hedyphane is an arseno-phosphate of lead and lime.

Oxide of Lead also occurs in combination with certain acids whose bases are metallic.

Arseniate of Lead: Gorlandite.—Occurs in crystals and massive. Primary form a rhomboid; usual form an hexagonal prism, which cleaves parallel to its lateral planes. Hardness 3·5 to 4·0. Colour pale-yellow, yellowish and reddish-brown. Lustre resinous. Transparent, translucent. Specific gravity uncertain, stated variously from 5·0 to 6·4, and 6·9 to 7·3. It is found in Cornwall and in France. The following is the analysis by Wöhler :—

Arsenic Acid	21·20
Phosphoric Acid	1·32
Oxide of Lead	75·59
Muriatic Acid	1·89
	100

It also occurs reniform. Structure compact, opaque. Lustre resinous. Colour brownish-red. Found in Siberia.

Chromate of Lead: Crocoisite.—Primary form an oblique rhombic prism. Cleavage parallel to the lateral planes of the primary form. Fracture conchoidal. Hardness 2·5. Colour aurora-red. Lustre adamantine. Translucent. Specific gravity 6·004. It occurs also massive :—Amorphous. Structure columnar, granular. It is found in Siberia and Brazil. The following is the analysis by Pfaff :—

Chromic Acid	32
Oxide of Lead	68
	100

It is the chrome-yellow of artists, and is made for their purposes artificially.

Vauquelinite is a chromate of lead and copper, of a dark-green colour.

Molybdate of Lead: Carinthite.—Primary form a square prism. Cleavage parallel to the primary planes. Fracture slightly undulating. Hardness 3·0. Colour different shades of yellow, greenish, and red. Lustre resinous. Translucent. Specific gravity 6·69 to 6·76. It rarely occurs massive. It is found chiefly in Carinthia, but also in North America, &c. The following is an analysis by Berzelius :—

Molybdic Acid	39·14
Oxide of Lead	60·86
	100

Tungstate of Lead: Scheelate of Lead.—Primary form a square prism. Cleavage parallel to the planes of the primary form. Fracture conchoidal and shining. Hardness 3·0. Colour yellowish-white and brownish. Lustre resinous. Translucent. Specific gravity 8·0. It is found in Bohemia and Carinthia. The following is the analysis by Lampadius :—

Tungstic Acid	51·72
Oxide of Lead	41·28
	100

Vanadiate of Lead: Johnstonite: Vanadurite.—Occurs crystallised and in small globular concretions. Primary form a rhomboid. Fracture conchoidal. Brittle. Colour straw-yellow to reddish-brown. Dull, opaque. Specific gravity 6·99 to 7·23. It is found at Tampico in Mexico, and Wanlockhead in Scotland. The following is the analysis by Berzelius :—

Vanadiate of Lead	74·00
Chloride of Lead	25·33
Oxide of Iron	0·63
	99·96

Chloride of Lead: Cerasite.—Has a white, yellowish, or reddish colour, nearly opaque. A pearly lustre. Its specific gravity is 7 to 71. *Cotunnite* is another chloride of lead. It occurs at Vesuvius in white acicular crystals.

Corneous Lead is a chloro-carbonate of lead occurring in whitish adamantine crystals, and found in Derbyshire and Germany.

Plumbo-Resinite is a protoxide of lead, alumina, and water. It is found at Huelgot in Brittany, and in a lead-mine in Beaujeu, also in the mines of Missouri.

LEAD, BLACK. [GRAPHITE.]

LEAD, RED. [CHROMIUM.]

LEAD, WHITE. [LEAD.]

LEADHILLITE. [LEAD.]

LEAF. Amongst the higher plants, the whole of their parts can be traced to modifications of the Leaf or Axis. What is not axis is leaf, and what is not leaf is axis. In the lower plants no such distinctions exist, as the tissues are not formed into leaves and their homologues. Although so common an organ, the leaf is not easily defined, and those who are inclined to enter on the subject would do well to consult Schleiden in his 'Principles of Scientific Botany.' We shall here follow Schleiden in our description of the structure of this most important organ.

Leaves (Folia) may be divided into Annual (Folia Annua) and Perennial (Folia Perennia); the former again into Deciduous (Folia Decidua), which live only in the early part of the period of vegetation; Yearling Leaves (Folia Annua sensu stricto), which live through the whole period; and Late Leaves (Folia Serotina), which are not perfected till toward the close of the period. With few exceptions every plant has temporary leaves, namely, the cotyledons and frequently those next following them. The *Orchidaceæ*, some species of *Cuscuta*, and some *Cactaceæ* are the only plants at present known with certainty to be destitute of cotyledons. Others, for instance the *Rhizantheæ*, have not yet been sufficiently investigated. Many plants are wholly destitute of leaves between the cotyledons and the peduncles of the flowers, as, for instance, all the *Cactaceæ*, excepting *Peireskia*, and some species of *Opuntia;* in others these are annual, as in *Alnus*, or perennial, as in *Pinus*. The floral parts, the leaves last perfected, exist in all Phanerogamous Plants.

When the leaf emerges from the axis it is a little conical body, the base of which gradually comes to occupy the entire circumference of the axis, a stem-embracing or Amplexicaul Leaf (Folium Amplexicaule); or it shares the circumference of the axis with one or more other leaves, which have originated with it on the axis in the same plane, Whorled Leaves (Folia Verticillata); or, lastly, it is confined to a small portion of the circumference, without any other leaves arising from the axis in the same plane, Scattered Leaves (Folia Sparsa). These three positions of the leaves upon the axis are, most undoubtedly, the primary ones occurring in the plant. We find the first in the cotyledon of the Monocotyledons; the second in the cotyledons of the Dicotyledons. But if we disregard, in the Monocotyledons, the character of embracing the stem, only looking to the fact that one leaf alone is formed at one level on the stem —if we trace the further development of the leaves of Monocotyledons, and of those of most Dicotyledons, since in the latter it is only in a few groups that the later leaves are formed in whorls—we find that the great majority of plants have scattered leaves. If every vegetable axis be regarded as a cylinder, the bases of the leaves must admit of being connected by a spiral line. More minute investigation, then, shows that the distances of the bases of the leaves on this spiral are not without law; but a certain regularity may be observed, and, in fact, the angle (angle of divergence) made by two planes, passing through the middle of the axis and the bases of two adjacent leaves, which angle therefore is the measure of the distance of these leaves from each other, is on an average 137° 30′ 28″, consequently a number bearing no ratio to the circumference of the stem (360°); so that no two leaves ever can be exactly in the same vertical line. In the course of the entire axis the distances of the turns of the spiral alter, but always regularly, sometimes even on account of accidental influences; and thus from the simplest fundamental condition proceeds an infinite multiplicity of modes of manifestation, even when the various forms of the axis do not interfere. Compare but the rosette of leaves of *Sempervivum tectorum*, the stalk of *Lilium Martagon*, a shoot of *Populus dilatata*, a cone of *Abies excelsa*, and the fruit peduncle of *Helianthus annuus*, which latter exhibits the regular position of the leaves even through its fruit which originate from axillary buds.

On this subject the student should consult the following works:—

Dr. Schimper, 'Description of Symphytum Zeyheri,' &c., in 'Geiger's Mag. für Pharmacie,' b. xxix. p. l. et. seq.

Dr. A. Braun, 'Comparative Researches into the Arrangement of the Scales in the Fir Cones,' &c. Nov. Act. Acad. C. L. N. C. T. xiv., vol. i. pp. 195—402.

Dr. Schimper, 'Essays on the Possibility of a Scientific Comprehension of the Position of Leaves,' &c. Published by Dr. A. Braun, 'Flora Jahrg.' xviii., No. 10, 11, 12 (1835).

L. and A. Bravais, 'Mémoires sur la Disposition géométrique des Feuilles et des Inflorescences, précédés d'un Résumé des Travaux des MM. Schimper et Braun sur le même Sujet, par Ch. Martins et A. Bravais.' Paris, 1838.

The primary form in which the leaf makes its appearance is, as above stated, always that of a little conical body which is pushed out from the axis; its ulterior form depending entirely upon the arrangement of the new cells, and the expansion of already existing cells, and the leaf is as little confined to a definite circle of forms as any other of the organs, except the ovule or seed-bud. It may be globular, ovate, elliptical, and prismatic, as well as filiform, strap-like, and flattened in its expansion, and, by the greater accumulation of the cells in the middle than on the borders, or more flattened mode of expansion in the middle than on the borders, the plane surface may also produce concave forms. The most striking forms of this kind are called Pouches (Asci), as in *Sarracenia*, *Cephalotus*, and *Utricularia*. One of the most frequent forms, which is usually laid down as the normal form, is this—the upper part is developed into a plane, the Blade of the Leaf (Lamina), the lower into a filiform part, the Petiole or Leaf Stalk (Petiolus), and in the latter may frequently be distinguished, still lower down, a somewhat thickened or expanded portion, a Sheathing Portion (Pars Vaginalis), with which the leaf partly or wholly embraces the axis. This latter portion is frequently, especially in compound leaves, swollen into a greater thickness (fleshy), and is then called the Cushion (Pulvinus) of the leaf or petiole. As a general rule, the flat leaf is so developed that its surfaces look more or less upward and downward, rarely so that its borders have these directions, so that the axis lies in the plane of the leaf, as, for instance, in many Australian *Myrtaceæ*. It is very different from this when a flat leaf of the usual development makes a half turn on its base, so that its surfaces are thus also placed vertically, as, for example, in *Lactuca Scariola*. One condition, which has already been mentioned when speaking of the axis, occurs also in the leaf, and here becomes of much greater importance. A Joint (Articulatio) is formed rarely (or never?) in the Monocotyledons, frequently in the Dicotyledons, between the leaf and the axis, in consequence of which the leaf is, after a certain time, thrown off from the axis, while in other cases it gradually dies and decays on the axis itself. This true articulation is often repeated in the continuity of one and the same leaf, either only so that a joint is formed between the petiole and the lamina (for example, in *Citrus*, *Dionæa*), or in such a manner that in the flat Subdivided Leaves (Folia Pinnatisecta, Palmatisecta, &c.), every lobe is connected to the main body by a joint. These latter are called Compound Leaves (Folia Composita), and, according to the subdivision, Digitate, or Pinnate (Folia Digitata, Pinnata, &c.). The separate parts are named Leaflets (Foliola), and the part connecting all these is the Common Petiole (Petiolus Communis). The leaflets can of course assume all the forms of the leaf, in particular they may be again separated into lamina, petiole, and pulvinus. In some Australian acacias (for instance, *Acacia heterophylla*) the first leaves are compound; they gradually form fewer and fewer leaflets, till at last the part corresponding to the common petiole alone remains, which then appears as a perpendicular plate, and is called a Phyllodium, to distinguish it from the other perfect leaves of the same plant.

The pouches or pitchers which occur in *Nepenthes*, *Sarracenia*, *Cephalotus*, *Dischidia Rafflesiana* and *D. clavata*, *Marcgravia*, *Norantea*, *Utricularia*, &c., are not yet perfectly understood. The pouches apparently present three different types:—1. In *Sarracenia* it is the lower part of the leaf which exhibits a form resembling a cornucopia, while at the upper border runs out a flat expansion (the lamina of the leaf), separated from the pouch by a deep incision on each side. The lower half of the internal surface of the pouch is clothed with hairs directed downwards; the upper part is smooth. In *Nepenthes* a pitcher-shaped structure is borne upon a long petiole, winged below, then often tendril-like, and carries upon its upper border an articulated (?) lamina, which originally closes the pitcher like a lid. The inner surface is clothed in the lower part with little papillæ of very delicate succulent cellular tissue, while above the epidermis projects down over these like the eaves of a house. In both the cavity is formed from the leaf in such a manner that the closed base of the pouch corresponds to the base of the leaf (*Sarracenia*), or lies quite close to it (*Nepenthes*). In *Dischidia Rafflesiana* and *D. clavata*, on the contrary, the opening of the pouch is turned towards the base of the leaf. *Cephalotus* appears to possess a structure similar to that of *Sarracenia*. In all the plants mentioned the pouch constitutes the main body of the leaf. 2. In *Marcgravia* and *Norantea*, on the other hand, according to Lindley, the pouches are formed by the stipules. 3. In *Utricularia* many separate portions of the divided leaf unite to assume a very complicated form of pouch. Originally these form a little shortly-stalked somewhat cornet-shaped body in the angles of the divisions of the leaves. In this little body are especially developed the under side and the inner border of the orifice (which does not increase much in size), so that the full-grown pouch presents itself as a roundish and somewhat laterally-compressed body, which above is continuous by one angle with the stem, while the other exhibits an orifice, which forms a little funnel projecting inwards. The external orifice of this funnel is closed by a kind of beard growing on the upper border; the lower part of the internal surface of the funnel is clothed with elegant hairs of various forms, but very regularly arranged, while the internal surface of the pouch exhibits peculiar hairs, consisting of two cells, each running out into a longer or shorter arm.

In leaves, as in plants in general, all forms are possible, and almost all actually existing—strict stereometric forms excepted. The terminology depends either on comparison with mathematical figures, or with objects presupposed to be familiar in common life. There is no scientific rule for this; æsthetic tact alone must be our guide. But within the limits of certain vegetable groups certain circles of forms do exclusively occur; and under the guidance of accurate observation we can here establish more definite modes of nomenclature, which however are only valid for these definite groups.

If the Cotyledon of most Monocotyledons is examined we find that in its gradual development it completely incloses the Terminal Bud (Plumula); indeed that the exceedingly delicate soft cells of the two borders of it become in part so firmly united that they may be regarded as grown together, only a little fissure, which exists in all Monocotyledons, remaining. In germination the developing bud has not room to protrude through the little fissure, so that it pushes the borders of it more or less forward, and then these appear as a peculiar appendage on the middle of the Cotyledon, as a membranous expansion of the border of the lower part of the leaf, or as lobes on its base. Similar conditions also occur frequently in the later leaves. In the Dicotyledons a like condition presents itself not unfrequently; either the borders become expanded like a membrane on the base of a petiole or stalk-like leaf, or the emerging bud lifts up a longer or shorter membranous sheath, or peculiar lobules are formed on the base of the petiole, sometimes assuming the form of leaflets, and even connected with the petiole by an articulation. In all cases, without exception, they are, from the course of the development, parts of a leaf developed principally at its base, and in their essential nature wholly identical structures throughout all the *Phanerogamia*, though they may vary most abundantly in their appearance. They have acquired very different names. In the Grasses these parts are called the Ligule (Ligula): in other Monocotyledons, sometimes Vagina Stipularis, if large and rising free from the lowest part of the leaf; Vagina Petiolaris, if small and showing itself first higher up the leaf: in the Dicotyledons, 'Petiolus Alatus, Stipulæ Adnatæ,' if on the margins of the leaf-stalk; Ochrea, if sheathing, as in the *Polygonaceæ*; or Stipules (Stipulæ), if appearing like special leaflets stationed beside the base of the petiole: lastly, in the floral leaves, Fornix, Corona, Nectarium, &c., as in *Lychnis*, *Boraginaceæ*, *Narcissus*, &c. They occur as stipules, especially in compound leaves, where sometimes they alone are developed into a flat surface, while the leaf itself merely forms a filiform process—for example, in *Lathyrus Aphaca*. At the base of the leaflets of compound leaves also little lobes sometimes occur, which, perhaps originating in the same manner, are called Stipelles (Stipellæ).

Every leaf, as already observed, originates as a little conical papilla at a definite point on the circumference of the axis. Even the sheathing leaves are produced in this manner, and at the point which corresponds to the middle line (the mid-rib) of the future leaf by degrees, and as it is pushed up further from the axis the parts of its circumference take part more and more in the development, and thus the base of the leaf gradually becomes broader, until it completely surrounds the axis. If the development of cells, or the expansion of existing ones, continues on the borders of the base of the leaf beyond the degree required to surround the axis, the newly-formed, still soft, and almost gelatinous cells of the two borders of the base of the leaf become applied to one another, and become united as firmly as the cells of a continuous tissue; in this way the lower part of a leaf then becomes a closed undivided whole surrounding the axis. If the lateral production of cells is small, and the union takes place relatively early, this closed portion forms a longer or shorter sheath, closely embracing the axis (vagina clausa), as in many Grasses. If, on the contrary, the lateral cell-production or expansion is considerable, and occurs relatively late, so that merely the base of the leaf forms a flat projecting border round the axis, the leaf is said to have the stem growing through it (folium perfoliatum)—*Bupleurum perfoliatum*, for example. When the axis is angular, and produces thin more or less projecting plates upon these angles (the so-called winged axis, 'axis alatus'), a similar process may enter into the bud in such a way that a flat leaf is connected at its base with the simultaneously-developed wing or angle of the axis, so that the full-grown leaf appears to be directly continuous with this. Such a leaf is said to run down the axis (folium decurrens), as in *Carduus*, or, by a wholly unfounded fiction, a leaf blended by growth with the axis (axis folio adnatus). Where several leaves arise simultaneously, or almost simultaneously, at about the same height upon the axis, the bases of the leaves become gradually approximated during development; and here it may readily happen that they approach so close that the same process occurs between the bases of two different leaves, as has been already described in the two borders of one and the same leaf. Thus it happens, that leaves, which in their origin and at their summits are free and isolated, in their ulterior development and at their bases form an undivided whole (leaves grown together, 'folia connata'). The leaves of *Lonicera Caprifolium* afford an example simplest and easiest to trace. Two foliaceous organs which originate one above the other on the same axis (as the petal and stamen), or a leaf and the bud developed in its axil (as the bract with the flower-stalk in the Lime) may grow together one above the other in the same way.

A process almost diametrically opposite to this may occur, where a leaf is developed, but becomes suddenly arrested in its development in a way as yet unknown, whether through mere mechanical pressure or some other cause, by the more rapid and powerful development of the contiguous leaves; so that either the little original papilla escapes notice, on account of its relatively minute size in the full-grown part, or the little prominence actually becomes effaced by the subsequent development of the part, or, finally, the little rudiment of a leaf dies and gradually decays. In this case the leaf is said to be abortive: an instance easily traced is afforded by the third perigonal leaf of *Carex*, which aborts in this way, while the two others form the so-called Utriculus; and not only may whole leaves become abortive in this way, but even individual portions of a leaf of which the rudiments already exist: thus it is not at all rare for the so-called stipules to become disproportionately developed in the rudimentary leaf, while the proper leaf, restrained in its growth, gradually disappears from sight. The Bud-Scales (Ramenta) on the perennial buds of *Corylus avellana* may serve as examples, being in fact nothing else than the stipules of an abortive leaf.

The same influence to which the parts closely crowded in the bud are subject, may merely cause the unsymmetrical development of the two halves of a particular foliar organ, so that one side, or that part of the leaf lying on one side of the midrib, assumes a form different from that of the other half, of which the species of *Begonia* afford a striking example.

The nascent leaf consists, like all nascent parts of vegetables, of cellular tissue; determinate cords of cellular tissue are first gradually organised into vascular bundles; and in fact this process proceeds from the vascular bundles of the axis, and advances gradually into the leaf. In many foliar organs, especially the parts of the flower, no vascular bundles are ever formed. The vascular bundles of the leaves are distinguished by the most inconveniently chosen expressions, Nerves or Veins (Nervi, Venæ). Ribs (Costæ) is a more correct expression. In Monocotyledons with undeveloped internodes, the whole of the vascular bundles together (?) of the internode, bounded above by the leaf, pass into the leaf. In all other plants, many at least of the vascular bundles entering the leaf are minor twigs of the vascular bundles of the axis; in the Dicotyledons proceeding exclusively, in great part, from the borders of the loop of the vascular bundles of the axis. The course of the vascular bundles in the leaf depends essentially on the form of the latter. In flat leaves, petioles, or vaginal portions, the vascular bundles lie in one plane; in relatively thick leaves, &c., they lie scattered (Palms) or in a circle (species of *Aloë*, *Mesembryanthemum*). The vascular bundles rarely run separately through the whole leaf (as in the last-named): they mostly anastomose in various ways with each other by lateral branches; frequently in the petiole, in such a manner that all the vascular bundles entering it unite into a single one, and then separate again in the blade of the leaf. The form of the combinations is very varied: in many Monocotyledons the branches are short, going off at right angles; in others, and in most Dicotyledons, more varied, so that a net with polygonal meshes is formed.

The vascular bundles of the leaves are progressive bundles, and they are so formed that (regarding the leaf as passing off horizontally from the axis) the oldest parts lie above, the youngest below. In the lower part also a cambium layer exists in the Dicotyledons: in the lower part liber-bundles accompany the vascular bundles, and in the under part the vascular bundles, in relatively thin and flat leaves, project above the surface (probably in consequence of gradual development), while the upper part of the leaf appears level.

The parenchyma of the leaf is developed in the most varied manner; in general, in thick solid leaves, it is composed externally of small crowded cells containing more chlorophyll, internally, of larger and looser cells filled with aqueous juices. Very often the outer layer passes into a tissue, the cells of which are elongated in a direction vertical to the surface of the leaf, are applied closely, almost without trace of intercellular passages, and thus are pretty sharply distinguished from the rest of the parenchyma, and occur in the whole of the periphery of the leaf, not only in round and triangular leaves, but also in flat ones, as in many Australian *Myrtaceæ*. In flat leaves, especially of Dicotyledons, there is very often a separation into two layers, the upper of which has the cells elongated perpendicularly to the surface, as just mentioned, filled with much chlorophyll, while the lower is composed of looser, globular, or, still more frequently, spongiform parenchyma containing little chlorophyll. In thick coriaceous or fleshy leaves, for instance in species of *Ficus* and *Peperomia*, one or more layers of cells containing little but watery juices, often lie between the upper layer and the epidermis; more rarely, in like manner, at the under surface of the leaf.

Besides these there appear at given places, or dispersed in the parenchyma, according to special peculiarities of the plant, spiral fibrous cells, very thick, and closely porous cells, and cells containing peculiar juices and crystals. Milk-vessels and passages, receptacles for gum, oil, and resin, are also found, and isolated liber-bundles, the last especially in the thin elongated leaves of Monocotyledons. Air-canals and air-cavities are found in the leaves; the last very regularly and beautifully arranged.

All foliar organs, soon after their origin, exhibit a delicate epithelium, which, in plants vegetating under earth or under water, is converted in time into epiblema, and in those vegetating above the surface is converted into epidermis. Some parts of flowers are clothed with a peculiar sort of covering, holding an intermediate station between epithelium and epidermis. [FLOWER.] To the epiblema stomata are wanting. The epidermis is commonly provided with them. [STOMATES.] In flat horizontal leaves they are very frequently wanting on the epidermis of the upper side, and they are usually only found where a thin or spongiform cellular tissue is present beneath the epidermis; in floating leaves, on the contrary, the upper epidermis only has stomata, and through the upper layer of condensed elongated parenchyma air-canals pass into the under and thinner layer of parenchyma; as occurs also in leaves that are surrounded with dense elongated cellular tissue. All parts usually known as appendages to the epidermis are also found occasionally on the leaves: even the cork structure is sometimes found on the petioles of long-enduring leaves, as, for example, in some species of *Pothos* and *Ficus*, as well as on the leaves of *Crassula*, *Bryophyllum*, &c.

The cells of the epidermis are usually filled with a clear watery fluid, which on the under surface of the leaf is sometimes coloured (red). They more rarely present crystals, and yet more seldom offer any peculiar matter, as resin, or the like. The form of the epidermis-cells is determined by the form of the leaf; long slender leaves usually present their epidermis-cells elongated in the same direction. The lateral walls of the epidermis-cells are often curved in the form of waves, but this peculiarity has been too little investigated to be explained at present.

The following is a complete view of the foliar organs:—The floral parts of a plant are distinguished from the other foliar organs, and are termed Flower-Leaves (Phylla), whilst other leaves are termed True Leaves (Folia sensu stricto).

1. True Leaves (Folia).

A. Seed-Leaves (Cotyledons), generally round or flat, fleshy, little divided, and never compound.

B. Stalk, or Stem-Leaves (Folia Caulina). Their forms are very various, as has been shown in the foregoing paragraphs. Those immediately following the Cotyledons are usually simple; the next more perfect; and again, as they rise into the vicinity of the blossoms, they become again more simple. Filiform leaves, or parts of leaves, when they twine around foreign objects, are termed Tendrils (Cirrhi), as in *Pisum*, *Clematis*, &c.; those which are stiff and pointed are termed Spines (Spinæ); very concave leaves that exhibit the form of a cup or pitcher are termed Pouches (Asci), as in *Nepenthes*, *Sarracenia*, *Utricularia*, &c. According to their various positions they are again distinguished from the True Leaves generally:—

a. Leaves of the Inflorescence (Folia Floralia). Indistinguishable from the stem-leaves, but bearing in their axils a blossom or a simple inflorescence.

b. Bracts (Bracteæ). Leaves different from the stem-leaves, and bearing in their axils a blossom or a simple inflorescence; for instance, the scarlet-red leaves of the *Salvia Horminum*. To these belong the Glumæ of Grasses, which are simply two bracts (which have commonly no blossoms in their axils), and the leaves which surround the capitula of the *Compositæ*. A number of bracts, inclosing an inflorescence, are also termed an Involucre (Involucrum). The quickly-drying bracteæ of the *Compositæ* are termed Scales, or Chaff (Paleæ), a word altogether superfluous.

c. Bracteoles (Bracteolæ), distinct from the stem-leaves, and standing beneath the blossom, but upon its axis; for example, the two leaves under the blossom of the *Aconitum*, &c.

C. Bud-Scales (Tegmenta). The very simple, mostly membranous, and quickly-falling outer leaves of a bud which remains for a length of time unexpanded. (See hereafter, under the *Bud*.)

2. Flower-Leaves (Phylla).

A. Perigonial Leaves (Phylla Perigonii).

B. Sepals of the Epi-Calyx (Phylla Epicalycis).

C. Sepals (Sepala).

D. Petals (Petala).

E. Pseudo-Petals (Parapetala).

F. Stamens (Stamina).

G. Pseudo-Stamens (Parastemones).

H. Carpels (Carpella).

In connection with the Leaf we may speak of the Bud, the organ from which the Leaf is developed.

The Bud is the end of a main or secondary axis, as yet undeveloped, but capable of development. We may distinguish—1. The Terminal Bud (Gemma Terminalis), the end of a developed axis, itself capable of development. 2. The Axillary Bud (Gemma Axillaris), the end, capable of development, of a secondary axis newly arising, according to law, in the axil of a leaf; since several buds may arise, without irregularity, in one axil, that which develops most vigorously is termed the main bud, the others accessory buds (gemma axillaris primaria and accessoria). 3. Lastly, the Adventitious Buds (Gemmæ Adventitiæ), formed at the end of any (secondary) axis capable of development, arising irregularly on the plant. In all these we distinguish buds continually progressing in development (gemma vegetatione continua) from buds whose vegetating activity rests for a time after their development into a bud (gemma vegetatione interrupta). Again, buds are distinguished into those which, in the natural course of vegetation, separate themselves from the parent plant and become independent plants (gemmæ plantiparæ), and those which always remain in connection with the parent plant (gemmæ ramiparæ). Finally, buds are distinguished according to their contents: there are the Flower-Buds (Gemmæ Floriparæ, alabastrus); the Leaf-Buds (Gemmæ Foliiparæ); and Mixed-Buds (Gemmæ Mixtæ).

With the exception of the true tuber in *Solanum* and *Helianthus* (?), and of the Tuber-Buds (Tubercula), all buds have a determinate number of rudimentary foliar organs. These foliar organs are folded in specific ways (vernatio), and have a definite position in relation to each other. From the origin of the foliar organs, it follows that when several arise at the same height, they will always be at some time in such a position that their edges will be in contact (vernatio simplex, foliatio valvata). This position often persists during the whole period of the bud remaining as such; it is however changed by various circumstances, not yet clearly understood, but which appear to be caused by the individual development of the separate leaves. In the vernation the following main forms may be distinguished: the foliar organs are either curled up in the direction of their length or their breadth, or they are compressed together in irregular folds (vernatio corrugativa). In those leaves that are curled up lengthways we distinguish sharp folds from those which make rounder curves.

Schleiden gives the following nomenclature of the kinds of Vernation and Foliation:—

A. With sharp folds.

a. Vernatio Duplicativa. Simply folded together (forwards) upon the upper surface of the leaf, as in *Quercus*, *Tilia*, and the lamina of *Liriodendron*.

b. Vernatio Replicativa. Folded in the same way backward upon the under surface of the leaf.

c. Vernatio Implicativa. The two borders folded in sharply forwards, as in the perigone of *Clematis*.

d. Vernatio Plicativa. Many longitudinal folds, as is seen, though not quite perfectly, in *Fagus* and *Carpinus*, but better in *Alchemilla*, and best of all in *Panicum plicatum*.

B. With rounded folds.

a. Vernatio Convolutiva. Simply rolled up, as in *Calla* and *Prunus*.

b. Vernatio Involutiva. With both edges equally rolled up forwards, as in *Alisma* and *Populus*.

c. Vernatio Revolutiva. Rolled backwards in a similar manner, as seen in *Salix* and *Nerium*.

In leaves curled and folded together the cross way, the most important distinctions occur.

a. Vernatio Inclinativa. Incurved forwards, as in the petiole of *Liriodendron* and *Hepatica*.

b. Vernatio Reclinativa. Recurved backwards, as in *Aconitum*.

c. Vernatio Circinata. Rolled up forwards from the point to the base, as in *Cycas*.

In the Foliation we distinguish the position of the foliar organs in relation to one another, in general, from the position of individual circles of foliar organs with respect to each other. With regard to the first of these, the conditions have been pointed out.

A. Foliatio Valvata. When the leaves only touch without covering each other with their borders.

a. Foliatio Valvata sensu stricto, in Vernatio Simplex. Flower in *Stapelia*.

b. Foliatio Induplicativa (?), in Vernatio Duplicativa.

c. Foliatio Implicativa, in Vernatio Implicativa, as in the perigone of *Clematis*.

B. Foliatio Amplexa. When each leaf embraces all those within it.

a. Foliatio Convolutiva, in Vernatio Convolutiva, as in *Prunus Armeniaca*.

b. Foliatio Equitans, in Vernatio Duplicativa, as in *Iris*.

C. Foliatio Semiamplexa. When each leaf embraces with one edge, and is embraced on the other.

a. Foliatio Contorta, in Vernatio Simplex (more than three leaves), as in the flower of *Dianthus* and *Linum*.

b. Foliatio Obvolutiva, in Vernatio Duplicativa, as in *Lychnis*.

D. Foliatio Quincuncialis. When five leaves so lie that between two external quite uncovered ones, and two inner quite covered ones, the fifth is so interposed as to cover one of the inner leaves with one edge, and to be covered at its other edge by one of the external leaves, as in the flower of *Rosa*.

E. Foliatio Connata. When the leaves of a circle are so perfectly and intimately grown together that on the full development they become ruptured from their common basis, and fall away like a cap, as in some calices, for instance, *Eucalyptus*, *Eschscholtzia*; and bracts, as in *Aponogeton distachyon*, &c.

Some of the above forms are given in the following wood-cut.

1. Applicative, or appressed (*Viscum album*). 2. Conduplicate (*Cerasus communis*). 3. Imbricate (*Syringa vulgaris*). 4. Equitant-Terete (*Vaccinium Myrtillus*). 5. Equitant-Ancipital (*Iris germanica*). 6. Equitant-Triquetrous (*Carex paludosa*). 7. Obvolute, or Semi-Amplexal (*Saponaria officinalis*). 8. Gyrate, or Circinate (*Drosera anglica*). 9. Involute (*Viola odorata*). 10. Equitant-Tetraquetral (Some *Carexes*). 11. Plicate (*Vitis vinifera*). 12. Involute (a variation) (*Pyrus Malus*). 13. Revolute (*Polygonum Persicaria*). 14. Convolute, or supervolute (*Prunus Armeniaca*).

Finally, in respect to the position of individual circles of foliar organs with respect to one another, the following have been distinguished:—

A. Foliatio Alternativa. When the members of the one circle stand before the interspaces occurring between the members of another circle, as in the calyx, corolla, and stamina of *Lysimachia*.

B. Foliatio Oppositiva. When the members of one circle stand before the members of another circle.

We may now speak of the particular Forms of Buds.

A. Buds developing in uninterrupted vegetation. These may also be termed open buds, because they seldom or never exhibit a closed form, since in these the leaves are gradually developed to the perfect form and size, from the perfect rudiments contained in the bud. Yet in these buds the foliation is always such, that the youngest and tenderest parts are defended from the influence of the atmosphere, and almost wholly inclosed.

B. Buds with vegetation dormant for a certain time.

I. Buds of Shoots.

a. Terminal and axillary buds of perennial plants, with periodically dormant vegetation. Of these we are only intimately acquainted with the native trees of our woods and forests. It is characteristic of these, that the young leaves, which subsequently come to perfection in the more developed axis, are enveloped whilst in the bud by stipules, which soon after the development of their leaf fall away (stipulæ deciduæ), as in *Liriodendron*, or in leaves or stipules of simple structure, of which the laminar portion is ahortive (tegmenta): and there are varieties amongst these, so far that either only the external or inferior leaves, or stipules, appear as coverings of the huds, as in *Fagus;* or the coverings of the hud seem to he continued into the interior of the hud, hut alternate with leaves capahle of perfect development, which lie hetween and are covered hy them, as in *Acer.* The coverings of the hud are for the most part tough, and almost leathery; they are often filled and coated over with resinous juices, and then mostly fall off in the development of the hud, hut they also occur thin and herhaceous in texture, and even change quickly into dry thin memhranes, which mostly remain upon the plant; these last are seen in *Pinus.*

b. Adventitious huds of perennial plants, with vegetation periodically dormant. They are only distinguished from the foregoing hy the mode of development. Each stem, whether a common one or a root stem, can develop a hud. These buds are caused, not only hy accidental and intentional wounding of the stem, hut also hy the inclination of plants to develop huds at certain places. Many plants exhibit upon their bark peculiar little groups of lax roundish cells, which originally lie under the epidermis, which however is soon destroyed ahove them, leaving them bare (lenticellæ). The result of this exposure is, that at these places the hark is rent hy the distension of the bough or stem; hence the newly vegetating part of the hark comes in contact with the air. It is principally at the edges of the rent hark that the adventitious buds are found.

2. Propagative Buds.

a. Bulhs (Bulbi) are monocotyledonous stems, with undeveloped nternodes, which gradually die away from helow upwards, and therefore remain always very short, with perennial leaves, whose vaginal parts die away and inclose thin memhranes, the sheaths of the inner leaves still living, and always fleshy and thick (hulb-scales); or more rarely die away speedily, and leave hare the latter, as in *Lilium.* They are formed either immediately from the emhryo, and then the sheathing part of the cotyledonary leaf hecomes the first hulh-scale; or they are formed from the axillary huds of the hulb, or from the axillary huds of the stems which have sprung from the hulhs, as in *Lilium bulbiferum:* less frequently they are from adventitious huds on leaves or other parts. We distinguish:—

A. The Leafy Bulh (Bulhus Foliosus).

1. The Tunicated Bulb (Bulhus Tunicatus), where many sheathing parts are closed round, or emhrace the axis pretty hroadly, as in *Hyacinthus orientalis.*

2. The Scaly Bulb (Bulhus Squamosus), where many sheathing parts, relatively slender and short, are seated on the axis, as in *Lilium candidum.*

B. The Solid Bulb (Bulhus Solidus), when the hulh is formed of one single living sheathing part.

b. Bulbels (Bulhilli). To plants not perennial hy means of a hulh (only Dicotyledonous?), the axillary buds are sometimes developed into hulb-like forms, in which the leaves are only developed as thickened sheathing parts, and the huds separate from the parent plant by the dying away of the supporting stem or stalk, and hecome independent plants, as with *Dentaria bulbifera.*

c. Tuhers (Tubera). On underground stems the axillary huds (of attenuated scaly leaves) are sometimes developed in such fashion that the entire axis of the hud hecomes thickened, fleshy, and of a knohhy form; the leaves are quite in rudimentary condition, or scarcely to he recognised, whilst the axillary and terminal huds remain capahle of development, and after the dying away of the stems of the parent plant form new stems, as in *Solanum tuberosum.*

d. Tuber-Buds, Tuhercles (Tubercula). Many plants form small tubers above the earth; seldom (if ever) indeed as axillary huds, hut frequently as adventitious huds, and especially on foliaceous organs, from which new independent plants develop as soon as they are separated from the parent plants: sometimes this is a specific peculiarity, as, for instance, the tuhers of the species of *Amorphophallus* and other *Aroideæ;* sometimes they arise in certain plants particularly readily in consequence of injuries, as, for instance, in the *Gesneriaceæ,* on the hroken surface, after cutting a leaf-nervo at the edge or the point of the leaf.

e. Pseudo-Tubers (Tuheridia). In somo plants a single, frequently an axillary, hud is transformed in a peculiar manner. The parenchyma of the axis of the bud, which is situated over the vascular surface, suddenly becomes exceedingly expanded in a solid and tuberculated form, by means of the sudden commencement of new formation of cells in isolated groups of cells; in the axillary hud this only occurs on one sido (as in our native *Orchideæ*), since, on the other side, the pressure of the stem prevents such distension. In *Aponogeton distachyon,* the thick fleshy cotyledon with the end of the root proves a corresponding ohstruction; hence here also the development of tho pseudo-tuber is only one-sided. In tho Dahlias, on the contrary, the tuhercular development is equal on hoth sides. The mass of cells enters between the hase of the cotyledon and the new adventitious roots, arising at a very early period almost immediately under the cotyledon, and which, through the formation of the pseudo-tuhers, hecome gradually removed far away from the ootyledou.

We may now add a few words on the function of the leaves. Works on hotany are full of speculations on the functions performed hy these organs. Without entering on this history we may say that the whole of the functions performed hy the leaves may he summed up in the word exhalation. The sap is hrought up from the soil hy the loss of water from the leaves. Hence this function of the leaves is necessary to the nutrition of the whole plant. It does not however follow as a consequence of this fact that the leaves send down nourishing materials into the stem and hranches.

It is also frequently stated that the leaves take up carhonic acid. Under certain circumstauces there can he no douht that leaves absorh as well as exhale, hut this is not their constant function. It depends on the condition of the atmosphere; when dry and the sun is shining the leaves exhale water, but if these conditions are not present, if the atmosphere is moist, and there is little or no heat and light, then the leaves absorh.

The following extract from Schleiden's 'Principles of Scientific Botany' supplies some of the data on which recent physiologists hase their view of the leaf heing simply an organ of exhalation.

"From those parts of plants which are exposed to an atmosphere which is not already perfectly saturated with moisture, a continual evaporation of water goes on. The process is purely physical, and, according to accurate investigations, it appears to proceed uninterruptedly, according to the dryness and motion of the atmosphere, with the temperature, and the amount of surface exposed to evaporation. It is highly prohahle that the epidermis permits of no passage to the evaporating water, hut that, the evaporation occurring in the neighhouring intercellular spaces, it escapes through the stomates when they are not closed by too strong evaporation and consequent relaxation. From this circumstance the exhaled water is never quite pure, hut it contains always a small admixture of vegetable suhstances which cannot he accurately analysed.

"Besides this evaporation of water, we sometimes find in a very damp atmosphere, and especially in the case of plants that have already exhaled very much, a taking up of moisture, especially through their green parts; hut our observations on this fact have heen too little accurate and purposeless to admit of a precise explanation of the process.

"The study of vegetable exhalation in general requires a repetition and improvement of the experiments made upon it. We need a set of experiments which should show, with the greatest exactitude, the difference hetween the quantity of water absorhed and exhaled, from which we might decide the quantity used for the nourishment of the plant. If the amount of oxygen exhaled with the water was also obtained, we should prohahly he ahle to arrive at conclusions respecting the nature of the chemical processes carried on within the plant. We have yet to ascertain the relation of the exhalation of the water to its absorption. The fact of its ahsorption (hy other means than the root) has heen estahlished hy Hales, hut we are still quite in the dark as to the manner. An accurate knowledge of these relations is so much the more to be desired, as the evaporation and ahsorption of water with the tension of the vapour must exert an influence upon the ahsorption or exhalation of the several kinds of gases. Yet in the experiments made upon the so-called respiration of plants, this has heen lost sight of.

"We know nothing of the precise types through which exhalation is effected. To myself it appears improhahle that the living epidermis should be permeable to water and the vapour of water, except through the stomates.

"It is an estahlished fact, that all evaporating water carries with it some portion of the matter which it held in solution. This is seen in the vapour of the ocean. It is prohahle that no water exhaled from plants is ahsolutely pure. But no accurate analyses havo heen made on this point.

"The natural consequence of this exhalation of water from the green parts of plants which are exposed to the air, is the continual concentration of the juices in the cells which lie next the evaporating surfaces. By this the endosmose of the cells which do not exhale undergoes a change, of which we shall have to speak hereafter.

"The information which we possess respecting the exhalation of plants is chiefly found in the experiments of Hales, Guettard, Seunehier, Schübler, and Neuffer.

"The strange tendency always to attrihute to vitality something different from the physical powers, has introduced into the doctrine of the transpiration of plants a distinction hetween evaporation and exhalation; the first heing supposed to take place in dead plants and the last in living ones. I can find no distinction in this case in the facts, hut merely in tho words.

"I will here add some facts upon the quantity of water exhaled hy plants.

"According to Hales, a sunflower evaporated daily 1·25 lhs. of water: now let us allow to each of these plants 4 □′ space of soil; then upon the old Hessian acre there would stand 10,000 plants, which in 120 days would exhale 1,500,000 lbs. of water.

"A cabhage exhaled in twelve hours of the day 1 lb. 6 oz. of water;

now if, according to Block, each plant occupies 5 □′ of soil, and if we reckon an inferior expenditure for the night, yet the plants on an acre would exhale 1,200,000 lbs. of water in 120 days.

"A dwarf pear-tree, according to Hales, exhaled in 10 hours of the day 15 lbs. of water. Allowing for each such tree 20 □′ of soil, the trees of an acre would exhale 3,600,000 lbs. of water, and probably another third of the quantity might be added for the grass between the trees, which would make for the acre almost 5,000,000 lbs. of water.

"An acre of 40,000 square feet, planted with hops, exhaled in 120 days 4,250,000 lbs. of water through the hops alone.

"A square foot of soil covered with *Poa annua* exhaled, according to Schübler, daily, on an average, during the summer, 33·12 cubic inches of water: thus an acre of meadow-land would exhale about 6,000,000 lbs."

The subject of the food of plants and the general processes of nutrition in the vegetable kingdom is described under the article SAP.

LECANORA. [LICHENS.]

LECYTHIDA'CEÆ, *Lecythis*, an important but small natural order of Plants with singular fruits, and very large fleshy flowers, inhabiting the woods of South America. They are regarded by De Candolle as a section of *Myrtaceæ*, from which they differ in their leaves being alternate, and not dotted, the stamens monadelphous, and extended on one side, in an unusual manner, into a broad lobe, which covers over the centre of the flower like a hood. They are natives of the hottest parts of South America, especially of Guyana.

Among the plants belonging to this order are the following, which deserve particular notice :—

Lecythis ollaria, a tree inhabiting the forests of Cumana and Brazil, with a hard woody fruit as large as a child's head, and opening by a lid like that of a jar or urn. It contains numerous large seeds, which are eatable.

L. Zapucaje, a large Guyana tree, with alternate oval leaves 12 inches long, and racemes of large fleshy red and white flowers. The fruit is hard, woody, urn-shaped, and about 4 inches broad by 6 inches high; it contains numerous seeds as large as almonds, and quito as agreeable when fresh. They are sometimes seen in the fruiterers' shops in London, where they are called Sapucaya Nuts.

Bertholletia excelsa, already described. [BERTHOLLETIA.]

Couroupita Guianensis, or Cannon-Ball Tree. This plant takes its name from its large heavy woody fruit, which, according to Aublet, is about the size of a 36-pound shot, and although urn-shaped like the others, does not open by its lid, but is broken by its fall, or lies on the ground till it rots, before the seeds can extricate themselves. The flowers are very large and handsome, deep rose-colour and white; the tree is of great size, with a trunk often more than 2 feet in diameter. The shells of the fruit are used as drinking vessels.

Flower of Cannon-Ball Tree (*Couroupita Guianensis*).

Fruit of Cannon-Ball Tree (*Couroupita Guianensis*).

LEDERERITE. [CHABAZITE.]

LEDERITE. [TITANIUM.]

LEDUM, a genus of Plants belonging to the natural order *Ericaceæ*. It has a minute 4-toothed calyx, 5 spreading petals, from 5 to 10 stamens, anthers opening by two pores at the apex. The capsules are subovate, 5-celled, 5-valved, stalked, and dehiscent at the base. The seeds are furnished with a membranous wing at each extremity.

L. latifolium is a small evergreen shrub, with an irregularly branched stem. The branches and under surface of the leaves are woolly; the calyx is very minute; the corolla white, with obovate obtuse petals. It has been commended as a stomachic; but an infusion of the leaves in beer renders it unusually heady, and produces headache, nausea, and even delirium. Pallas however says that they have been used with advantage in tertian agues, dysentery, and diarrhœa. They have an aromatic bitter flavour. This species is a native of the swamps around Hudson's Bay, Labrador, Greenland, and various parts of the United States.

L. palustre has linear leaves, with revolute margins, clothed with rusty tomentum beneath; it has 10 stamens, longer than the corolla. It is a native of North America, in the swamps of Canada and New York, also the North of Europe, Denmark, Silesia, &c. *L. palustre* has somewhat similar properties to those ascribed to the former species. In Germany a kind of beer is made from its leaves, and it has also been recommended as a febrifuge. This species was formerly admitted into the catalogue of British plants; but Mr. Babington considers that it has no claim to appear there, and has omitted it accordingly.

L. Canadense has ovate petiolate leaves, white beneath; the flowers disposed in terminal large umbellate corymbs of a white hue. It is a native of the swamps of Canada. A peat soil or a very sandy loam answers best for the cultivation of the species of Ledum, and they are readily propagated by layers or by seeds. The seeds should be sown, and the seedlings afterwards managed in the same manner as the *Rhododendron*.

(Don, *Dichlamydeous Plants*; Burnett, *Outlines*; Babington, *Manual of British Botany*.)

LEECH. [ANNELIDA.]

LEEK. [ALLIUM.]

LEERSIA, a genus of Grasses belonging to the tribe *Oryzeæ*. It has 2 paleæ compressed, keeled, and awnless, the lower one much broader; stigmas protruding from the side of the florets; nut inclosed in the paleæ.

L. oryzoides has a patent panicle with wavy branches, spikelets triandrous, half oval, ciliated on the back. It is a creeping plant with a stem one to two feet high, never procumbent, and rooting at the joints. The leaves are broad and rough-edged, the uppermost horizontal at the flowering season; panicle rarely, if ever, protruded in this country, mostly inclosed in the sheath of the uppermost leaf. It is found in marsh ditches in Sussex and Hampshire.

LEGUMINOSÆ, or FABACEÆ, a very extensive natural order of Plants, consisting of herbaceous plants, shrubs, or vast trees, extremely variable in appearance. The leaves are alternate, most commonly compound, occasionally marked with transparent dots; petiole tumid at the base; stipules 2 at the base of the petiole, and 2 at the base of each leaflet; pedicels usually articulated, with 2 bractlets under the flower; calyx 5-parted, toothed, or cleft, inferior, with the odd segment anterior, the segments often unequal and variously combined; petals 5, or by abortion 4, 3, 2, 1, or none, inserted into the base of the calyx, either papilionaceous or regularly spreading; the odd petal, if any, posterior; stamens definite or indefinite, perigynous, rarely hypogynous, either distinct, or monadelphous, or diadelphous, very rarely triadelphous; anthers versatile; pistil simple, superior, 1-celled, 1- or many-seeded, commonly consisting of a single carpel, but occasionally of 2 or even of 5 carpels; style simple, proceeding from the upper margin; stigma simple; fruit either a legume or a drupe; seeds attached to the upper suture, solitary or several, occasionally with an aril; embryo with or without albumen, either straight, or with the radicle bent upon the cotyledons; cotyledons either remaining underground in germination or elevated above the ground, and becoming green like leaves, always very large in proportion to the radicle, and very often amygdaloid.

The most common feature of Leguminous Plants is to have what are called papilionaceous flowers, and when these exist no difficulty is experienced in recognising them, for papilionaceous flowers are found nowhere else. Another character is to have a leguminous fruit: and by one of these two characters all the plants of the order are known. It is remarkable however that one or other of these distinctions disappears in a great many cases. *Cæsalpinieæ* have an irregular flower with spreading petals and stamens adhering to the calyx; others have no petals at all, or some number less than five, while *Mimoseæ* have perfectly regular flowers and indefinite hypogynous stamens. *Detarium*, *Dipteryx*, and others, instead of a legume have a fruit not distinguishable from a drupe. This last circumstance is easily to be understood if we bear in mind that a legume and a drupe differ more in name than reality, the latter being formed on precisely the same plan as the former, but with this modification, that its pericarp is thickened, more or less fleshy on the outside and stony on the inside, 1-seeded, and indehiscent. Hence some of the regular flowered genera with distinct stamens may be said to be rosaceous in flower and leguminous in fruit. Simple therefore as the diagnosis of this order usually is, Brown is perfectly correct in asserting that, until he indicated the difference of the position of the odd lobe of the calyx in Leguminous Plants and Roseworts, no positive character had been discovered to distinguish the one order from the other. Very few double flowers are known in this order; those of *Spartium junceum* and *Ulex Europæa* are the most remarkable. Two ovaries are common in *Wistaria Sinensis*, and the same phenomenon is to be seen, according to De Candolle, in *Gleditschia*. On account of these and other circumstances, De Candolle assumes the carpel of Leguminous Plants to be solitary by abortion, and that a whorl of 5 is that which is necessary to complete the symmetry of the flowers.

In consequence of the highly irritable nature of the leaves of many of the plants of this order, and of the tendency to irritability discoverable in them all, some botanists have placed them at the extremity of their system, in contact with the limits of the animal kingdom. For observations upon the nature of this irritability see Dutrochet, 'Sur la Motilité,' Paris 1824, in which the author endeavours to show that the motion is the effect of galvanic agency; and the same writer's 'Nouvelles Recherches sur l'Exosmose,' in which he alters the explanation of the manner in which galvanism produces the motion, adhering however to his opinion of that subtle principle being the real agent. It is more probable however that these movements are connected with the inherent irritability of the protein common to all plants.

In many respects this order is one of the most important which the botanist can study; more especially as it serves to show how little real importance ought to be attached to dehiscence of fruit in determining the limits of natural orders. What may be called the normal fruit of Leguminous Plants is a legume, that is to say, a dry simple carpel, with a suture running along both its margins, so that at maturity it separates through the line of each suture into two valves; but every conceivable degree of deviation from this type occurs. *Arachis* and many more are indehiscent; in *Carmichælia* the valves separate from the suture, which remains entire, like the replum of *Cruciferæ*; in all Lomentaceous genera, such as *Ornithopus*, the valves are indehiscent in the line of the suture, but separate transversely; in *Entada* a combination of the peculiarities of *Carmichælia* and *Lomentaceæ* occurs; in *Hæmatoxylon* the valves adhere by the suture and split along the axis; and finally, *Detariun*, *Dipteryx*, and others, are true drupes, in no respect different from those of *Amygdaleæ*.

The geographical distribution of this order has been considered with great care by De Candolle, from whom the substance of what follows is borrowed. One of the first things that strikes the observer is, that if a number of genera of Leguminous Plants have as extensive a range as those of other orders there is a considerable number of which the geographical limits are clearly defined. Thus, the genera of Australia are in most cases unknown beyond that vast island; the same may be said of north and South America, and the Cape of Good Hope; and there are 14 or 15 genera unknown beyond the limits of Europe and the neighbouring borders of Asia and Africa. About 92 genera out of 280 are what are called 'sporadic,' or dispersed over different and widely-separated regions, such as *Tephrosia*, *Acacia*, *Glycine*, and *Sophora*. The species are found more or less in every part of the known world, with the exception of the islands of Tristan d'Acugna and St. Helena, neither of which do they inhabit; but they are distributed in extremely unequal proportions. In general they diminish sensibly in approaching the pole. This will be apparent from the following table :—

Europe, with the exception of the Mediterranean	184
Siberia	129
United States	183
China, Japan, and Cochin China	77
Levant	250
Basin of the Mediterranean	463
Canaries	21
Arabia and Egypt	87
Mexico	152
West Indies	221
East Indies	452
Equinoctial America	605
Equinoctial Africa	130
Australia	229
Isles of Southern Africa	42
South America beyond the tropics	29
Cape of Good Hope	353
South Sea Islands	13

This distribution, if condensed, will give the following results :—

Equinoctial Zone	1602
Beyond the Tropics to the North	1312
Beyond the Tropics to the South	524

Since the time this calculation was made the order has been prodigiously enlarged and a very considerable number of species has been added to those from the tropical parts of America, Australia, and the Cape of Good Hope. Nevertheless the calculation, with these exceptions, is instructive as a general sketch of the statistics of this branch of Geographical Botany. The Leguminous order is not only among the most extensive that are known, but also one of the most important to man, whether we consider the beauty of the numerous species, which are among the gayest-coloured and most graceful plants of every region, or their applicability to a thousand useful purposes. The properties of the order are very various: some are nutritious, others tonic and astringent, others purgative, and some poisonous. The plants supply timber, fibres, gum, dyes, and various other economical articles. There is however to be borne in mind, in regarding the qualities of this order in a general point of view, that upon the whole it must be considered poisonous, and that those species which are used for food by man and animals are exceptions to the general rule.

The species amount to some thousands, and are conveniently divided into three sub-orders, *Papilionaceæ*, *Cæsalpinieæ*, and *Mimoseæ*.

Papilionaceæ, Pulse section, have what are called papilionaceous flowers, that is, of the five petals one is large, broad, spread open, and called the standard; two others are parallel, convex, or slightly spreading, and called wings; and the two remaining ones are also parallel, but united by their anterior edge so as to form a body not unlike the keel of a boat, after which it is named. In all these plants the stamens are definite in number, and inserted with tolerable distinctness into the calyx; but while many are diadelphous, others are monadelphous or decandrous; the fruit is either a legume, a lomentum, or a drupe, or some form intermediate between the first and last. It is here that the great mass of the order occurs, especially in the colder parts of the world. Peas, beans, clover, saintfoin, lucern, liquorice, indigo, medicks, and trefoils, lupines, and numerous other common European genera, belong to *Papilionaceæ*.

Indigofera Anil.

1, Standard; 2, wings; 3, keel of the flower; 4, calyx; 5, diadelphous stamens; 6, legume.

Many species are tonics and astringents, and others yield a kind of gum, and among those that yield dyes is the *Baptisea tinctoria*, the Wild Indigo of America.

In a very large number of species narcotic properties have been discovered.

The descriptions of the useful genera will be found under their respective heads, such as ASTRAGALUS, BUTEA, COLUTEA, CYTISUS, INDIGOFERA, ERVUM, GLYCYRRHIZA, GEOFFROYA, MAVIA, CROTALARIA, MELILOTUS, TRIPTOLOMEA, &c., &c.

The sub-order *Cæsalpinieæ* have the petals spread out, and nearly equal-sized, with distinct unequal stamens; they may be considered the regular form of the order, while *Papilionaceæ* are the irregular form. Their fruit is usually a legume, but not always. The *Cassia*, which furnishes the senna-leaves of the shops, is the most interesting among them; to this sub-order also belong the Tamarind and Algaroba fruits, the trees yielding logwood, Brazil-wood, Sappan-wood, &c., and *Hymenæa*, from which gum anime is procured.

Purgative properties are the great characteristic of this sub-order. Senna is their most remarkable product. Some of them yield dyes. The Locust-Trees of North America belong to this order, and are celebrated for their gigantic stature. The principal species are described under CASSIA, CERATONIA, COPAIFERA, HÆMATOXYLON, HYMENÆA, ROBINIA, TAMARINDUS, &c.

Cassia elongata.

The sub-order *Mimoseæ* have small regular flowers collected into heads, numerous often indefinite stamens, usually hypogynous, and a legume. They are unknown in cold countries in a wild state, but in the hotter parts of the world they form a strikingly beautiful portion of the vegetation. From the much greater length of their stamens, their petals, and the clustered compact arrangement of their flowers, the latter often resemble tassels of silk, of the most vivid colours, intermingled among the leaves. Their bark is usually astringent, with a frequent intermixture of gum. The gums Arabic, Senegal, Sassa, and others, are produced by different species; catechu is the extract of the astringent bark of *Acacia Catechu*, and rose-wood is said to be the timber of some *Mimosa* inhabiting the interior of Brazil. One of the most striking phenomena among the plants of this order is the excessive irritability observable in the leaves of certain species of *Mimosæ*, such as *M. pudica*, *M. sensitiva*, &c., which are hence called Sensitive Plants. It is however a special peculiarity, and not one of general occurrence; unless the folding up at night of the leaves of the whole sub-order be regarded as an instance of the same irritable quality in a low degree.

The species of this order are described under ACACIA, ENTADA, MIMOSA, &c.

Mimosa pudica.

1, a flower, much magnified; 2, a legume.

In 1845 Mr. Bentham made the following estimate of the numbers of genera and species belonging to the order *Leguminosæ*.

	Genera.	Species.
Papilionaceæ:—		
Podalyrieæ	33	350
Loteæ	133	3000
Hedysareæ	52	500
Phaseoleæ	70	650
Dalbergieæ	41	250
Sophoreæ	21	50
Cæsalpinieæ	88	700
Mimoseæ	29	1000
	467	6500

LEGUMINOSITES, a genus of Fossil Fruits, from the Isle of Sheppey. (Bowerbank.)

LEHUNTITE, a Mineral consisting of silicate of alumina and soda. It occurs massive. Its colour is flesh-red, the mass when broken exhibiting two parallel white lines near the centre. Under the microscope it appears to be composed of minute scales. Hardness 3·75. Translucent on the edges. Specific gravity 1·953. Before the blowpipe it fuses into a white enamel. It is found at Glenarm, county of Antrim, in an amygdaloidal rock. Analysis by Dr. R. D. Thomson:—

Silica	47·33	
Alumina	24·00	
Soda	13·20	
Lime	1·52	
Water	13·60	
		99·65

LEIOCEPHALUS. [IGUANIDÆ.]

LEIODERA. [IGUANIDÆ.]

LEIODON. [SAURIA.]

LEIOLÆMUS. [IGUANIDÆ.]

LEIOLEPIS. [AGAMA; DRACONINA.]

LEIOSAURUS. [IGUANIDÆ.]

LEI'OTHRIX, a genus of Birds established by Mr. Swainson, with the following generic characters:—Bill much compressed; culmen gradually curved; nostrils large, membranaceous; tail moderate, deeply forked.

L. furcatus ('Pl. Col.,' 287, f. 1.: India). The genus belongs to Mr. Swainson's sub-family *Leiotrichanæ* (Silky Chatterers?), being the first of his family *Ampelidæ* (Fruit-Eaters, or Chatterers). [LEIOTRICHANÆ.]

LEIOTRICHA'NÆ (Swainson), a sub-family of the *Ampelidæ*, a family of Birds. It is thus defined by Mr. Swainson:—Legs large, robust, syndactyle; hind toe longer than the outer; wings short and rounded; bill strong; the gonys ascending.

The only other genus besides *Leiothrix* placed in this sub-family by Mr. Swainson is *Pteruthius* (Sw.), to which that author gives the following generic characters:—Bill short, compressed, thick; the tip shrike-like, hooked; culmen arched; gonys ascending; nostrils basal; the aperture round; gape wide; rictus slightly bristled; wings very short, rounded; tail short, broad, rounded; the tips obtuse; tarsi smooth, pale. *P. erythropterus*, Gould's 'Century of Himalaya Birds,' pl. 11 (*Lanius erythropterus*), India, is an example.

LEMMING. [MURIDÆ.]

LEMMUS. [MURIDÆ.]

LEMNA, a genus of Plants belonging to the natural order *Araceæ*, and the sub-order *Lemneæ*. It has a 2-flowered membraneous urceolate spathe; the male flowers consist of 2 stamens; the fruit is reticular and indehiscent; the fronds are without distinction of stems or leaves; the flowers appear just below the margiu of the frond. Several species have been described. They are all inhabitants of stagnant waters, and are known familiarly by the name of Duck-Weeds. The following are the British species:—*L. trisulca*, with lanceolate fronds; *L. minor*, with compressed obovate fronds; *L. polyrhiza*, with roundish-obovate compressed fronds; *L. gibba*, with obovate hemispherical fronds. (Babington, *Manual of British Botany*.)

LEMNIAN EARTH, occurs in the Isle of Lemnos, whence its name. It is found massive. Fracture earthy. Dull. Has a meagre feel. Soft. Opaque. Colour grayish or yellowish-white. Falls to pieces when put into water. It was formerly used in medicine under the name of *Terra Sigillata*. According to Klaproth it consists of—

Silica	66·0
Alumina	14·5
Oxide of Iron	6·0
Soda	3·5
Water	8·5
Traces of Lime, Magnesia, and Loss	1·5
	100·0

LEMON. [CITRUS.]

LEMUR. [LEMURIDÆ.]

LEMU'RIDÆ, a family of Animals belonging to the *Quadrumana*. Linnæus, in his 'Characteres Mammalium,' defines *Lemur*, the third genus of his *Primates*, thus—"Dentes primores inferiores 6." In the body of the work ('Syst. Nat.') he characterises the genus as follows:—Upper incisors (primores) 4; the intermediate ones remote; lower incisors 6, longer, prominent (porrecti), compressed, parallel, and approximate. Canines (laniarii) solitary, approximate. Molars numerous (plures), sublobate, the anterior ones longer and more acute. The genus consists of *Lemur tardigradus*, *L. Mongoz*, *L. Macaco*, *L. Catta*, and *L. volans*. To these species Gmelin added *L. Indri*, *L. Potto*, *L. murinus*, *L. bicolor*, aud *L. laniger*.

Cuvier remarks that the Makis (*Lemur*, Linn.) comprehend, according to Linnæus, all the *Quadrumana* which have, in the one or the other jaw, incisors which differ in number from four, or at least otherwise directed than in the Monkeys (Singes). This negative character, Cuvier observes, could not fail of embracing considerably different beings, and did not even collect all those which ought to be together. He goes on to notice that M. Geoffroy has established in this genus many divisions much better characterised. These animals have all the four thumbs well developed and opposable, and the first hind finger or toe armed with a pointed and raised nail or claw, whilst all the other nails are flat. Their fur is woolly; their teeth begin to exhibit pointed tubercles fitting into each other (engrenant les uns dans les autres), as in the *Insectivora*. The following groups are adopted by Cuvier:—

1. The Makis, or Macancos, properly so called, *Lemur*.
2. The Indris, *Lichanotus*, Illiger.
3. The Loris group (Slow Lemurs, *Stenops*, Illiger).
4. The Galagos, *Otolicnus*, Illiger.
5. The Tarsiers. *Tarsius*.

Dr. J. E. Gray arranges the *Lemuridæ* as the third family (Quadrupedoid) of the order *Primates* (Linn.), and he thus characterises the family:—

Grinders 6—6 above, 5—5 below; nostrils terminal; extremities free; first finger of the hind feet armed with recurved claws.

† Head long; grinders blunt.

1. *Lemurina:* genus *Lemur*, Linn. 2. *Lichanotina:* genera *Indris*, Lacép.; *Lichanotis* (*Lichanotus*), Ill.

†† Head round.

3. *Loridina:* genera *Loris*, Geoff.; *Nyaticebus* (*Nycticebus*), Geoff. 4. *Galagonina:* genera *Otolicnus* (*Otolicnus*), Ill.; *Galago*, Adams; *Cheirogallus* (*Cheirogaleus*), Geoff. 5. *Tarsina:* genus *Tarsius*. 6. *Cheiromina:* genus *Cheiromys*, Cuv.

Mr. Swainson makes the *Lemuridæ* his third family of *Quadrumana*, with the following characters:—

Form approaching that of quadrupeds; cutting teeth, $\frac{4}{4}$ or $\frac{4}{6}$; canine, $\frac{1-1}{1-1}$; grinders, $\frac{5-5}{5-5}$ or $\frac{5-5}{4-4}$, obtusely tubercular; head long, triangular; nostrils terminal; ears generally concealed, very small.

The following genera are comprised by the author last mentioned under this family:—*Lemur*, Linn.; *Indris*, Lacép.; *Lichanotus*, Ill.; *Scartes*, Sw.; *Stenops*, Ill.; *Otolicnus*, Geoff.; *Cephalopachus* (*Tarsius Bancanus*, Horsf.); *Tarsius*, Storr; *Aötes*, Humboldt; *Galeopithecus*, Pallas; *Cheirogaleus*, Geoff.

The author of 'The Natural History of Monkeys, Lemurs, and Opossums' ('Library of Entertaining Knowledge,' vol. xlii.) divides the Mammals with opposable thumbs into three sections, like Storr; and the author's arrangement is almost the same, differing only in the removal of the *Simiadæ* or *Prosimia*, as Storr calls them, from the second to the third section in consequence of observations made since Storr's time. The author observes that the coincidence is the more remarkable inasmuch as the arrangement of Storr was unknown to him till long after the publication of his own views. [CHEIROPODA.] The author makes his second section of Cheiropeds consist of the *Quadrumana*, or those which have opposable thumbs on both fore and hind hands; and he divides the section into two sub-divisions, the first consisting of the *Simiæ* (with anthropoid teeth), and the second of the *Lemuridæ* (with abnormal teeth). The genera arranged by him under this last sub-division are *Lichanotus*, *Propithecus*, *Lemur*, *Otolicnus*, *Cheirogaleus*, *Stenops*, *Tarsius*, *Cheiromys* and *Galeopithecus*.

Dr. J. E. Gray's sub-family *Lemurina* contains the true Lemurs, or Macaucos.

The genus *Lemur*, properly so called, is thus characterised:—

$$\text{Incisors, } \frac{4}{6}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{4-4} = 32.$$

Teeth of *Lemur*, more than one-third larger than nature. F. Cuvier.

M. Geoffroy maintains that the number of incisors in both jaws is equal, coinciding with the number in the Monkeys, the two outermost of the six, which are larger than the rest, being, according to him, the true canines; while the teeth commonly called canines are, in his opinion, only the first series of molars. "This conjecture," says Mr. Bennett, "unquestionably derives considerable strength from the fact that when the animal closes its mouth the supposed canines of the lower jaw pass behind those of the upper, a position directly contrary to that which they uniformly assume in every other animal that is furnished with that kind of teeth."

The muzzle is very pointed; the tail very long, the fur woolly and soft, and there are two pectoral mammæ. The structure of the hands and nails is mentioned above. (Cuvier's description of the Makis.)

"The whole of the genus thus characterised," writes Mr. Bennett in his 'Tower Menagerie,' "are natives of Madagascar, and of two or three of the smaller islands in its immediate vicinity. They appear to occupy in that remarkable and very imperfectly-known country the place of the Monkeys, none of which have yet been detected within its precincts. They are said to live in numerous troops upon the trees, and to feed upon fruit and insects; but their habits in a state of nature have not yet been observed with sufficient accuracy to enable us to form any clear idea of their mode of existence. In captivity they are particularly tame and good-tempered, fond of being noticed, delighting in motion, and leaping with surprising agility. They are however in some degree nocturnal, and when undisturbed pass a considerable portion of the day in sleep. If alone they roll themselves up in the form of a ball, and wind their long tail in a very curious manner round their body, apparently for the purpose of keeping themselves warm, for they are naturally chilly, and delight in basking in the rays of the sun, or in keeping as close as possible to the fire. When two of them are confined together they interlace their limbs and tails after a singular fashion, and placing their heads in such a position as that each may, if disturbed, see what is going on behind the other's back, fall comfortably asleep."

There are several species, and all that we have seen, some of them very beautiful, and exhibited in the Zoological Society's Collection at the Regent's Park, have been very mild.

L. albifrons, the White-Fronted Lemur, may be taken as an example.

The fur is ruddy or bronzed-gray above, whitish below; male with the front white; female with the same part of a deep gray and a black longitudinal line on the top of the head. M. Lesson remarks that the female is the Maki d'Anjouan of M. Geoffroy St.-Hilaire, and the Maki aux Pieds Fauves of Brisson.

White-Fronted Lemur (*Lemur albifrons*).

The bounding elasticity of this species, when familiar and quite at its ease, is wonderful. It pitches, after a leap of many yards, so lightly as hardly to attract the notice of the ear when it alights. If it take a leap from a table to the back of a distant chair, or even to the upper angle of an open door, it never misses its hold. Under the points of the fingers are elastic cushions, which no doubt assist it in performing these feats. It is a very affectionate animal, and a most amusing companion. Our limits will not permit us to indulge in an account of one which we kept, and which was suffered to go at large. When tired with playing about in the evening, its favourite perch was on the instep of the uppermost leg of his master, as he sat cross-legged before the fire. Having obtained leave, he used to take his seat, wrap his boa-like tail round his shoulders and back, and enjoy his nap.

In the catalogue of the 'Specimens of Mammalia,' in the collection of the British Museum, the following species of *Lemuridæ* are found:—

L. Macaco, the Ruffed Lemur. A native of Madagascar.
L. Catta, the Ring-Tailed Macauco. Also a native of Madagascar.
L. ruber, the Red Lemur. From Madagascar.
L. albifrons, the species described above.
L. nigrifrons, the Black-Fronted Macauco. Madagascar.
L. coronatus, the Crowned Macauco. Madagascar.

All these species of *Lemur* were living in the gardens of the Zoological Society in Regent's Park in 1852. In addition to these the following species are given in the Society's list:—

L. albimanus, the White-Handed Lemur. Madagascar.
L. rubrifrons, the Red-Fronted Lemur. Madagascar.
L. Mongoz, Mongozheim. Madagascar.
L. Anjuanensis, Anjouan Lemur. Madagascar.
L. niger, Black Lemur. Madagascar.

Stenops is Illiger's name for a genus of *Prosimii*, his third family of his second order, *Pollicata*, of *Mammalia* including the genera *Loris* and *Nycticebus* of Geoffroy.

Mr. Bennett, in his 'Gardens and Menagerie of the Zoological Society,' observes that in an early memoir on the family to which the Slow-Paced Lemur belongs, M. Geoffroy St.-Hilaire divided it for the first time into those minor groups of which it was most obviously composed. But Mr. Bennett remarks that M. Geoffroy has since carried the principle of subdivision to a still greater extent by separating the Slow-Paced Lemur from the slender *Loris*, with which he had previously associated it, in order to form from it and some other doubtful species the genus *Nycticebus*. Mr. Bennett cannot perceive any sufficient grounds for thus disuniting two animals so intimately allied to each other, and differing in no more essential characters than the somewhat greater length of the nose and of the limbs in the one than in the other. For this reason Mr. Bennett prefers M. Geoffroy's older arrangement, and proceeds, in accordance therewith, to describe the Slow-Paced Lemur as a species of *Loris*, which he considers to be a well-marked and circumscribed natural genus, differing from the Lemurs of the same author in many highly important characters. Mr. Bennett adds, that it is to be regretted that M. Geoffroy should not have applied the latter name to the species to which it was originally given by Linnæus, and to which alone it is, in Mr. Bennett's opinion, in any degree applicable; the Madagascar animals at present comprehended under it not presenting, he observes, even one of those characters on which Linnæus himself states that his generic name is founded.

"In common with the latter group," says Mr. Bennett in continuation, "the genus *Loris* forms part of that division of the Quadrumanous order which is essentially distinguished by an unequal number or irregular disposition of the incisor teeth in the two jaws; terminal nostrils with sinuous openings; and a long subulate or sickle-shaped claw upon the fore-finger of the hinder hands, all the rest of the nails being flat and rounded like those of the greater part of the monkeys and of man. The *Loris* differs from the other genera of this family in having four incisors in the upper jaw, placed in pairs with a vacant space between, and six in the lower, directed obliquely forwards; canines of moderate size; twelve molars above and ten below; a short rounded head and little or no tail. Sometimes, it would appear, the lateral incisors of the upper jaw, which are always smaller than the others, are either entirely wanting or so minute as not to be easily seen. But M. Geoffroy was enabled to detect them in the identical specimen which Vosmaer had declared not to possess them: and it is by no means improbable that future investigators may ascertain their existence in the stuffed individuals sent from Java by M. Leschenhault, of which M. Geoffroy has made a new species, principally on account of the supposed absence of these teeth. In addition to these primary characters, the *Loris* are distinguished by large prominent eyes, placed in front of the head and at no great distance from each other; short ears, scarcely rising through the hair with which they are invested; a rough tongue; nostrils projecting beyond the mouth and surrounded by a naked muzzle; and thumbs widely separated from the fingers, both on the fore and hinder hands."

Cuvier states that the *Loris* have the teeth of the *Makis*, only that the points of the molars are sharper; a short muzzle (museau court d'un doguin); a slender body; no tail; great approximated eyes; and a rough tongue. Their nourishment, he says, consists of insects, small birds or quadrupeds; sometimes their progression is excessively slow, and their habits nocturnal. Sir Anthony Carlisle, he adds, found at the base of the arteries of the limbs the same division into small branches as exists in the true sloths. To this part of their organisation we shall presently allude more at large. Cuvier remarks that two species are known, both from the East Indies—Le Loris Paresseux, on Le Paresseux de Bengale (*Lemur tardigradus*, Linn.), and Le Loris Grêle (*L. gracilis*); the latter, he remarks, has the nose more raised by a projection of the intermaxillary bones, and upon this difference of the nose M. Geoffroy has made of the first-named species his genus *Nycticebus*, and of the second his genus *Loris*.

M. F. Cuvier assigns the following dentition (that of the Great Galago)—

$$\text{Incisors, } \frac{4}{6}\text{; canines, } \frac{2}{2}\text{; molars, } \frac{6-6}{5-5} = 36$$

—to the Small Galago, the Slender Loris, the Cingalese Loris, the Slow-Paced Loris or Lemur, and the Dwarf Lemur, with hardly more than very slight exceptions, which are only manifested in the incisors and false molars.

The following are the generic characters of *Loris* and *Nycticebus*, Geoffroy:—

Loris.—Four upper incisors; six lower incisors inclining forwards; head round, eyes very large, limbs very slender, no tail; four mammæ coming from two mammary glands only. The tibia longer than the femur; ears short and hairy.

$$\text{Incisors, } \frac{4}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{6-6}{5-5} = 36.$$

Species.—1. Loris Grêle, *Loris gracilis*, Geoff.; Le Loris, Buffon; Le Tardigradus, Seba. 2. Loris de Ceylon; *Loris Ceylonicus*, Fisch.

The locality assigned to both these species is Ceylon; but, according to M. Lesson, neither Geoffroy, Desmarest, nor F. Cuvier admit the second species, regarding it as a simple variety differing hardly at all from *Loris gracilis*.

Nycticebus.—Head round; muzzle short; eyes very large; ears short and hairy; a tail more or less long; extremities strong and robust.

$$\text{Incisors, } \frac{6}{2\text{ or }4}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{6-6}{5-5} = 34\text{ or }36.$$

The species are—*N. Bengalensis*; *N. Javanicus*; and *N. Ceylonicus*. All from the East Indies.

We here adopt Mr. Bennett's view of the subject, and take the Slender Loris and the Slow-Paced Loris, or Slow-Paced Lemur, both of which are confounded by Linnæus under the name of *Lemur tardigradus*, as examples of the genus *Loris*.

Loris gracilis, the Slender Loris, has the visage produced and dog-like; forehead high above the nose; ears large, thin, and rounded; body slender and weak; limbs very long and slender; thumb on each foot more distinct, and separate from the toes; on that and the three outmost toes are flat nails; on the interior toe of every foot a crooked claw; no tail; the hair on the body universally short and delicately soft; the colour on the upper part tawny, beneath whitish, space round the eyes dusky; on the head is a dark-shaped spot with the end pointing to the interval between the eyes. Length from the tip of the nose to the anus only eight inches.

Pennant, whose description we have given, states that notwithstanding the epithet (tardigradum) given in Seba, who has figured the animal (male and female) in the 35th plate of his first volume, the Slender Lemur is very active, ascending trees most nimbly, and having the actions of an ape. "If," says Pennant, "we credit Seba, the male climbs the trees and tastes the fruits before it presents them to its mate." Seba himself observes that the epithet 'tardigradum' is misapplied. Others say that it is a melancholy animal, silent and very slow, sleeping in the day and only awaking in the evening, and living on insects, fruits, and eggs. There is a living specimen in the gardens of the Zoological Society, Regent's Park, London.

Slender Loris (*Loris gracilis*).

L. tardigradus, the Slow-Paced Lemur.—The most accurate description known to us is that given by Mr. Bennett:—"The Slow-Paced Lemur," he says, "is an animal of small size, scarcely equal to that of a cat. The largest individual yet noticed appears to be that seen by Pennant, who states its length at no less than 16 inches from the nose to the extremity of its back. Its proportions are short and thick-set; and the apparent clumsiness of its form is much increased by the manner in which it usually contracts itself into a kind of ball. Its head is broad, flat, and rounded, with a slightly projecting and pointed muzzle, in which the nostrils are perforated laterally. Its eyes are large and perfectly orbicular, and furnished with transverse pupils capable of being entirely closed during the day, and of being very largely dilated at night; their inner canthus is situated so low towards the nose that the motion of the eyelids appears to take place in a diagonal instead of a horizontal direction. The ears are short, round, widely open, but buried in the fur; and the tail is merely a rudiment of a few lines in length. The hinder limbs are considerably longer than the fore. The whole of the body, with the exception of the muzzle and hands, is thickly invested with long close woolly hair of a deep ashy gray with something of a brownish tinge. A deep brown or chestnut band passes along the middle line of the back, and is accompanied on either side by a faint grayish stripe, expanding on the back of the head into a still lighter patch. The dark middle stripe divides on the head into two branches, each of which is again subdivided, the posterior division passing transversely across the forehead and inclosing the ear, the anterior crossing the eye obliquely and extending to the angle of the mouth. Between the two, above the outer angle of the eye, is a large white spot. Each of the eyes is surrounded by a ring of dusky black, between which a narrow white line passes from the back part of the head to the tip of the nose, which, with the exception of the naked muzzle, is also white. The latter, together with the naked parts of the hands, is of a livid flesh-colour with a tinge of black. On the under surface the fur is of a lighter gray than above."

There are some parts of the organisation of this animal that require more particular notice.

Sir Anthony Carlisle injected the arterial system of a *Lemur tardigradus*, and upon tracing the course of the vessels, so as to make a dried preparation, which is now in the Museum of the Royal College of Surgeons in London, he found that an unusual appearance of distribution was exhibited by the large trunks of the subclavian and external iliac arteries. He shows that immediately after the subclavian has penetrated the axilla, it is divided into 23 equal-sized cylinders, which surround the principal trunk of the artery, here diminished in size to an inconsiderable vessel. These cylindrical arteries, he observes, accompany each other, and divide with the ulnar and radial branches, being distributed in their route upon the muscles, each of which has one of these cylinders. The other branches, for example the radial and ulnar, proceed like the arteries in general, dispersing themselves upon the skin, the membranes, joints, bones, &c., in an arborescent form. The iliac artery, he tells us, divides upon the margin of the pelvis into upwards of 20 equal-sized cylinders, surrounding the main trunk, as described in the axillary artery; these vessels are also finally distributed as in the upper extremity; the cylinders wholly upon the muscles, and the arborescent branches on all the other parts. The cylindrical arteries, he adds, do not divide into equal-sized cylinders, but are distributed as in the generality of animals.

Slow-Paced Lemur (*Loris* (*Nycticebus*) *tardigradus*).

Sir Anthony concludes by observing that it would be of some importance in physiology to ascertain whether the other slow-moving quadrupeds have any peculiar arrangement of the arteries of those limbs. This solitary fact, he remarks, is hardly sufficient for the foundation of any theoretical explanation of the slow movement of these muscles: if however it should be corroborated by similar circumstances in other animals, he thinks that a new light may be thrown upon muscular motion, by tracing a connection between the kind of action produced in a muscle, and the condition of its vascularity or supply of blood.

Mr. Baird, in his interesting paper in the 'Magazine of Nat. Hist.,' vol. i., 1829, remarks that all the known *Mammalia* close their eyelids in a direction upwards and downwards, and in general the upper eyelid is the one possessing the greatest degree of motion. He found however that in his Slow-Paced Lemur the eyelids were brought together in a diagonal direction, or outwards and inwards, which gave the animal at the moment of shutting its eyes a most peculiar look. It was the under or outer eyelid that had the greatest degree of motion, the upper or inner one being almost fixed; and he concludes that the orbicularis oculi must be very powerful. After the death of the animal, and when Mr. Baird had left this country on a second voyage to India, the eye was dissected by Dr. Knox, who found that the peculiar movement of the eyelids above described did not depend on any peculiar structure, but merely on the greater degree of strength of the orbicularis muscle.

Mr. Baird also observed another peculiarity in the species. "Beneath the tongue proper," says he, "if I may so call it, which is somewhat like that of the cat, though not rough, is another tongue, white-coloured, narrow, and very sharp-pointed, which he projects along with the other one when he eats or drinks, though he has the power of retaining it within his mouth at pleasure." Mr. Baird however had not been able to see any particular purpose to which he applied it; but he saw him use this double tongue when eating flies, of which he was exceedingly fond, snapping them up most eagerly when presented to him, and catching them himself when they were reposing in the evening upon the walls of the room.

Little or nothing certain appears to be known of the habits of the Slow Lemur of Bengal in a state of nature, except as they may be inferred from those which it exhibits in captivity. In this latter state many good observers have narrowly watched it, and have recorded their observations.

Vosmaer received one in June 1768, and kept it in his chamber. It slept all day till the evening, not waking (it being summer) till half-past eight. It was shut up in an oblong cage, secured with iron bars, and constantly slept sitting on its hinder parts close to the bars, with its head brought forwards between its fore-feet, which were bent against its belly. In this attitude it held on strongly to the wires with its hind feet, and often by one of the anterior feet as well, which induced Vosmaer to think that the animal ordinarily slept in trees attached to the branches. When awakened it moved very slowly, and always the same from the commencement to the end, dragging itself from bar to bar, grasping one above with its fore foot or rather hand, and not quitting its hold till it had slowly but very powerfully seized another with one of its anterior feet or hands. The same slowness marked its creeping on the ground, along which it dragged one foot after the other, as if it had been paralytic. In this mode of progression it raised its body but very little, so little, that as it dragged itself forward the belly was frequently not more than the breadth of a finger from the ground. It was vain to attempt to drive it by putting a stick through the bars; for it would not quit its hold, and if pushed too roughly, its only defence was biting the stick. As the evening approached it awaked by degrees, like one whose sleep is broken after long watching. Its first care was to eat, for the day had been dedicated to repose. After its repast, which it dispatched with comparative celerity, the remains of its former meal were evacuated. The fæces were in small pellets like sheep's dung, and the urine had a strong disagreeable odour. The sea-captain who brought it over stated that it fed on rice boiled very thick, and that it had never been seen to drink.

Vosmaer, impressed with the belief that his animal would not refuse a different sort of food, gave it a leafy lime-tree sprig: this it rejected. Fruits, such as pears and cherries, were more to its taste. It willingly ate dry bread and biscuit; but if dipped in water would touch neither. When offered water it smelt it, but drank not. Eggs were a favourite diet. "Il aimoit à la fureur les œufs," are the words of Vosmaer, who, concluding from its appetite for eggs that it would eat birds, gave it a live sparrow, which it instantly killed with a bite, and ate the whole very greedily. He gave it a live cockchafer, to try whether it would eat insects: it took the offering in its paw, and devoured it completely. Vosmaer afterwards gave it a chaffinch (pinçon), which it ate with much relish, and afterwards slept for the remainder of the day. He often saw it still awake at two hours past midnight; but from half-past six in the morning its sleep was so sound that its cage might be cleaned without disturbance to its repose. If forcibly awaked during the day in order to teize it, it was vexed and bit the stick; but with a very slow motion, repeating the cry 'ai, ai, ai,' drawing out the ai each time into a plaintive, languid, and trembling note, in the same manner as is reported of the American Sloths. When it was thus harassed for a long time, and thoroughly roused, it crawled two or three times round its cage, and then slept again.

The specimen observed by Sir William Jones was a male, as Vosmaer's appears to have been; and Sir William thus gracefully describes its habits:—"In his manners he was for the most part gentle, except in the cold season, when his temper seemed wholly changed; and his creator, who made him so sensible of cold, to which he must often have been exposed even in his native forests, gave him, probably for that reason, his thick fur, which we rarely see on animals in these tropical climates: to me, who not only constantly fed him, but bathed him twice a week in water accommodated to the seasons, and whom he clearly distinguished from others, he was at all times grateful; but when I disturbed him in winter, he was usually indignant, and seemed to reproach me with the uneasiness which he felt, though no possible precautions had been omitted to keep him in a proper degree of warmth. At all times he was pleased with being stroked on the head and throat, and frequently suffered me to touch his extremely sharp teeth; but at all times his temper was quick; and when he was unseasonably disturbed, he expressed a little resentment by an obscure murmur, like that of a squirrel, or a greater degree of displeasure by a peevish cry, especially in winter, when he was often as fierce, on being much importuned, as any beast of the woods. From half an hour after sunrise to half an hour before sunset he slept without intermission, rolled up like a hedgehog; and, as soon as he awoke, he began to prepare himself for the labours of his approaching day, licking and dressing himself like a cat, an operation which the flexibility of his neck and limbs enabled him to perform very completely; he was then ready for a slight breakfast, after which he commonly took a short nap; but when the sun was quite set, he recovered all his vivacity. His ordinary food was the sweet fruit of this country; plantains always, and mangoes during the season; but he refused peaches, and was not fond of mulberries, or even of guaiavas: milk he lapped eagerly, but was contented with plain water. In general he was not voracious, but never appeared satiated with grasshoppers, and passed the whole night, while the hot season lasted, in prowling for them: when a grasshopper, or any insect, alighted within his reach, his eyes, which he fixed on his prey, glowed with uncommon fire; and having drawn himself back, to spring on it with greater force, he seized his victim with both his fore paws, but held it in one of them while he devoured it. For other purposes, and sometimes even for that of holding his food, he used all his paws, indifferently, as hands, and frequently grasped with one of them the higher part of his ample cage, while his three others were severally engaged at the bottom of it; but the posture of which he seemed fondest was to cling with all four of them to the upper wires, his body being inverted; and in the evening he usually stood erect for many minutes, playing on the wires with his fingers, and rapidly moving his body from side to side, as if he had found the utility of exercise in his unnatural state of confinement. A little before day-break, when my early hours gave me frequent opportunities of observing him, he seemed to solicit my attention; and if I presented my finger to him, he licked or nibbled it with great gentleness, but eagerly took fruit when I offered it, though he seldom ate much at his morning repast: when the day brought back the night, his eyes lost their lustre and strength, and he composed himself for a slumber of 10 or 11 hours. . . . . My little friend was, upon the whole, very engaging; and when he was found lifeless in the same posture in which he would naturally have slept, I consoled myself with believing that he had died without pain, and lived with as much pleasure as he could have enjoyed in a state of captivity."

Mr. Baird, in the paper above quoted, gives an account of one of these Loris (loeris, a clown, Dutch; name in Ceylon, according to that gentleman). Mr. Baird's specimen was a male, and was obtained at Pulo-Penang (Prince of Wales's Island). When Mr. Baird wrote, he had been in possession of the animal upwards of nine months. Its food consisted of fruit and small animals, such as birds and mice. The plantain was the fruit of which he was the most fond, and was the only food Mr. Baird saw him eat when he first got him into his possession. The necks of fresh-killed fowls formed the major part of its sustenance during the voyage. It was particularly fond of small birds: these, when put into his cage, he killed speedily, and, stripping off the feathers, soon devoured them, eating the bones as well as the flesh. Veal was preferred to all other butcher's meat, and it was fond of eggs; meat boiled, or otherwise cooked, it would not touch. Sugar appeared to be grateful to its palate, and it ate gum-arabic. "As flesh is not always to be had quite fresh (the only state in which it is acceptable to him), he has for some time past been fed upon bread sopped in water, and sprinkled with sugar; this he eats readily, and seems to relish it much. M. Vosmaer mentions that his animal eat dry biscuit, but refused it if moistened with water; neither would it ever taste water. This is completely at variance with the habits of my animal, for he not only eats moistened bread, but laps water like a cat. When food is presented to him, if hungry, he seizes it with both hands, and letting go with his right, holds it with his left all the time he is eating. Frequently, when feeding, he grasps the bars in the upper part of his cage with his hind paws and hangs inverted, appearing exceedingly intent upon the food he holds fast in the left hand. He is exceedingly fond of oranges;"—in this the animal resembled a domesticated *Lemur albifrons* once in our possession;—"but when they are at all hard, he seems very much puzzled how to extract the juice. I have, upon such an occasion, seen him lie all his length upon his back, in the bottom of his cage, and, firmly grasping the piece of orange with both hands, squeeze the juice into his mouth." Mr. Baird, after noticing the cry mentioned by Vosmaer and Sir W. Jones, says, "When the cat annoys him, which she does very frequently by leaping over him, he repeats the cry nearly a dozen times: it is always however expressive of anger. He has also another sort of cry expressive of eagerness to obtain anything: this is much gruffer in sound, not shrill nor loud, but apparently made by forcing the air out of his nostrils. He likes much to be stroked under the chin and throat, and also under the arms, turning his head round to the hand like a cat, and lifting his arm, stretching it out beyond his head. Though not a very sensible animal, he is still evidently capable of feeling kindness and showing resentment. He allows his throat and fore arms to be stroked, but refuses to let the same liberty be taken with his lower limbs. For some time while in China, a little Chinese dog was his companion, sleeping in the same cage with him; and, with the exception of a few occasional jars, they lived very comfortably together. As the dog grew up however they were separated. A cat, the only animal in the house besides himself, has made many overtures to him, and when he is allowed to get out of his cage, he is followed up and down the room by his feline companion, who evidently wishes to make him her playfellow. Any undue familiarities however on her part are met with an immediate repulse from him; and, one time, when patting him rather incautiously with her foot, he bit her so severely, that she now, though evidently wishing to be on good terms with him, keeps at a safe distance. This same cat has, since this, become more familiar. Though not daring to approach him, she follows him wherever he goes, to his great annoyance, and renders herself an object of his abhorrence. He cries out on her approach, and is sadly tantalised by her playful trick of leaping over him. He seems to be rather a social animal notwithstanding. A large japanned tray attracts a good deal of his attention. Seeing his image reflected in it, he walks before it, and tries to grasp his own image. Finding his efforts ineffectual, he imitates the action of the child, by peeping behind it, with xpectation to see the object there. Before a looking-glass he shows the same regard and curiosity." In most respects, the rest of Mr. Baird's description agrees with those of Vosmaer and Sir W. Jones.

M. D'Obsonville's memoir is very interesting, but offers no differences sufficient to justify the insertion of his account of his specimen at length. The little animal, which enjoyed comparative liberty, being suffered to go at large, appeared to him to be very much attached. He used to caress it after giving it food; and the marks of sensibility upon the part of his favourite were, taking the end of his hand and pressing it to its bosom, fixing, at the same time, its half-opened eyes upon his.

One that Pennant saw in London, slept holding fast to the wires of its cage with its claws, as above described, and he states that the inhabitants of Bengal call the animal Chirmundi Billi, or Bashful Billy. Sir W. Jones says of it, "The Pandits know little or nothing of the animal: the lower Hindoos of this province generally call it Lajjábánar, or the Bashful Ape; and the Mussulmans, retaining the sense of the epithet, give it the absurd appellation of a cat; but it is neither a cat nor bashful; for though a Pandit, who saw my Lemur by day-light, remarked that he was Lajjàlu, or modest (a word which the Hindoos apply to all sensitive plants), yet he only seemed bashful, while in fact he was dimsighted and drowsy; for at night, as you see by his figure, he had open eyes, and as much boldness as any of the *Lemures* poetical or Linnean."

In a state of nature there can be no doubt that its habits are, for the most part, arboreal; and that it takes its prey by night, seizing that which is living, such as small birds, mice, and insects, by surprise, probably whilst they are sleeping; and varying its diet by having recourse to fruits.

"As to his country," says the author last quoted, "the first of the species that I saw in India was in the district of Tipra, properly Tripura, whither it had been brought, like mine, from the Garrow Mountains; and Dr. Anderson informs me that it is found in the woods on the coast of Coromandel: another has been sent to a member of our society from one of the eastern isles; and though the Loris may be a native of Silán, yet I cannot agree with M. de Buffon that it is the minute, sociable, and docile animal mentioned by Thevenot, which it resembles neither in size nor disposition."

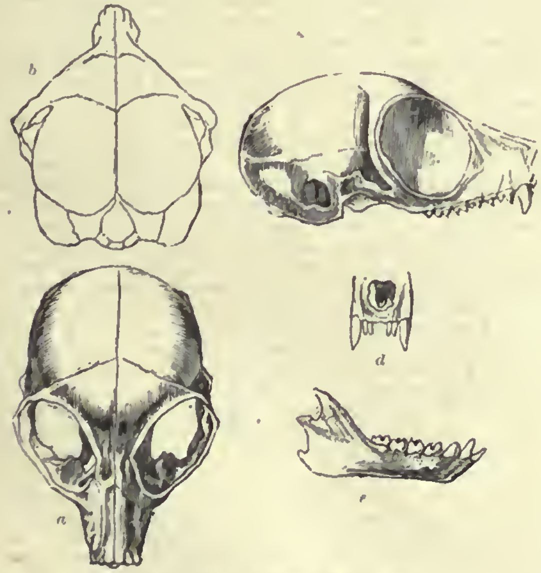
It has been found in other parts of the peninsula of Hindustan; and in Java, Penang, and Ceylon.

The genus *Galago*, Geoffroy, has the following dental formula, which is generally given by authors thus:—

Incisors, $\frac{2}{6}$ or $\frac{4}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{6-6}{5-5}$.

In the species which we select to illustrate the form, Dr. Andrew Smith found the dentition as follows:—

Incisors, $\frac{4}{6}$; canines, $\frac{1-1}{1-1}$; false molars, $\frac{2-2}{1-1}$; true molars, $\frac{4-4}{4-4} = 18$ in each jaw.



Skull and Teeth of *Galago Moholi*. Smith.

a, front view of skull; *b*, back view of same; *c*, lateral view; *d*, front view of the anterior portion of upper jaw; *e*, lateral view of lower jaw. All the figures natural size. Smith.

The head is rounded, muzzle short, eyes very large, ears very large. Feet pentadactyle; all the nails flat with the exception of the first digit of the hind feet, which is armed with a sharp subulate claw; two teats; tail very long, loose, and villous. The species are found in Africa, to which Mr. Swainson adds India.

a, Basal view of skull, exhibiting the teeth; *b*, lower jaw. Both figures double the natural size. Smith.

The habits of these creatures are arboreal. The great size of the orbits will at once strike every observer. The large development of the eyes requires such spacious receptacles; and this development is necessary on account of the nocturnal habits of the genus. The food of these animals consists of soft fruits, and, from the structure of the teeth, probably of insects also. They are fond of vegetable gum, and their large ears are said to be closed when they sleep, but to be opened upon their hearing the least noise.

G. Moholi, Smith.—The upper parts of the head and neck, the back, the sides of the body, and the outer and hinder surfaces of the extremities are intermediate between a pearl and yellowish-gray colour; the back is finely brindled, from the dark colour of the basal portion of the fur being here and there seen through the surface tints; the extremities are of a lighter hue than the other parts enumerated, and their outer and hinder surfaces are distinctly tinted with yellow; the middle of the face, the lips, the sides of the head, below and behind the eyes, the chin, throat, abdomen, and the upper surface of the fingers, white; inner surfaces of extremities white, tinged with yellow. Tail glossy; the colour intermediate between yellowish-brown and cochineal red; the fur is througbout of the same colour; that of the other parts is a dark slate-colour except at and near its surface. Ears flesh-coloured; and the down, which is very sparingly scattered over their outer surface, is pure white. Eyes deep topaz yellow; the palms of the hands and under surface of the fingers are of a flesh-colour tinged with brown. Figure slender and elegant. Head broad, subglobular, and anteriorly terminated by a short, high, and almost pointed nose. Ears large, bare, and patulous, their tips rather narrow and slightly rounded; the outer margin of each ear has two faint emarginations, and the internal or anterior surface of each is distinctly marked with four or more transverse ridges; the eyeballs and the pupils large; anterior extremities short and slender; posterior ones long, rather robust, and each is terminated by four fingers and an opposable thumb, the tips of which are dilated and depressed; the nail of the forefinger of each of the hinder extremities is narrow, convex, considerably elongated beyond the soft parts, and obtusely pointed; all the other nails both of the anterior and posterior extremities small, thin, flat, roundish or ovate in form, and not extended to the points of the fingers. Tail cylindrical, slender towards the base, much thicker towards and at the tip, which arises from the fur being longer on those parts. On the head, body, and extremities, the covering consists of a very fine short woolly fur, which on the tail and the upper surface of the fingers is rather harsher. Palm of the hands and under surface of the fingers naked. (Smith.) Length from nose to tip of the tail, 16 inches. It is found in Southern Africa, and probably Western Africa.

The first specimens observed by Dr. Smith were upon trees close to the Limpopo River, in about 25° S. lat., and from that parallel he continued to observe others as the expedition travelled. They were very active, springing from branch to branch and tree to tree with extraordinary facility, and always seized the branch on which they intended to rest. In their manners they considerably resembled the monkeys, particularly in grimaces and gesticulations. According to the natives, the species is entirely nocturnal, and rarely to be seen during the day, which the animal spends in the nest which it has formed in the forks of branches or in cavities of decayed trees; and in these nests, constructed of soft grass, the females bring forth and rear their young (generally two at a birth). Dr. Smith states that the food of the *Moholi* consists principally of pulpy fruits, though there is reason to believe it also consumes insects, as remains of the latter were discovered in the stomachs of several individuals which he examined.

Moholi (*Galago Moholi*).

Dr. Smith for the reasons stated in his work, considers this animal different from *G. Senegalensis*. He gives an elaborate anatomical description and good figures of the more important and interesting parts of this animal.

In the 'British Museum Catalogue' the following species of *Galago* are found:—

G. Senegalensis, the Senegal Galago. From Gambia, Western Africa.
G. Alleni, the Black Galago. From Fernando Po.
G. minor, the Little Galago. From Madagascar.

Perodicticus (Bennett).—Face somewhat lengthened. Limbs subequal. Tail moderate. Index very short, the ungueal phalanx alone exserted.

$$\text{Incisors, } \frac{4}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{4-4}{3-3}\ (?).$$

The upper incisors are subequal, and the lower slender and sloping (declives); the canines conic, compressed, with the anterior and posterior margins acute; the first upper molar smallest, the second larger, and both conic; the third acutely tuberculate, the tubercles being two externally and one internally; the fourth like the preceding, its internal tubercle rather larger than the rest (absent in the young specimen); the lower molars consist of two, conic and equal, and a third externally acutely bituberculated, and one internal tubercle; the rest absent.

P. Geoffroyi (Bennett) is of a chestnut colour, paler below, with a few ash-coloured hairs interspersed; fleece woolly. It is a native of Sierra Leone. A live specimen of this animal exists in the Gardens of the Zoological Society of London.

Mr. Bennett gives the following as the synonyms of this highly-interesting animal:—Potto, Bosman ('Guin.,' li. 35, No. 4 l); *Lemur Potto*, Gmel. (Linn., 'Syst. Nat.,' 42 ?); *Nycticebus Potto*, Geoff. ('Ann. Mus.,' xix. 165 ?); *Galago Guineensis* (Desm., 'Mamm.,' 104, No. 127 ?); and describes the head as rounded, with a projecting muzzle; the nostrils lateral, small, sinuous, with an intermediate groove extending to the upper lip; the tongue rough with minute papillæ, rather large, thin, and rounded at the tip, and furnished beneath with a tongue-like appendage, which is shorter than the tongue itself, and terminates in about six rather long lanceolate processes, forming a pectinated tip. The eyes are small, round, somewhat lateral, and oblique; the ears moderate, open, and slightly hairy both within and without; the body rather slender, and the fingers moderately long. The index on the forehands is excessively short, the first phalanx being concealed, and the ungueal phalanx (the only phalanx free) being barely large enough to support a rounded nail, which did not exist on the specimen, but of which there was an apparent cicatrix; nails of all the other anterior fingers flat and rounded; those of the hinder hands similar, except that of the fore finger, which, as in the Lemurs generally, is long, subulate, and curved. Tail of moderate length, covered with hairs resembling those of the body. Hairs generally long, soft, and woolly, each of them mouse-coloured at the base, rufous in the middle, and paler at the tip; some few tipped with white. This arrangement produces on the upper surface and on the outside of the limbs a chestnut hue, slightly mixed with gray; the under surface is paler. Muzzle and chin almost naked, and having only a few scattered whitish hairs. Length of the head two inches and two-tenths; of the body six inches; of the tail one inch and six-tenths, or, including the hairs, two inches and three-tenths. Breadth of the head in front of the ears one inch and four-tenths; distance between the eyes four-tenths; from the anterior angle of the eye to the end of the nose seven-tenths; from the eye to the ear fifteen-twentieths; length of ears behind five-tenths, of their aperture eight-tenths, breadth five-tenths. Elaborate measurements of the anterior and posterior limbs are given by the author, to which we refer the reader.

The animal is described as slothful and retiring, seldom making its appearance except in the night-time, when it feeds upon vegetables, chiefly the *Cassada*. It is known to the colonists of Sierra Leone as the Bush-Dog.

Mr. Bennett remarks that the genus is readily distinguishable from the other *Lemuridæ* by the comparative length of the tail. In this, he observes, in the moderate elongation of the face, in the moderate size of the ears, in the equality of the limbs, and especially in the extreme shortness of the index of the anterior hands, reside its essential characters. The latter character is regarded by Mr. Bennett as especially important, and he considers it as indicating its typical station in a family, all of which are distinguished from the neighbouring groups by a variation in the form of the index or of its appendages. "In the *Lemuridæ* generally," says Mr. Bennett in conclusion, "the nail of the index of the hinder hands is elongated and claw-shaped, and unlike those of the other fingers, which are flat, as in the Monkeys. This is frequently accompanied by an abbreviation of the index of the fore hands, which becomes in *Loris* (Geoff.) very considerable, and is in *Perodicticus* carried to its maximum, that organ being here almost obsolete." ('Zool. Proc.,' 1831.)

Of *Cheirogaleus* but little is known. M. Geoffroy characterised the genus from the drawings and manuscript of Commerson. He gives the following generic characters:—Head round; nose and muzzle short; whiskers long; eyes large and prominent; ears short and oval; tail long, full (touffue), cylindrical, and curled (euroulée); nails of the thumbs flat, and all the other nails subulate; fur short.

The three species mentioned in Commerson's manuscript notes are —*Cheirogaleus major*, *C. medius*, and *C. minor*, all from Madagascar. M. Geoffroy thinks that the species last-named is *Galago Madagascariensis*.

Two species are named in 'the British Museum Catalogue,' *C. Smithii* and *C. typicus*, both from Madagascar. [LICHANOTUS.]

LENTIBULARIA'CEÆ, *Butter-Worts*, a small monopetalous order of Exogenous Plants, resembling *Scrophulariaceæ* very much in all respects, except that their seeds are arranged upon a free central placenta. They are natives of marshes or rivulets or fountains, in all parts of the world, especially within the tropics. *Pinguicula vulgaris* has the property of giving consistence to milk and of preventing its separating either into whey or cream. It is by the use of the leaves of this plant that the solid milk of the Laplanders is prepared. There are 4 genera and 175 species of this genus, all of which are herbaceous plants, living in water or marshes, chiefly within the tropics. The species of *Genlisea* are exclusively Brazilian.

LENTIL. [ERVUM.]

LENZINITE, a Mineral consisting of silicate of alumina. It occurs massive. Fracture earthy. Sometimes slightly conchoidal. Hardness 1·5; easily scratched by the point of a knife. Colour white. Lustre rather greasy. Translucent, transparent on the edges. Specific gravity 1·8 to 2·10. When put into water it divides into numerous small translucent bits, which, when touched, fall into grains of great hardness; by heat loses 25 per cent. in weight, and becomes hard enough to scratch glass. It is found at Eifeld in Prussia. Dr. John's analysis gives—

Silica	37·5
Alumina	37·5
Water	25·0
	100

LEO. [FELIDÆ.]

LEO'DICE. [ANNELIDA.]

LEONHARDITE, a Mineral occurring crystallised. Primary form

Pinguicula vulgaris.

1, an anther; 2, the glandular ovary, with a two-lobed stigma, of which one of the lobes is much larger than the other.

an oblique rhombic prism. Cleavage very perfect, parallel to the lateral planes. Colour white, yellowish, and more rarely brownish. Streak white. Fracture uneven. Frequently coated with brownish or black powder. Hardness 3·0 to 3·5. Lustre pearly, especially on perfect cleavage planes; on the fractured surface vitreous. Translucent on the edges. Specific gravity 2.25. Found near Wolfstein in Rhenish Bavaria. The following is its analysis by Dr. Delf:—

Silica	56·128
Alumina	22·980
Lime	9·251
Water and Loss	11·641
	100

LEONTICE, a genus of Plants belonging to the natural order *Berberidaceæ*, the root of one species of which is used at Aleppo as a substitute for soap, and is regarded by the Turks as a corrective of overdoses of opium.

LEONTODON, a genus of Plants belonging to the natural order *Compositæ*. The heads are many-flowered; involucre double, the inner row erect, outer of few short lax or adpressed imbricated phyllaries; fruit sub-compressed, muricated, and suddenly contracted above, produced into a filiform beak.

L. Taraxacum, Dandelion, is a well-known plant found in dry places, in bogs or damp places. It has runcinate toothed leaves; fruit linear, obovate, blunt, and squamosely muricated at the summit, longitudinally striated with a long beak; stalks single-headed, radical; florets yellow; leaves all radical, very variable, glabrous or slightly hispid.

The following varieties are considered as species by De Candolle, but are described merely as varieties by Babington. *L. Taraxacum* of Smith is known by the outer scales being linear, deflexed. *T. lævigatum* has its outer scales erect, patent, ovate. *T. erythrospermum* has the outer scales lanceolate, depressed, or patent. *L. palustre* with the outer scales ovate, acuminate.

The root, leaves, and flower stem (scape) of the Dandelion contain much milky juice; but the root only is employed in medicine: though the leaves by blanching can be rendered fit for use as a salad, retaining then only a moderate degree of bitterness. The root of plants which are three or four years old should alone be collected, and at Midsummer; as young plants or roots collected in spring merely contain a reddish mucilaginous juice, while those of older plants taken up in summer have a brown, bitter, and saline juice. Those from rich soil are not so potent as those from a poorer land. The root may either be speedily and carefully dried for preservation, or the expressed juice may be inspissated, and so form what is termed the extract.

The chemical constitution is a peculiar bitter principle, grumous sugar, and inulin, and probably some important salts.

Either an infusion, decoction, or extract possesses sedative, deobstruent, and diuretic properties. In chronic subacute inflammation of the stomach or liver, enlargements of the liver, or spleen, it proves more beneficial than almost any other vegetable remedy. In many cases of dropsy, particularly connected with obstruction of the liver, it has often succeeded when all other diuretics have failed. It is very extensively employed in Holland to obviate the effects of the intermittents or agues common there, and with the greatest advantage. The extract, unless very carefully prepared, soon ferments and spoils.

There are 14 European species of this genus described in Wood's 'Tourist's Flora.'

LEONU'RUS (from λέων, a lion, and οὐρά, a tail), a genus of Plants belonging to the natural order *Labiatæ*. The anthers approximate in pairs, with parallel cells and naked valves. The upper lip of the corolla is nearly flat, the lower one trifid, with the middle lobe obcordate. The calyx is tubular and 5-toothed; the nuts flatly truncate.

L. cardiaca, Mother-Wort, is a bitter herb, with a pungent unpleasant smell. The stems rise from two to three feet in height; they are wand-like, downy, purplish, and quadrangular. The leaves are long-stalked, somewhat downy, and of a dark-green colour. The lower leaves are the broadest, and deeply jagged, the upper ones 3-lobed, and those about the summit lanceolate and undivided. The corolla is of a purple colour, and externally hairy; the calyx rigid and pungent. It is found in hedges and waste places in Great Britain, all over Europe, and the middle of Asia. The reputed tonic powers of this herb as a remedy in palpitations of the heart and cardialgia, or hearthurn, are now disregarded: from being used however in the last complaint it derives its name. It has been extolled by the Russians as an antidote to canine madness, and bees are fond of the honey contained in its flowers.

L. marrubiastrum has elongated pubescent branches, oblong-ovate deeply-toothed leaves, the calyx nearly glabrous, and the corolla small, white or pale-red, and shorter than the calycine teeth, which are subulate, spiny, and diverging. It is found in waste places throughout Europe and Asiatic Russia.

There are 8 species of *Leonurus* described by botanists as growing chiefly in Europe and the north of Asia. None of them are very ornamental, and being biennial plants the seeds only require to be sown in the open ground.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica;* Babington, *Manual of British Botany.*)

LEOPARD. [FELIDÆ.]

LEOPARD'S BANE. [ARNICA.]

LEPADITES, one of the many names of the supposed bivalvular opercula of *Ammonites*, found at Solenhofen, termed *Trigonellites* by Parkinson, *Solenites* by Schlottheim, and *Aptychus* by Meyer.

LEPAS. [CIRRIPEDIA.]

LEPEDOLITE, *Lilac Mica*, a Mineral which occurs massive, and is usually composed of small flexible thin scales. The fracture is uneven. Colour pearl-gray, peach-blossom, rose- and purple-red, and greenish. The scales, which are sometimes hexagonal, are translucent. Specific gravity 2·85. Before the blow-pipe it melts into a spongy semi-transparent white globule. It is found in granite near Rosena in Moravia, at Perm in Russia, at the Isle of Uton in Sweden, and in North America.

Analysis by Dr. Turner of the red variety from Moravia:—

Silica	50·35
Alumina	28·30
Potash	9·04
Lithia	4·49
Oxide of Manganese	1·23
Fluoric Acid and Water	5·20
	98·61

LEPI'DIUM (from λεπίς, a scale, in allusion to the form of the pods, which resemble little scales), a genus of Plants belonging to the natural order *Cruciferæ*, and the tribe *Lepidineæ*. It has a roundish or oblong pouch, either notched or entire, compressed valves, keeled or winged at the back. There is but one seed in each cell; the filaments are simple The species consist of herbs, some of which are shrubby, with small white flowers. This genus is divided into seven sections, the first of which, *Cardaria*, is so called from the heart-shaped form of the silicles. To this section belong

L. Draba. It has oblong leaves, entire or toothed, the lower ones narrowed into a foot-stalk, the stem-leaves sagittate and amplexicaule, the style as long as the dissepiment. It is native in the south of Europe from Spain to Tauria, and from Greece to Paris. It was introduced into Great Britain probably by foreign seed, and is now found in the hedges of Kent.

L. sativum, Common Garden Cress, belongs to the section *Cardamom* of this genus. It has orbicular pods, variously cut winged leaves, and smooth branches. It is native of Persia and the island of Cyprus in corn-fields. There are three varieties of the species: the Broad-Leaved Cress, which is cultivated chiefly for rearing young turkeys; the Curled Variety, which is sometimes used as a salad, but is considered preferable as a garnish; and the Common Plain-Leaved Cress, which forms one of our earliest spring salads, and has a peculiarly warm and grateful relish. All the varieties are raised from seed, of which one ounce will serve for a bed 4 feet square. Cress should be raised four or five times a month, so as to have the crops delicately young in succession. When raised in the open garden it should be sown early in March, and if the weather be cold it should be covered either with matting or a frame during the night. Cress is often raised on porous earthenware vessels of a conical form, having small gutters on the sides for retaining the seeds. These are called pyramids: they are somewhat ornamental in winter, and afford repeated gatherings. This species is the Λεπίδιον of Dioscorides, 2, 203.

L. campestris has downy leaves, the upper ones toothed, the lower ones oblong and narrowed into a foot-stalk, the stem-leaves lanceolate, sagittate, and amplexicaule. It is distinguished from the other species by the pouch being ovate, rough, and covered with minute scales, notched and rounded at the end, the style scarcely longer than the notch. It grows on dry gravelly soil in Great Britain.

L. latifolium has ovate lanceolate leaves, serrated or entire; the pouch is oval and downy. It has numerous small flowers in compound leafy panicled clusters. It is a native of Europe, also of Algiers, and of several parts of England, generally near the sea. It has a very hot biting taste, and has been used instead of horse-radish, occasionally as a salad. The poor people are in the habit of eating it as a condiment to their food; hence it has acquired the name of Poor Man's Pepper. An infusion of it acts as an emetic. Fraas believes this to be the Κράμβη ἀγρία of Dioscorides, 2, 147, although it is usually referred to the *Brassica cretica*. It is also the *Lepidium* of Pliny, 20, 17, 19, 5.

The green-house species will thrive well in any kind of light soil, and are readily propagated by cuttings planted under a hand-glass, or by seeds. The hardy perennial species, by dividing at the roots or by seeds, will grow in any kind of soil. The hardy annual kinds only require to be sown in the open ground. None of the species are worth cultivating for ornament.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Fraas, *Synopsis Floræ Classicæ*; Burnett, *Outlines of Botany*.)

LEPIDODENDRON (λεπίς, a scale, and δένδρον, wood), an important genus of Fossil Plants, in the examination of which Sternberg ('Flora der Vorwelt'), Brongniart ('Végétaux Fossiles'), and Lindley ('Fossil Flora') have signalised their abilities, not without success, though some uncertainty yet attaches to the botanical relations of these singular specimens of the flora of earlier nature. M. Brongniart in 1822, and again in his 'Prodrome' (1828), referred the *Lepidodendra* to the natural group of *Lycopodiaceæ*, pointing out however their analogies to *Cycadeæ* and *Coniferæ*, and assigned the following characters:—

Stems dichotomous, covered near the extremities with simple linear or lanceolate leaves, inserted on rhomboidal areolæ; lower part of the stems leafless; the areolæ for their insertion marked in the upper part with a transverse cicatrix, of a deltoid figure, the lateral angles acute, the inferior angle obtuse or wanting. The form of the cicatrix of the leaves is the essential character of the genus; it indicates that the leaves were nearly trigonal at the base, becoming plane at some distance therefrom, with a strong midrib. A rounded cicatrix distinguishes the leaf-base of stigmaria, which was perhaps an aquatic plant of the same natural group as the terrestrial *Lepidodendron*.

Lepidodendron Sternbergii. Brongniart. (From the 'Fossil Flora,' pl. 4.)

The stems thus named and characterised attain the size of 60 or 70 feet in length, with a diameter exceeding 3 feet: their whole surface is covered by rhomboidal eminences, arranged in spiral rows, so as to present a beautiful quincuncial ornament. In the opinion of M. Brongniart the mode of division (dichotomous) of the stem and the form of the leaves determine a great affinity between the *Lepidodendra* and *Lycopodiaceæ*. The growth of the stem he compares to that of *Cycadeæ*, and the form of the reproductive organs (cones) shows analogy to *Coniferæ*, and especially *Araucaria*.

Dr. Lindley, in the first volume of the 'Fossil Flora of Great Britain,' after discussing the botanical relations of *Lepidodendra* as far as the facts then collected allowed, thus expresses his opinion:—"Upon the whole, we are led to conclude that the *Lepidodendron* genus was not exactly like either *Coniferæ* or *Lycopodiaceæ*; but that it occupied an intermediate station between these two orders, approaching more nearly to the latter than the former."

A great addition to the data requisite for determining the problem of the true characters of *Lepidodendron* was made by the Rev. C. V. Harcourt, who discovered a specimen in which the internal structure of a branch was perfectly observable, and which, when cut thin and polished, cleared up many important points. Mr. Witham, the authors of the 'Fossil Flora,' and finally M. Brongniart, have published drawings and descriptions derived from this precious fragment. Dr. Lindley and Mr. W. Hutton ('Fossil Flora,' ii. p. 51) consider their former view entirely confirmed by this discovery. "It had a central pith, a vascular sheath surrounding that pith, and fistular passages in its cortical integument: thus far it was Coniferous. But as no trace can be found of glandular woody fibre, it can scarcely be said to have had any wood, and it is uncertain whether it had any bark. . . . Its vascular system was confined to the middle of the stem and to the curved passages emanating from it: the stem consisted of lax cellular tissue, which became more compact towards the outside, and it had a very powerful communication between the bases of its leaves and the central vascular system: thus far it was Lycopodiaceous." Spiral vessels are stated to be seen round the central cellular tissue; and (tab. 113) it is further said, "the genus was more nearly related to *Coniferæ* than to *Lycopodiaceæ*."

M. Brongniart, renewing his investigations with the aid of these new facts, evidenced by *Lepidodendron Harcourtii*, adopted a different view concerning the vascular system of the stem, for he supposes the central cellular tissue to be entirely surrounded by a narrow zone of large vessels, "rayés transversalement' (by Dr. Lindley considered as a loose cellular tissue), as in *Lycopodiaceæ* and Ferns, without medullary rays, and of which the exterior parts go off in bundles to the leaves.

From the whole discussion he adopts the conclusion that by the interior structure of the stems, as well as by their exterior form, their mode of ramification, and the arrangement of their leaves, the *Lepidodendra* agree almost completely with *Lycopodiaceæ*, and may be regarded as arborescent groups of that family, which contains in the living creation only small and humble plants; nor does it appear that his conviction is weakened by the comparison of these elongated (cylindrical) fossil 'cones' (*Lepidostrobi*), which are by most botanists referred to *Lepidodendron*, with the analogous organs of *Lycopodiaceæ* and *Coniferæ*. [LEPIDOSTROBI; COAL-PLANTS.]

The species are numerous, and confined to the older strata, and specially abundant in the Coal-Formation.

(Brongniart, *Histoire des Végétaux Fossiles*; Lindley and Hutton, *Fossil Flora of Great Britain*.)

LEPIDOGASTER, a genus of Fishes belonging to the Subbrachial *Malacopterygii*, and to the family *Cyclopteridæ*, or *Discoboli*. [DISCOBOLI.] The genus *Lepidogaster* is distinguished by its smooth body without scales; dorsal and anal fins opposite and near the tail; pectoral fins large, descending to the inferior surface of the body, and by an extension of the membrane surrounding an oval disc; ventral fins united by a membrane which extends circularly under the belly, forming a second concave disc.

L. Cornubiensis, the Cornish Sucker, Jura Sucker, and Ocellated Sucker, *Cyclopterus Lepidogaster* of Pennant and *L. biciliatus* of Risso, is occasionally seen on the Cornish coasts, and has been taken on the coasts of Antrim and Clare in Ireland. This fish is small, a specimen described by Mr. Couch not being more than two inches and a half in length. It adheres with its sucker to almost any substance presented to it, and even to the human hand. The general tint of this fish is a pale flesh-colour, with spots and patches of carmine about the upper and under surface of the jaws, around the eyes, on the top of the head, sides of the body, and abdomen.

L. bimaculatus, the Bimaculated Sucker, is a second British species. This fish is rarer than the last. It has been taken on the southern coasts of Great Britain. It seldom exceeds three-quarters of an inch to an inch in length. Its general colour is a carmine red; pale flesh-colour underneath, with a light-coloured patch between the eyes, and otherwise liable to some variation in the markings: the two spots on the sides not always very obvious. It lives in deeper water than the last species.

(Yarrell, *British Fishes*.)

LEPIDOGONYS. [FALCONIDÆ.]

LEPIDOKROKITE. [GÖTHITE.]

LEPIDOLEPRUS, a genus of Fishes belonging to the family *Gadidæ*. It is closely related to the genus *Morrhua*, to which the Common Cod belongs. The suborbitals are united with the nasal bone, and form a depressed muzzle, advancing before the mouth, which however retains its mobility. The head and body have hard spinous scales; the ventrals are a little on the throat; the pectoral of mean size; the first dorsal high; the second dorsal, anal, and caudal united; the jaws short; the teeth fine and short. The species inhabit deep water, and utter a grumbling noise when taken out of the water. Two species are known. They inhabit the Mediterranean and Atlantic.

LEPIDOLITE. [MICA.]

LEPIDOMELANE. [MICA.]

LEPIDOPHYLLUM. Fossil Leaves which occur in the coal formation are thus named by M. Brongniart. They appear to have been sessile, simple, entire, lanceolate or linear, traversed by a single simple midrib, or three parallel nervures, and without secondary nervures. (Some of these belong to *Lepidodendron*, others to *Stigmaria*.)

LEPIDO'PTERA, one of the Orders into which Insects are divided, called *Glossata* by Fabricius.

This order is composed of those insects which are commonly known by the names Butterflies and Moths, and which possess four wings, usually of large size, and covered with a multitude of minute scales, which to the naked eye appear like powder. The nervures of the wings are not very numerous, and are disposed chiefly in a longitudinal direction: a small tippet-like appendage is situated on each side of the thorax at the base of the wings, which appendages are called by Latreillo Pterygoda. The antennæ are almost always distinct, and are composed of numerous minute joints. The parts of the mouth are formed into a proboscis fitted for extracting the nectar from flowers, or conveying other juices to the œsophagus. This proboscis, when not in use, lies spirally folded beneath the head and between two palpi covered with hair, which are usually directed forwards and upwards, and which represent the labial-palpi. The proboscis is called, in these insects, Antlia by Messrs. Kirby and Spence, Spiritrompe by Latreille, and Lingua according to the nomenclature of Fabricius; and is composed of two sub-cylindrical tubes, which vary greatly in length in the different species of Lepidopterous Insects, and between which there is an intermediate one, formed by their junction, which is effected by means of a series of hooks inosculating one with another like the laminæ of a feather. It is through this central tube that the juices are conveyed, the lateral tubes being intended, as it is supposed, for the reception of air; they are called by Messrs. Kirby and Spence Solenaria, a name however which is not wanted, since the two tubes in question represent the maxillæ, and are furnished with minute maxillary-palpi at their base. The mandibles and labrum in these insects are reduced to mere rudiments. The head, thorax, and abdomen are always more or less covered with hair; the former, besides the ordinary compound eyes, is sometimes furnished with simple eyes or stemmata; these however are generally hidden by the hair of the head, and, according to M. Dalman, do not exist in the diurnal *Lepidoptera*. Of the three segments of which the thorax is composed, the first is usually distinct, though small; the others are confluent; the scutellum is triangular, the apex of the triangle pointing towards the head. The abdomen is composed of six or seven distinct segments, and is attached to the thorax only by a small portion of its diameter. There are only two kinds of individuals, males and females.

The principal modifications of the larvæ, or caterpillars, of Lepidopterous insects are noticed in the article INSECTA.

The food of the larvæ almost always consists of vegetable substances, generally the leaves of plants; some live in rotten, or rather, dead wood, upon which they feed; others feed upon animal substances, and are very destructive to furs, woollen goods, feathers, &c.; and the larva of a species of moth (the honeycomb moth, *Galleria cereana*) subsists upon wax, living in bee-hives.*

The pupæ, or chrysalises, are incapable of eating or locomotion, and are termed obtected; they usually approach somewhat to an oval form, but are pointed more or less at the posterior extremity. The shape of the pupæ however varies much according to the species; and those of butterflies often present numerous angular projections, and sometimes exhibit brilliant metallic colours. The parts of the perfect insect, such as the head, thorax, segments of the abdomen, wings, and legs, can be distinctly traced. Various modifications of the pupa state of the present insects are noticed in the separate articles on species which are described.

Latreille divides this order into three principal groups, according with the three Linnæan genera *Papilio*, *Sphinx*, and *Phalæna*. To the first group he applied the name *Diurna; Crepuscularia* is used to designate the second; and the third group, or that corresponding to *Phalæna* of Linnæus, is called by Latreille *Nocturna*.

The group *Lepidoptera Diurna* comprises those species which fly by day, called Butterflies, in which the antennæ are terminated by a knob, or at least somewhat suddenly thicker at the extremity; the anterior margin of the posterior wings is simple; the wings are usually erect when the insect is in a state of repose; the larvæ have 16 legs; the chrysalises are always naked, attached by the posterior extremity, so that the head hangs downwards, and have usually angular projections.

The *Lepidoptera Crepuscularia* are distinguished by the antennæ being gradually thicker from the base towards the extremity, and forming a prismatic or fusiform club; the extreme tip is slender, pointed, and often recurved. The wings are in a horizontal position when at rest, or a little inclined; the posterior wings have a rigid spine at the anterior margin, which is received into a hook on the under surface of the superior wings. The caterpillars have 16 feet, 6 of which are thoracic, 8 abdominal, and 2 anal; and many of them have a horn-like process on the upper side of the last segment. The pupæ are never angular like those of butterflies, but are generally smooth, and sometimes furnished with small spines. The perfect insects generally fly in the morning, evening, or afternoon.

The *Lepidoptera Nocturna* have the antennæ setaceous, or diminishing gradually from the base to the apex, often serrated or pectinated, especially in the male sex: the wings during repose are horizontal or deflexed, and sometimes convoluted and inclosing the body; the posterior wings, as in *L. Crepuscularia*, have a rigid seta on their anterior margin, which hooks into a corresponding groove in the anterior wings. The larvæ differ much in form, and in the number of feet they possess, varying from 10 to 16. They frequently inclose themselves in a cocoon before assuming the pupa state. The pupa is most frequently smooth, but is sometimes furnished with spines, and in some instances it is hairy.

The perfect insect almost always flies by night or after sunset. In some species the females are apterous.

* This larva forms galleries in the honeycomb, which are invariably inclosed by a strong silken web, serving to protect it from the bees; and as the moths increase rapidly in number, the hive is of necessity soon deserted by its proper inhabitants.

LEPIDOPUS. [TÆNIOIDES.]

LEPIDOSTROBI. Detached petrified cones which are scattered through the various strata of the Coal Formation have been thus named. They are obviously organs of fructification, and have therefore belonged to some of the arborescent plants whose remains they accompany. Such of them as are preserved in the nodules of iron-stone, or are otherwise mineralised without pressure, alone offer the means of ascertaining to what existing families of plants they are most nearly allied; for in those that are crushed flat in the shales the internal structure is wholly destroyed. Many of the better-preserved specimens have been sliced, polished, and examined with the greatest care; but this expensive operation has hitherto thrown little light upon the true nature of the objects investigated. This is owing to the fact that the three conditions necessary for their complete illustration have never been displayed by one specimen, and the most important point, the nature of the organs of fructification, has hitherto wholly escaped observation in all. Every one being an aggregation of organs of some kind it becomes necessary to ascertain, not only the arrangement of these organs, but the nature of the tissues composing them, and their contents, before satisfactory conclusions can be drawn as to their relationship to any of the vegetable remains they accompany, or to whatever existing order of plants they are allied. The three necessary conditions are these:—

1. The arrangement of the individual organs of fructification, of which the cone is an aggregation, and the nature of the scales supporting them. These are characters sometimes displayed on the fracture of the specimen by ordinary means, though rarely, from the parts appearing to have suffered partial decay previous to or during petrifaction. The imbricating apices of the scales, which lie over one another like those of a pine cone, are generally removed with the matrix wherein the fossil is embedded.

2. The tissues, or anatomical structure of the various organs composing the cone: namely, of the central axis, which is a continuation of the stem of the plant; of the scales, which being inserted into the axis support the individual male or female organs; and of the latter themselves. These tissues can only be displayed by slicing fossils in the very best state of preservation, and in such as are changed into a more or less transparent mineral. Specimens of this description are exceedingly rare.

3. The two preceding considerations are secondary to the remaining one—the nature of the contents of the cones. There may be stamens or male organs—ovaria or female ones—or, lastly, capsules containing reproductive spores (which are peculiar to plants having no sexual system); for these three kinds of organs all occur arranged in the form of cones, undistinguishable from one another by any external marks. Up to the present time no carboniferous fossil cone has ever been known to supply this great desideratum, without which we can arrive at no exact conclusion as to whether these curious objects are clusters of flowers or fruits, or are the spore-bearing organs of flowerless vegetables, as mentioned above.

Specimens of *Lepidostrobi* are mostly found in seams or nodules of clay iron-stone, and are very highly mineralised, sometimes containing crystals of iron, and the cavities in their substance being filled with white carbonate of lime and magnesia. Those which are most complete always form the nuclei to nodules of clay iron-stone; others again, including all in which the spores are preserved, have occurred as broken frustules within stems of *Lepidodendron elegans* and other species of that genus. Usually the fragments of *Lepidostrobi* are not more than half an inch long, and very frequently are mere discs; so that though there is often the appearance of one several inches long, and traversing the whole length of the fragment of *Lepidodendron*, it will generally be found that this is owing to two being placed each at an extremity of the truncheon, and opposite to one another. [See Figure, COAL PLANTS.] That all were exceedingly brittle cannot be doubted, for no modern cone of any natural order could be broken up into the shallow discs which many of these fossils present. It is difficult to account for the presence of these fragments of *Lepidostrobi* in the stems of *Lepidodendron;* we can but conjecture that the trunks of the latter were erect stumps, whose interior was hollowed out by decay—that these stumps were covered with water in which were fragments of *Lepidostrobi* and other vegetable matter, which were thus washed into the stumps. This supposition is founded on the following considerations :—

1. The stumps of *Lepidodendron* appear to have been rooted and erect, and to have received the cone fragments into their cavity as fern fronds find their way into the axis of *Sigillariæ*. Were the stumps mere prostrate portions of stems it is evident that cones would have lain horizontally in them, and that no washing or drifting could have induced the fragments of these cones to lie with their axes parallel to them, or could have introduced so many into one trunk; and the latter would certainly have been materially compressed had they received on one side the pressure of the superincumbent shales.

2. The stumps must have been submerged, and the fragments quietly deposited from the water. Had the cones fallen from an overhanging forest they would have alighted in all manner of irregular positions, and in some cases overlain one another, which is never the case.

3. The deposit appears to have been effected by the gradual subsidence of the water, and not by a sudden rush or current. This again is proved by the non-interference of the cones, and their uniformly vertical position with respect to the *Lepidodendron*.

It is hard to account for the accession of so large a volume of water as would submerge these stumps and deposit these fragments, and yet exhibit no signs of drifting in its course. The sudden fall of a tropical torrent of rain on a *Lepidodendron* forest, in which were hollow stumps of these trees, must at once suggest itself. This would both carry down the *Lepidostrobi* from the trees and float up the fragments on the ground, depositing them together in the stumps. Another effect of such a fall would be to break down some of the older trees, whose decaying stumps would be prepared to inclose other *Lepidostrobi* on the precipitation of the next similar torrent. The extreme fragility of the *Lepidostrobi* displayed by these specimens is very satisfactory, as the Lepidodendrons of which they are the fruit no doubt partook of this character, which is eminently favourable to a rapid decomposition and intimate union with the silt or mud which is the basis of the clay-ironstone in the one case, and the formation of a homogeneous bed of vegetable matter, such as the coal presents, in another. The extraordinary abundance of the fragments too suggests a most vigorous vegetation, for they must indeed have been profusely scattered to be deposited in such numbers within narrow cylinders into which no current appears to have been directed.

It is worthy of remark that no fern-leaves are contained in any of these *Lepidodendron* stems; and their absence is the more singular from their being commonly deposited along with branches of *Calamites*, &c., in the erect stumps of *Sigillaria* resting on the coal-shales. This is no doubt connected with the well-known fact of the *Sigillaria* stumps being filled with sandstone, or the same materials as those composing the stratum above the shales they root into; whilst the fossil *Lepidodendron* of the clay-ironstone seams is of the same mineral as that wherein it is imbedded. Were the fragments of *Lepidostrobi* washed into their inclosing stumps by any current, that agent would in all probability have transported the remains of other plants to the same spot. The perfect preservation in which these fragments occur must be attributed to the protection afforded them by the surrounding *Lepidodendron* bark. That the circumference of the latter has been subjected to pressure may be inferred from the flattening of the prominences to which the leaves were attached. This pressure was moreover very considerable, as may be proved by comparing the evenness of their surface with that of a piece of *Lepidodendron* bark fossilised without pressure, and imbedded within the stem along with the *Lepidostrobi*.

If these cones be examined with reference to the known contemporaneous fossils which accompany them, it will appear impossible to deny their having the reproductive organs of *Lepidodendron*, not only from their association with the fragments of that genus, because the arrangement of the tissue in the axis of the cone entirely accords with that of the stem of *Lepidodendron*. Just as we find in modern cones of *Lycopodiaceæ* and *Coniferæ* that the axis is a continuation of the branch, which bears leaves modified into organs adapted to support and protect the parts of fructification. The most positive evidence that can be adduced of *Lepidostrobi* belonging to a genus allied to *Lycopodium* is afforded by the spores, the presence of which not only removes them from *Cycadeæ*, *Coniferæ*, or any other order of flowering plants, but directly refers them to the family of *Lycopodiaceæ*. It is well known to botanists not only that cones are far from being peculiar to one natural order of plants, but that their extreme form is no indication either of their contents or of the affinities of the plants which produced them. Accordingly we find that Dr. Lindley, the first English observer who published any extended views on the affinities of these plants, suggests the probability of their being referrible either to *Coniferæ*, *Lycopodiaceæ*, or more probably still to *Cycadeæ*. Dr. Hooker, after describing the nature of spurious cones which have no relation to the reproductive organs of the plant, as in the common cone-bearing willow, the larch, &c., and those produced by the puncture of an insect, as in a genus inhabiting Terra del Fuego, where a cone is formed by this means from a leaf, says :—"Some of the so-called *Lepidostrobi* may be of this nature: witness the *Lepidodendron oöcephalum*, of which it is impossible to say whether it be a *Lepidostrobus* or the apex of a branch crowded with short leaves. Were the Fuegian plant to occur in a fossil state the probability is, that its cones would be regarded as undoubted reproductive organs, and the plants themselves be referred to *Coniferæ*."

(Hooker, *On the Structure and Affinities of Lepidostrobi*, in *Transactions of Geological Survey of Great Britain*.)

LEPIDOSTEUS, a genus of Fishes belonging to the family *Clupeidæ*. The species are natives of tropical America. They are remarkable for their long teeth, which have their anterior surfaces rasp-like; the scales are very hard, like stone. The dorsal and anal fins are opposite, and far back. The intestine has two folds and numerous cæca; the air-bladder is cellular. The species of this genus are interesting, with those of *Polypterus*, as being the only living representatives of the vast numbers of extinct voracious fishes whose remains are found in the various secondary formations. [POLYPTERUS.]

LEPIGONUM, a genus of Plants belonging to the natural order *Paronychiaceæ*. It has 5 flatish sepals; petals 5, entire, as long as the calyx; stamens from 5 to 10; styles 3- or 5; fruit 3- to 5-valved, many-seeded, valves fewer than the sepals, or alternate with them.

L. rubrum is found in sandy fields near the sea in Great Britain. It has a round stem, flat leaves linear-pointed, capsules about equalling the calyx, rather shorter than the slightly declining fruit-stalks; seeds triangular, obovate, with a thickened rough border; stem procumbent.

L. marinum has a compressed stem, fleshy leaves, blunt apiculate, capsules exceeding the calyx, much shorter than the declining fruit-stalks; seeds roundish, usually surrounded by a membranous striated wing; the root is almost woody; stem glabrous or glandular, hairy. It is found on the sea-coast.

(Babington, *Manual of British Botany*.)

LEPIDO'TUS, a genus of Fossil Ganoid Fishes, abundant in the Oolitic strata. (Agassiz.)

LEPISMA. [THYSANURA.]

LEP'ORIDÆ, a family of *Rodentia*, the type of which may be considered as existing in the Common Hare.

Linnæus characterised his genus *Lepus*, the second of his order *Glires*, as having two incisor teeth (dentes primores 2), the upper ones double, the interior being the least, and he placed the following under it, namely, *Lepus timidus*, *L. cuniculus*, *L. Capensis*, and *L. Brasiliensis*. Gmelin added several species, some of which had no claim to a place among the Hares.

Cuvier characterised the Hares as having the proper incisor teeth double; that is to say, each of them has, behind, another smaller one. Their molars, to the number of five, are formed each of two vertical laminæ soldered together. In the upper jaw there is a sixth, which is simple and very small. They have five toes before and four behind, an enormous cæcum, five or six times larger than the stomach, and furnished within with a spiral lamina (lame spirale), which runs throughout its length. The interior of their mouth and the bottom of their feet are furnished with hair, like the rest of their body. He divides the group into—

1. The Hares, properly so called, which have long ears, a short tail, the hind feet much longer than the fore feet, imperfect clavicles, and the suborbital space in the skeleton pierced like net-work (en reseau). The species are, he observes, rather numerous, and so much alike, that it is difficult to define them.

2. Of *Lagomys*, his 2nd division, he says that the species composing it have the ears moderate, the legs not much differing from each other, nearly perfect clavicles and no tail: they have hitherto, he adds, been only found recent in Siberia, and fossil remains of an unknown species have been detected in the Osseous Breccia of Corsica.

Dr. Gray's third family of the order *Glires* is named *Leporidæ*, and is thus defined :—

Cutting teeth two in each jaw, or four in the upper one, lower one subsubulate; grinders numerous, rootless; ears generally large; tongue often hairy: eyes large; clavicles none; fore feet short; hinder ones long; tail none, or very short, hairy; fur soft.

† Cutting-teeth four above.

1. *Leporina*, genus *Lepus* (?). 2. *Lagomina*, genus *Lagomys*.

†† Cutting-teeth, two above.

3. *Caviina*. genera *Kerodon*, F. Cuv. 4. *Hydrocharina* (Hydrochœrina (?), genus *Hydrocharus* (Hydrochœrus), Brisson. 5. *Dasyporcyna* (Dasyproctina ?), genera *Cœlogenys*, Illig., *Dasyporca* (Dasyprocta ?), Illig., *Dolichotis*, Desm.

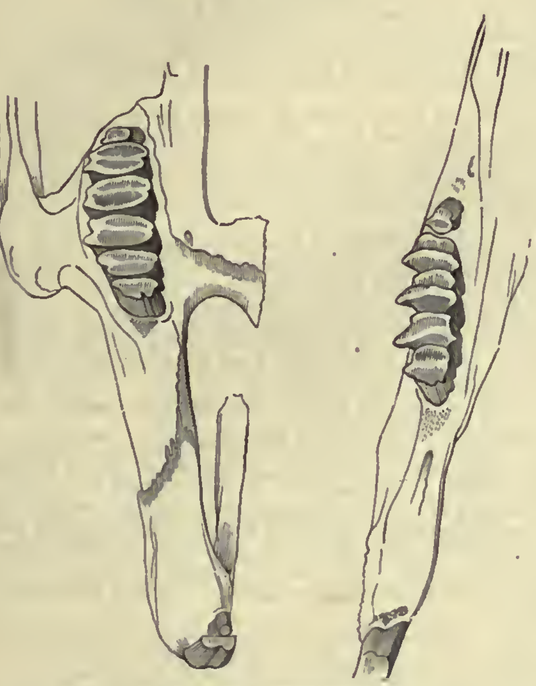
Mr. Swainson defines the genus *Lepus* thus :—Cutting teeth $\frac{4}{2}$, the upper in pairs two in front, large and grooved, and two smaller behind; lower teeth square; grinders $\frac{6-6}{5-5}$, composed of two soldered vertical plates; a sixth, very small, in the upper jaw; soles of the feet hairy; anterior feet with five toes; posterior with four; tail very short, turned upwards.

L. timidus, the Common Hare.

Lagomys, Geoff., Mr. Swainson appears to give as a sub-genus of *Lepus*.

The sub-family *Leporina* seems to be strictly natural, consisting entirely of those species, and they are not few, which are usually known by the name of Hares and Rabbits.

$$\text{Incisors, } \frac{4}{2}; \text{ molars, } \frac{6-6}{5-5} = 28.$$



Teeth of Common Hare (*Lepus timidus*). F. Cuvier.

L. timidus, the Common Hare, which is generally considered as the type, is too well known to need description, and it will suffice to state that it is the Λαγώς of the Greeks; *Lepus* of the Romans; Lepre of the Italians; Liebre of the Spaniards; Lebre of the Portuguese; Lièvre of the French; Hase of the Germans; Haas and Haze of the Danes; Hara of the Swedes, according to Mr. Bell; Hara of the Anglo-Saxons; Ysgyfarnog, Ceinach, of the Welsh; Maukin of the Scotch.

The usual weight of a full-grown Hare is 8 or 9 lbs.; but one is mentioned in 'Loudon's Magazine' of extraordinary size: this weighed 13 lbs. 1½ oz.

L. Hibernicus, the Irish Hare. The Earl of Derby appears to have been the first who drew particular attention to this species, and it was described in the 'Proceedings of the Zoological Society' by Mr. Yarrell in 1833. Mr. Jenyns gives it as a variety of the *L. timidus;* but Mr. Bell ('British Quadrupeds') states that a careful examination of several specimens has assured him that it is not merely a variety of the Common Hare of England, but that it is specifically distinct. He mentions the following differences of character:—The Irish Hare is somewhat larger; the head is rather shorter; the ears are even shorter than the head, while those of the English Hare are fully an inch longer; the limbs are proportionally rather shorter; and the hinder legs do not much exceed the fore legs in length. The fur is also remarkably different: it is composed exclusively of the uniform soft and shorter hair which in the English species is mixed with the black-tipped long hairs that give the peculiar mottled appearance of that animal; it is therefore of a uniform reddish-brown colour on the back and sides. The ears are reddish gray, blackish at the tip with a dark line near the outer margin. The tail is nearly of the same relative length as in the common species.

It further appears that *L. Hibernicus* is the only Hare found in Ireland, which may account for its remaining so long unnoticed; for opportunities of comparison could not have been very frequent. Its fur is considered valueless.

Whether the Irish Hare will take the water willingly does not appear; that the English Hare is, occasionally at least, an accomplished and bold swimmer is manifest from the following account related by Mr. Yarrell in 'Loudon's Magazine' (vol. 5):—"A harbour of great extent on our southern coast has an island near the middle of considerable size, the nearest point of which is a mile distant from the mainland at high water, and with which point there is frequent communication by a ferry. Early one morning in spring two hares were observed to come down from the hills of the mainland towards the sea-side; one of which from time to time left its companion, and proceeding to the very edge of the water, stopped there a minute or two, and then returned to its mate. The tide was rising; and after waiting some time one of them exactly at high water took to the sea, and swam rapidly over in a straight line to the opposite projecting point of land. The observer on this occasion, who was near the spot, but remained unperceived by the hares, had no doubt they were of different sexes, and that it was the male that swam across the water, as he had probably done many times before. It was remarkable that the hares remained on the shore nearly half an hour; one of them occasionally examining, as it would seem, the state of the current, and ultimately taking to the sea at that precise period of the tide called slack-water, when the passage across could be effected without being carried by the force of the stream either above or below the desired point of landing. The other hare then cantered back to the hills."

The female goes thirty days with young, and produces from two to five at a birth; these are born well covered with hair and with their eyes open. The leveret quits the mother and provides for itself in less than a month, and is capable of breeding when it is a year old.

The Common Hare sometimes varies accidentally; there is such a variety in the museum of the Zoological Society of London. All attempts to promote a breed between the hare and rabbit appear to have been hitherto fruitless.

L. variabilis, the Varying Hare, or Alpine Hare, of Pallas, which changes the colour of its coat with the seasons, requires a short notice. The fur, which is full and soft, is in summer gray intermixed with silky hair of a yellowish brown; the ears are tipped with black, and the under parts are light gray. The tail is white beneath and gray above. As the winter approaches the fur gradually becomes white, except that on the lips and the tips of the ears, which remains black. In the 'Edinburgh Philosophical Journal,' vol. ii., is an interesting account of the process as it occurs in Scotland, from which it would seem that the winter change of colour takes place without any removal of the hair, as in the Ermine, and somewhat in the same way that the change is effected on the head of the Black-Headed Gull, *Xema ridibundus*, and in the feathers of other birds. "About the middle of September," says the writer in the 'Journal,' "the gray feet begin to be white, and before the month ends all the four feet are white, and the ears and muzzle are of a brighter colour. The white colour gradually ascends the legs and thighs, and we observe under the gray hairs whitish spots, which continue to increase till the end of October; but still the back continues of a gray colour, while the eyebrows and ears are nearly white. From this period the change of colour advances very rapidly, and by the middle of November the whole fur, with the exception of the tips of the ears, which remain black, is of a fine shining white. The back becomes white within eight days. During the whole of this remarkable change in the fur no hair falls from the animal; hence it appears that the hair actually changes its colour, and that there is no renewal of it. The fur retains its white colour until the month of March, or even later, depending on the temperature of the atmosphere; and by the middle of May it has again a gray colour. But the spring change is different from the winter, as the hair is completely shed."

L. Cuniculus, Linn., the Rabbet, Rabbit, or Coney; Coniglio of the Italians; Conejo of the Spanish; Coelho of the Portuguese; Kaninchen of the Germans; Konyn or Konin of the Dutch and Belgians; Kanin of the Swedes; Kanine of the Danes; and Cwningen of the Welsh, is known to every one.

The fertility of the animal may be imagined when it is remembered that it will begin to breed at the age of six months, and produce several broods in a year, generally from five to seven or eight at a time. Pennant says:—"Rabbits will breed seven times a year, and bring eight young ones each time. On a supposition that this happens regularly during four years, their numbers will amount to 1,274,840." The young are blind at their birth, and nearly naked.

The fur of the Rabbit is in considerable demand, particularly for the hat trade; and at one time the silver-haired varieties, or silver-sprigs, fetched three shillings a piece, for ornamental linings to cloaks, &c.; in Pennant's time however the price had fallen to sixpence.

The following additional species of *Lepus* are found in the 'British Museum Catalogue:'—

L. Altaicus, from the Altai Mountains.
L. arcticus, the Rekalek, or Polar Hare. Labrador.
L. Tolai, the Tolai. Siberia.
L. macrotus, the Indian Hare. Nepaul.
L. diostolus, the Woolly Hare of Thibet. Nepaul.
L. Douglasii, the Marsh Hare. California.
L. kurgosa, the Lasa, or Khargosh.
L. Vermicula, the Irish Rabbit. Ireland.
L. Capensis, the Vlakte Haas. Cape of Good Hope.
L. arenarius, the Barrow Hare. Cape of Good Hope.
L. saxatilis, the Rock Hare. Cape of Good Hope.
L. Bennettii. California.
L. Americanus, the Wawproos, or American Hare. North America.
L. Ægypticus, Egyptian Hare. Egypt.

The subfamily *Lagomina* consists of a single genus, *Lagomys*, which has the muzzle acute, the ears short and somewhat rounded, the soles of the feet hairy, the claws falcular, and no tail.

$$\text{Incisors, } \frac{4}{2}; \text{ molars, } \frac{5-5}{5-5} = 26.$$

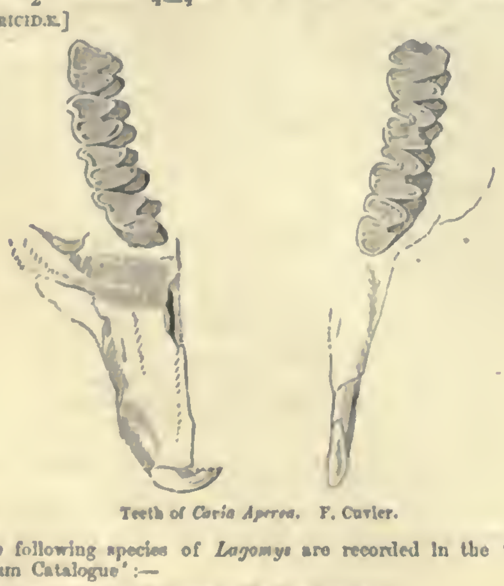
L. pusillus (*Lepus pusillus* of Pallas; Semlanoi Saetshik, or Ground Hare, of the Russians about the Volga; Tschotschot, or Ittsitskan, or the Barking Mouse of the Tartars; Rusla of the Kalmucs; Calling Hare of Pennant) has the head longer than usual with hares, and thickly covered with fur, even to the tip of the nose; numerous hairs in the whiskers; ears large and rounded; legs very short; soles furred beneath; its whole coat very soft, long, and smooth, with a thick long fine down beneath of a brownish-lead colour; the hairs of the same colour, towards the ends of a light gray, and tipt with black; the lower part of the body hoary; the sides and ends of the fur yellowish. Length about 6 inches; weight from 3½ to 4½ ounces; in winter scarcely 2½ ounces. (Pallas; Pennant.)

Calling Hare (*Lagomys pusillus*).

It inhabits the south-eastern parts of Russia, and is found about all the ridges spreading from the Ural Mountains to the south, about the Irtish, and in the western parts of the Altai Mountains, but nowhere in the East beyond the Oby. (Pallas; Pennant.)

It delights in the most sunny valleys and hills, where the herbage is plentiful and delicate. The Calling Hares choose these localities when in the vicinity of a wood, which will afford them a ready refuge in the case of danger or alarm. Their burrows, especially those belonging to the old ones and to females, are curious and intricate, so well concealed amid the shrubs of some dry spot that detection is very difficult; and to increase the difficulty the animal is said to drop its excrements under some bush, that they may not betray its abode, which would almost defy search were it not for their peculiar cry or call. This is described as being like the piping of a quail, but deeper, and so loud as to be heard at the distance of half a German mile. It is repeated at just intervals, thrice, four times, and even six, at night and morning, but seldom in the day, unless the weather be cloudy. Both the male and female emit this note, but the latter is silent for some time after she has given birth (in May) to her young, which are born naked and blind, and are carefully attended to by the mother, who covers them up warm with the cosy materials of her nest.

The sub-family *Caviina*, which has the following dental formula—Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$—is often referred to *Hystricidæ*. [HYSTRICIDÆ.]



Teeth of *Cavia Aperea*. F. Cuvier.

The following species of *Lagomys* are recorded in the 'British Museum Catalogue':—

L. princeps, the Little Chief. North America.
L. alpinus, the Ladajac. Siberia.
L. Roylei, the Indian Sulgan. Himalaya.
L. Nepalensis, the Red-Shouldered Sulgan. Nepaul.
L. rufescens, the Reddish Sulgan. Cabul.

Fossil Leporidæ.

Of the genus *Lepus* the following species are named:—*L. diluvianus*, Hare of the Caverns, Cuvier, Buckland, Pander, and D'Alton; *L. priscus*, Hare of the Osseous Breccias, Cuvier. Fossil Hares and rabbits are also recorded by M. Bourdet, M. D'Orbigny, M. Risso, M. Wagner, Messrs. Croizet and Jobert, and Messrs. Marcel de Serres and Pitorre.

The following fossil species of *Lagomys* are recorded:—*L. Corsicanus* and *L. Sardus*, from the Osseous Breccia of Corsica and Sardinia respectively. Other remains of *Lagomys* are noticed by Cuvier, Wagner, M. de Serres, Risso, Chabriol and Bouillet, Croizet and Jobert, Bravard, Sedgwick (Oeningen beds), and Murchison. All tertiary.

Of the Agouti (*Dasyprocta* of Illiger; *Chloromys* of F. Cuvier) remains are noticed by M. Bravard and M. Eichwald in tertiary beds.

LEPTACANTHUS, a genus of Fossil Placoid Fishes occurring in the Carboniferous and Oolitic strata. (Agassiz.)

LEPTÆNA, a subdivision of the great family of Fossil *Brachiopoda*, proposed by Dalman to include species which Mr. Sowerby named *Producta*. Its use is at present more restricted, and has become rather indefinite. *Leptæna lata*, of the Silurian system, may be regarded as a frequent type. The species are extinct, and are confined to Palæozoic strata.

LEPTIDES, a sub-family of Dipterous Insects of the family *Brachystoma* (Macquart). The family of insects to which the present section belongs is distinguished by the proboscis being short and membranous; the lips terminal and thick; third joint of the antennæ simple, often spatulate; stylet often dorsal; abdomen usually with five distinct segments. The wings have commonly one submarginal and three posterior cells. The family *Brachystoma* is divided by Macquart into four tribes or sub-families—*Xylotomæ*, *Leptides*, *Dolichopoda*, and *Syrphidæ*.

The first, or the *Xylotomæ*, are distinguished by the third joint of the antennæ being conical, by the wing having two submarginal cells, and by the tarsi being furnished with two small cushions.

In the sub-family *Leptides* the antennæ are inserted near the base of the head, and have generally a terminal stylet; the tarsi are furnished with three small cushions; the femora are elongated; the wings have two submarginal and generally five posterior cells. This group contains six genera, of which one (*Clinocera*) is distinguished from all the other Leptides by its possessing only three posterior cells to the wings, the remaining genera having five.

In the genus *Leptis* the head is depressed; the palpi are generally decumbent, with the second joint conical and the third joint short and generally conical. The thorax has a distinct tubercle; body conical and transparent. The species inhabit Europe. The *Leptis vermileo* (*Musca vermileo*, Linn.) has been separated from *Leptis* proper by Macquart, and forms the type of his genus *Vermileo*, distinguished chiefly by the body being elongated and depressed, the first joint of the antennæ elevated, and the last conical and horizontal in its direction.

L. vermileo of Fabricius, or *Vermileo Degeerii*, Macquart. This Fly is about 4 or 5 lines in length, of a yellow colour, having four black streaks on the thorax, and five ranges of black spots on the body; the wings immaculate. The larva somewhat resembles the stick-like caterpillar of the *Geometræ*, and is nearly of a cylindrical form, but narrower towards the anterior extremity of the body; the posterior extremity is furnished with four fleshy tubercles. It lives in sandy districts, forms excavations in the soil, at the bottom of which it secretes itself either wholly or partially. If an insect falls into its trap it rises suddenly, clasps the insect with its body, and having sucked all its juices, bends itself in the form of a bow, and by suddenly relaxing throws away the remains.

The next genus, *Chrysophila* (Macquart), has the body furnished with velvet-like hair, the palpi elevated and with the second joint cylindrical, the third being generally conical; thorax without a distinct tubercle. Several species are found in Europe. The genus *Spania*, which is the next in succession according to Macquart, has but two distinct joints to the antennæ; it contains but one species. The genus *Atherix* has the third joint of the antennæ distinct; the stylet is generally dorsal; the body depressed. All the species of this genus are European.

The third sub-family, *Dolichopoda*, is distinguished by the second joint of the palpi being membranous, depressed, and covering the base of the proboscis. The stylet of the antennæ is sometimes dorsal and sometimes apical; the eyes are generally separated in both sexes; the abdomen is somewhat cylindrical, or approaches a conical form; wings decumbent, without any discoidal cell, and generally possessing four posterior cells.

The *Syrphidæ* are a very extensive group, and although given by Macquart as a division of his family *Brachystoma*, certainly constitute a section of higher value than a sub-family. [SYRPHIDÆ.]

LEPTOCEPHALUS, a remarkable fish of the Eel tribe, discovered on the British coast in Pennant's time, and since observed in the

Mediterranean. The *Leptocephalus Morrisii* is a small, slender, and compressed animal, as thin as a piece of tape, aud at first sight resembling a marine worm. The head is extremely small and short, the eyes large, the jaws furnished with numerous miuute teeth; the pectoral fins and gill-openings very small, and the anal and dorsal fins connected with the tail. The outline of the hody resembles that of the Lancelet (*Branchiostoma*); hut the organisation of the *Leptocephalus* is that of a perfect fish. Mr. Yarrell describes the vertebræ as having no spinous processes. It lives among sea-weed.

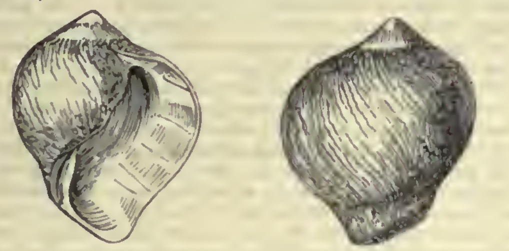
(Montagu, in 2nd vol. of the *Wernerian Memoirs*; Yarrell, *British Fishes*, vol. ii.)

LEPTOCLINUM. [BOTRYLLIDÆ.]

LEPTOCONCHUS (λεπτὸς, thin, and κόγχος, a shell), Rüppell's name for a genus of Pectinihranchiate Gasteropodous *Mollusca*. The genus is thus characterised:—Head of the animal with an elongated proboscis, hut which is entirely retractile; mouth without any apparent armour; tentacles two, flattened, triangular, short, united at their internal base, supporting the eyes at one-half of their length on their external side. Foot moderate, muscular, without any operculum. Mantle with a circular border, without ornament, and with a slight prolongation on the left side. Branchial cavity with a rather large aperture, the gill composed of a single comb formed of triangular laminæ close set one against the other: at the hottom of this cavity is found the orifice of the ovaria, whence (in the month of July) the eggs come forth in numerous hundles (par paquets nombreux), each enveloped in a viscous sac, which is flattened, elliptical, and three lines in length. In the middle of the branchial cavity is the orifice of the anus. On the right side of the neck, a little behind the right tentacle, there is another orifice, which may have some relation to the male organs of generation.

Shell subglobular, delicate, fragile, translucent, with a low spire, which is nearly effaced by the encroachment (surcroissement) of the laminæ of the last whorl. Aperture large, suboval, with its two extremities turned contrariwise, so that the aperture has some resemhlance to the letter S reversed; the two margins not united, the right one delicate at all ages, and a little expanded anteriorly as in adult *Janthinæ*. No columella. No umhilicus.

L. striatus, Rüppell. The shell of this species, which served Rüppell for the type of the genus, is a rather dirty milk white; it is furrowed externally with numerous longitudinal undulated lines very much approximated. Length of adult, 14¾ lines; breadth, 12½: young, 7¼; hreadth, 6.



1 2

Shell of *Leptoconchus striatus*. 1, anterior view; 2, view of the back.

It inhahits the Red Sea, where it is found imbedded in the calcareous mass of *Polyparia*, and having no communication with the water except hy a moderate opening. These corals prove almost always to to be a species of *Meandrina* (*M. Phrygia*) in which *Magilus*, *Venerupis*, &c., occur.

Rüppell is of opinion, from the few words of M. Rang concerning the young of *Magilus*, that the last-named naturalist had before him the genus above described. Rüppell notices the following distinctions hetween *Leptoconchus* and *Magilus*. In the former the margins of the shell are always disunited; in the latter they are always united. The animals of the two genera are distinguished hy the possession of an operculum in the one (*Magilus*) and its absence in the other, and by the difference in the proboscis; nor is the siphou of the *Magilus* present in *Leptoconchus*.

Rüppell suggests that *Leptoconchus* approximates to the *Janthinæ*. The numher of the tentacles, the oval proboscis, the mantle deprived of a siphon, the pectinated branchiæ framed of crowded pyramids, and the ahsence of an operculum, favour this approximation, as well as the analogies of the shell; hut he adds that he is perfectly aware that the difference of the hahitations of the two genera is too great to allow of a reliance on this suggestion. ('Transactions of the Zoological Society of London,' vol. i.; 'Proceedings' of the same Society, 1834.)

LEPTO'LEPIS, a genus of Fossil Ganoid Fishes, occurring in the Liassic strata.

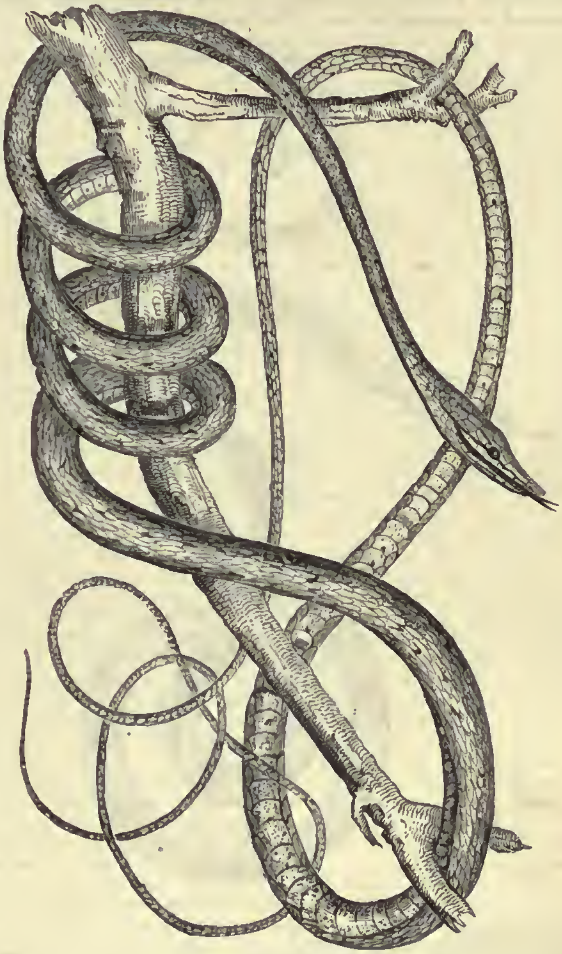
LEPTOMÆRA. [LÆMADIPODA.]

LEPTOMERIA. [SANTALACEÆ.]

LEPTON, a genus of Acephalous Lamellibranchiate *Mollusca*, belonging to the family *Kelliadæ*. This genus is closely allied to *Kellia*. Only three species havo heen described, two of which, *L. squamosum* and *L. convexum*, are British. *L. fabagella* has heen taken on the shores of the United States. The species are all small and rare.

LEPTOPHI'NA, the name given by Professor Bell to a sub-family of Serpents belonging to the family *Colubridæ*. It is thus defined:—Head elongate, hroad behind, narrowed before; the anterior part covered with nine scutæ. Eyes large. Gape wide, somewhat waved. Maxillary and palatine teeth; no poisonous fangs. Body very slender, slightly depressed. Tail very long, slender, the point acute. Dorsal scales oval, elongate, loose; caudal scales very small, closely arranged. Abdominal scuta very long; subcaudal scuta small, indistinct.

The genera *Dryinus* and *Leptophis* are included in this family, of which *Dryinus auratus* and *Leptophis purpurascens* may he regarded as examples.



Dryinus auratus. Bell.

"The whole of the serpents composing these genera live," says Mr. Bell, "in woods, entwining themselves amongst the hrauches of trees, and gliding with great rapidity and elegance from one to another. These hahits, combined with the graceful slenderness of their form, the beautiful metallic reflection from the surface in some species, and the bright and changeable hues in others, place them amongst the most interesting of the serpent trihe. Their food consists of large insects, young hirds, &c., which the extraordinary size of the head, the width of the gape, and the great dilatability of the neck and hody, enahle them to swallow, notwithstanding the small size of these parts in a state of rest. In a specimen in my possession of *Dryinus auratus*, for instance, the lcugth of which is 4 feet 9 inches, the diameter of the neck is hardly 2 lines. When the skin is distended either by food or during inspiration, the scales are separated from each other, and the skin, which is of a different colour, hecomes visible in the interstices, producing a curious reticulated appearance. Notwithstanding the poisonous mark was affixed hy Linnæus to the only species of *Dryinus* known to him (*Coluber mycterizans*, Linn.), it is well ascertained that they are all of them perfectly harmless; and it is asserted of that species that the children are in the hahit of taming and playing with them, twining them round their necks and arms, and that the snakes appear pleased at heing thus caressed."

Dryinus (Merrem).—Upper jaw much longer than the lower. Rostrum very narrow, more or less acute at the apex, which in some species is distinctly mucronate and moveahle. (Bell.)

Mr. Bell records six species, three of which are American, Carolina, Mexico, and Brazil; and the other three Asiatic, two from the East Indies and one from the island of Java.

D. auratus. Yellowish-gray, shining with pale gold-colour, dotted with whitish and black; rostrum subobtuse. It is a native of Mexico.

Leptophis (Bell).—Rostrum obtuse; upper jaw projecting, but very slightly beyond the lower.

Mr. Bell records three species, three from the East Indies, and one from America (Carolina). To these Dr. Gray subsequently added two species, *L. punctulatus* and *L. spilotus* (*Coluber spilotus*, Lacépède), collected by the expedition under Captain Phillip Parker King, R.N. ('Survey of Australia.')

L. purpurascens (*Coluber purpurascens*, Shaw). Violet, changing to green, gilded; a lateral and dorsal line of a paler hue; head obtuse. It is found in the East Indies. ('Zool. Jonrnal,' vol. ii.)

Leptophis purpurascens. Seba.

LEPTOPHIS. [LEPTOPHINA.]

LEPTOPODIA. [MACROPODIDÆ.]

LEPTOSOMA. [CUCULIDÆ.]

LEPTOSO'MUS, a genus of Birds established by Vieillot, and belonging to the family *Cuculidæ.* Example: *Leptosomus afer; Cuculus afer*, Gmel.; Edolian Cuckoo of Shaw, noticed by the late Major James Franklin, F.R.S., &c., in his 'Catalogue of Birds' collected in the Ganges between Calcutta and Benares, and in the Vindhyian Hills between the latter place and Gurrah Mundela on the Nerbudda. ('Zool. Proc.,' 1830-31.) Lieutenant-Colonel Sykes also describes and notices it in his interesting Catalogue as occurring in the Dukhun (Deccan), but as being rare. ('Zool. Proc.,' 1832.)

LEPTOSTOMA. [CUCULIDÆ.]

LEPTURUS, a genus of Grasses having solitary spikelets, imbedded alternately on opposite sides of the rachis of 1 flower and a superior rudiment. Glumes 1 or 2 opposite to the rachis, cartilaginous, covering the flower. Paleæ scarious. Stigmas feathery.

L. incurvatus has a cylindrical subulate spike; 2 glumes equalling or slightly longer than the flowers; stem from 2 to 6 inches long; spike long, curved when dry. In a variety of this species, *L. filiformis*, the spikes are much more slender, filiform, scarcely at all curved. It grows in sandy salt-marshes.

LEPTYNITE, a form of Granite in which mica is absent. It consists of a granular mixture of felspar and quartz. It is also called *Granulite.*

LEPUS. [LEPORIDÆ.]

LERISTA, a genus of Reptiles belonging to the family *Scincidæ*, established by Mr. Bell, and thus characterised by him:—Head scutated; no eyelids; ears hidden under the skin. Body slender; the scales smooth and equal. Feet four; the anterior little, very short, and didactylous; the posterior longer, and tridactylous. Vent simple, semicircular; no præanal or femoral pores.

L. lineata is bronze-green, paler beneath, with two dorsal and two lateral black lines. It is a native of Australia.

Mr. Bell observes that this new genus agrees with *Gymnophthalmus*, Merr., and *Ablepharus*, Fitzing., in the absence of eyelids, but differs from both in the number of its toes. In addition to this difference in the structure of the feet, it is, he adds, remarkably distinguished by the want of external ears, and by its elongated and anguiform body; characters in which it agrees with *Saiphos*, Gray. The last-named genus, he remarks, however, possesses eyelids, and differs also in the number of its toes from *Lerista.* ('Zool. Proc.,' 1833.)

LERNEA. [LERNEADÆ.]

LERNEADÆ, the second order of the legion *Pœcilopoda* amongst the Entomostracous *Crustacea.* [ENTOMOSTRACA.]

This order is characterised by Dr. Baird in his 'History of British Entomostraca' as follows:—Mouth suctorial; thorax not articulated; feet and other organs belonging to thoracic segment nearly rudimentary; no eyes; body very outré in appearance.

The existence of the *Lerneæ* seems to have been known to the ancients. Aristotle informs us, in his 'Historia Animalium,' that the tunny and sword-fish are tormented by a sort of worm which fastens itself under the fin, and causes such irritation to the animal that it often leaps out of the water and falls on board of ships. Pliny repeats the assertion almost in the words of Aristotle. Oppianus, in his poem 'Alieuticon,' describes the sufferings of the poor tunny and sword-fish in moving language, and asserts that the fish are frequently killed by their pigmy assailants. Athenæus repeats what his predecessors had written before him; and Salvianus, in his 'Aquatilium Animalium Historia,' 1554, quotes at length the passages bearing upon the subject from Aristotle, Pliny, Oppianus, and Athenæus. Rondeletius, in his 'Libri de Piscibus Marinis,' 1554, repeats for the sixth time Aristotle's and Pliny's accounts of this parasite of the tunny and sword-fish; and to prove his personal knowledge of the little animal in question gives a figure of a tunny, with the parasite attached, near the pectoral fin. He says it adheres so tenaciously, that it cannot be shaken off by any agitation of the body of its host.

Conrad Gesner, in his 'Historia Animalium — De Aquatilibus,' 1558, enters largely into the history of this parasite.

Boccone, a Sicilian gentleman, in his 'Recherches et Observations Naturelles,' published at Amsterdam in 1674, informs us, that at Messina his attention was called by M. Scilla, a famous painter and antiquary of that town, to the fact that the *Xiphias*, or Sword-Fish, was well known to the fishermen on the coast to be tormented by a parasite which they called Sanguisuca. The only information he received was that the motion of the creature was like that of a gimlet in plunging itself into the flesh of the fish. He succeeded however in obtaining a specimen, which he describes and figures. They bury, he says, their whole head or trunk in the flesh of the sword-fish. They are not generally confined to one part of the body, but always on such places as that the fin of the animal cannot reach them. Boccone refers this species to the *Oistros*, or *Asilus marinus* of Gesner, &c.

In 1746 Linnæus, in his 'Fauna Suecica,' first edition, described a parasitic animal found upon the *Cyprinus Carassius*, "whose blood it sucks." He established from this species the genus *Lernea.* In his 'Iter Wast Gotha,' 1747, he notices another species found on the gills of a species of *Gadus;* and in his second edition of the 'Fauna Suecica,' 1761, he adds a third, as inhabiting the gills of the salmon, which had been figured and described by Gisler, in the 'Act. Holmens.' (Kongl. Vetensk. Handling.) for 1751, under the name of *Pediculus Salmonis.* In the 'Syst. Nat.,' 12th edition, 1766, he adds a fourth species to the list, and up to that time these four constituted all that Linnæus admitted into the genus *Lernea*—a genus which, since his time, notwithstanding the difficulties attending its investigation, has increased a hundredfold, and now constitutes a large family. So bizarre in appearance are these *Lerneæ*, that Linnæus had no idea that they belonged to the *Crustacea;* on the contrary, he places them amongst the worms.

"Of all the curious creatures which the naturalist meets with in his researches," says Dr. Johnston, "there are none more paradoxical than the *Lerneæ;* none which are more at variance with our notions of animal conformation, and which exhibit less of that decent proportion between a body and its members which constitutes what we choose to call symmetry or beauty." It is no wonder then that, with the scanty knowledge he had of their habits and history, Linnæus should have considered their proper place in the system of nature to be amongst his *Mollusca;* animals belonging to his class *Vermes*, and characterised by him, from the softness of their body and the want of a shell.

In 1817 Cuvier adopted the view taken by Bosc, and in his 'Règne Animal' placed the *Lerneæ* amongst the intestinal worms.

There is nothing very instructive in this detail of the difficulties felt by systematic writers in knowing or determining where these curious and at first sight bizarre-looking animals should be placed. Little was known of their habits, manners, or mode of propagation, and though their near relations with the *Caligi* had been observed by several authors, they had not sought to resolve the question by deeper anatomical researches or investigations into their mode of life and habits. Their true position however was soon about to be ascertained. Soon after Cuvier had published the first edition of his celebrated work, the 'Règne Animal,' a French physician at Havre, M. Surriray, made the important discovery that the ova were contained in the long filaments suspended from the abdomen, and that the young when born bore no resemblance to their parent, but on the contrary were extremely similar to the young of the Cyclops. De Blainville recorded the fact in the 'Journal de Physique,' 1822, in his excellent article 'Lernea,' and fully admitted the truth of Surriray's statement. In this article he remarks the near approach of his last genus among the *Lerneadæ* to the last of the *Caligidæ*, and traced the almost insensible gradations by which we are carried from that genus to the *Caligus* itself, thence to *Argulus*, and through it to the *Apus* and other Branchiopods. He still retained them however amongst the *Epizoa*; and Desmarest, in his 'Cons. Gén. sur la Classe des Crust.,' 1825, appears to have been the first to distinctly refer them, as a group, to the class *Crustacea*.

In 1826 Messrs. Audouin and Milne-Edwards discovered a parasite upon the *Astacus*, or lobster, the *Nicothoe*; and in the course of their observations upon the history of this curious Siphonostome they came to the conclusion, reasoning from analogy, that the *Lerneæ* were real *Crustacea* that "became monstrous after they had fixed themselves" upon the animal which was to serve them with nourishment.

Kroyer informs us that several German zoologists, as Nitsch, Leuckart, and Schwegger, had advanced similar opinions, though it would appear, from his references to their observations, upon very insufficient grounds. Zoologists however were gradually coming to the conclusion that these fantastically-formed creatures were in reality crustaceous. But it is to Alexander Von Nordmann, an eminent Prussian naturalist, that we are indebted for a complete and satisfactory solution of our doubts upon the subject. In his work, 'Mikrographische Beitrage zur Naturgeschichte der Wirbellosen Thiere,' Berlin, 1832, he has confirmed the observations of Surriray upon the young when first hatched from the ova, shown the dissimilarity which exists between the male and female, and thrown much light upon the anatomy of this interesting group of animals, especially with regard to the structure of their mouth and feet. Since the publication of his excellent work his observations have received still further confirmation, additions, and corrections by three zoologists of considerable reputation—the well-known entomologist Burmeister; an Austrian naturalist, Vincenz Kollar; and the acute observer Rathke.

The form of the animals belonging to the *Lerneadæ* is very variable. "Respecting this," says Kroyer, "it is not easy to say anything general. The remark only forces itself upon every observer, that the exterior of these animals is often so highly fantastical, that we are disposed to admire the freaks of nature in bringing forth such forms. But it is evident, that when continued observations and investigations have put us in possession of the condition of these forms, we shall see here, as everywhere else, that singularity resolves itself into regularity."

For the most part the skin, or external envelope, is soft and flexible, but there are many species in which it is somewhat of a cartilaginous consistence. Nordmann has discovered that it consists of a threefold structure; an external layer, tolerably firm and elastic; next, a very loose and soft cellular tissue; and finally, a third layer, composed of a number of muscular fibres crossing each other in length and breadth, and having in consequence a reticulated appearance.

We can generally trace, more or less distinctly, a division of the body into two parts; the first of which, the smaller of the two, forms the head, and the other the thorax. This latter is generally of considerable size, whilst the abdomen, in almost all the species, has become very nearly rudimentary. Attached to the head, in the greater number of the *Lerneadæ*, we find one pair of antennæ, and two pairs of foot-jaws, by means of which they attach themselves to their prey. In a few we find no antennæ, and only one pair of foot-jaws. We find no appearance of eyes. The organs corresponding to the thoracic feet of the *Siphonostoma* are variable in form, but in general are almost rudimentary, sometimes indeed altogether wanting. It is this very rudimentary state of the organs of motion and other appendages that forms the principal mark of distinction between the *Lerneadæ* and the *Siphonostoma*. The mouth, according to Kroyer, has generally the shape of a blunt spherical snout, placed on the most advanced portion of the head, and terminating in a roundish opening, though in some of the genera it is in the form of a slight elevation merely, and is placed at a considerable distance from the anterior part of the head.

The manner in which these animals fasten themselves to the fishes upon which they live varies much. In some it is by means of the foot-jaws alone, which in these species are strong and of a hooked form. In others it is by means of two long appendages springing from the upper part of the thorax, one on each side, and uniting at the tip, forming at their junction a sort of round button. In a third set, again, the organs of attachment are a series of horns or appendages proceeding from the side of the head.

The females are generally furnished with large external ovaries, containing numerous ova. The intestinal canal is very distinct, extending through the whole body. It is cylindrical, and widens towards the middle of its length into a stomach. The motion in the living individuals may be plainly seen, a series of rhythmical movements to both sides, occurring to the number of from about 60 to 65 in the minute; besides a sort of peristaltic motion, or an alternate contracting and lengthening itself upwards and downwards.

Nordmann has described what he considers may be the liver and brain, and has pointed out the heart. This latter organ contracts and expands regularly, but no blood-vessels are to be seen, the blood flowing freely about in the hollow of the body and arms. The blood is a clear watery-like fluid, composed of three kinds of globules, differing in form and dimensions. The internal ovaries lie on each side of the intestinal canal, and open by means of a canalis deferens on each side of the inferior portion of the thorax, where the external ovaries take their origin.

In general it is only the adult female of the *Lerneadæ* that we are in the habit of observing, and in an animal whose organs of motion and perception for the most part are merely rudimentary, and whose existence is strictly stationary, the manner of life must be very simple. Immoveably fixed upon the fish which serves it for food, its existence depending upon the life of its host, it requires neither feet to transport it from place to place, nor eyes to guide it in its search for fresh abodes. In fact, the whole of its active existence consists in the two operations of taking food, and propagating its species. We find them in all instances more or less deeply fixed in the tissue of the parts upon which they have taken up their habitation, and often so deeply lodged, that little else but the oviferous tubes are visible externally. There they remain, living at the expense of their host, those that inhabit the branchiæ or are deeply fixed in the soft tissue of the bodies, drinking up the blood; and the others which are fixed less deeply, and take up their abode under the fins and such places, sucking the slimy juices of the skin. As they are never seen to change their place of residence, the question naturally occurs—how did they come there originally? Having no feet to propel them through the water, and no eyes to guide them, even if they possessed the faculty of transporting themselves from one place to another, how is it that we thus find them fixed upon these fishes, mature and possessing ova? Blainville answers this question by saying, "It is difficult to conceive how these animals, which spring from eggs, are fixed upon fishes without admitting that in their young age they possess a little motion." M. Surriray had at that time demonstrated to Blainville the existence of the young when just hatched; but less importance was attached to this discovery than it deserved; and it was not till Nordmann corroborated the fact, and followed it up by his more patient researches, that we were enabled to answer the question fully.

The circumstance that the *Lerneadæ* soon die after being taken from the fish that has served them for nourishment and a habitation, certainly throws great difficulty in our way of observing the development of the young; but we now know that when hatched, and for some time afterwards, the young *Lerneadæ* are nimble and active, and possess both the organs of motion and the faculty of using them. When they first come out of the egg they are of an oval shape, and very much resemble the young of the *Cyclopidæ*. They possess a large eye, situated in the centre of the anterior and upper part of the body, and are provided with two large pairs of swimming-feet, and a pair of jointed antennæ. As in the *Cyclopidæ*, these young *Lerneadæ* cast their skin repeatedly before they arrive at maturity. After the first moulting the body is seen plainly divided into two parts, the anterior of which is furnished with three pairs of hooked feet, and the posterior with two pairs of swimming-feet. No doubt there are a good many stages of development to go through before they assume the mature form, but it has not yet been possible to follow them out. It is not the least curious part of the history of these singular-looking animals that the young should thus stand on a higher stage of development than the mother; and that their progress from youth to maturity should be in the directly opposite ratio to that of all the other *Crustaceæ*. At what period of their existence they fasten themselves upon their prey is at present unknown; but no sooner apparently does this happen than the eye disappears, and the feet either disappear also, or are transformed into other organs. In some they are changed into foot-jaws, by means of which they fix themselves upon the body of the fish they select for their habitation. In others they are transformed into long and strong prolongations like arms, which unite together either at the tips only, or from the roots all the way up to the point, where they send forth a short horny stem, that widens into the shape of a round button, and which, when buried in the skin or flesh of the fish, forms such a strong attachment, that the *Lerneadæ* cannot be detached without being torn, or by being carefully dissected out. Most probably the species in which this development takes place first fasten themselves to their foster-mother by the foot-jaws, as the first-mentioned set do, and after being buried in the flesh, these organs assume this peculiar formation, otherwise it is difficult to conceive how such an instrument could penetrate deeply into the body of the fish. A third mode of transformation of the feet appears to be into a series of horny branchlets developed round the mouth, and which, when they have penetrated deeply into the soft parts of their host, serve effectually to retain the parasite in its place. The adult *Lerneadæ* show, with the exception of taking food and laying eggs, very few and feeble signs of life, whether attached to the nourishing animal or when separated from it. Many of the genera show no external signs of life at all after separation from their foster-mother;

others move their jaws for a short period, or their head may be seen to move leisurely in different directions for a little time and then cease. In one species (*L. branchialis*) Kroyer tells us that he observed a singular phenomenon that nobody else had before noticed. When he touched an individual, it squirted, he says, "from the vent a transparent stream of fluid to the distance of a foot and a half, and this it repeated several times one after another."

That part of the history of the *Lerneadæ* which is connected with their sexual relations and propagation is still involved in much obscurity; but the details we have received from Nordmann and Kroyer with regard to the males are no less singular than many of the other curious parts of the history of these animals. By some of the earlier observers it was supposed that those individuals which had not oviferous tubes were males, while others imagined that they were hermaphrodites. Neither of these opinions however will stand the test of inquiry. The ovaries of the female, after the eggs have attained maturity, burst and disappear, and thus, as Kroyer observes, "the *Lernea* which to-day was considered a female to-morrow might be regarded as a male." In the course of investigating different species of *Lerneadæ* Nordmann discovered, in several instances, small bodies adhering to the generative organs of the females, which on closer inspection proved to be animals that differed very much in appearance from the female, and, on the contrary, bore considerable resemblance to the young ones in the first stage of their development. These, he believed, were the males, and though Burmeister has thrown great doubts as to the entire accuracy of Nordmann's observations, his statements as to the fact of these animals being males are borne out by Kroyer and others. It is probable, as Nordmann remarks, "that the males and females are mixed together when they come out of the eggs, but that they develope themselves differently at the last change of skin." They continue to show uniformity in regard to the form of the head, and the form and situation of the parts connected with it, but they want the apparatus for attaching themselves which the females possess, having instead two pairs of strong hooked feet. They differ constantly in the form of the other parts of the body, and show a remarkable diversity from the female with respect to size, being very much smaller. These males bear a strong resemblance to each other, even in different genera, in which the females are very unlike. This fact and the preceding, namely, the great difference of size, have been considered by Burmeister as strong objections to the truth of Nordmann's conclusions. It is true many experiments and careful anatomical investigations are still wanting to establish conclusively the facts as stated by Nordmann, but still the observations made by him upon one or two genera leave little room to doubt the truth of the opinion, as regards these individuals at least. Kroyer considers that the *Lerneadæ* are at a very early age capable of breeding, though it is not yet known at what stage of development exactly they become so. Certain it is we see, in small specimens of some of these animals, small ovaries and a few eggs contained in them, whilst as the females increase in size the ovaries become larger and the eggs more numerous. Burmeister affirms that the *Lerneadæ* only propagate once, and the ovary continues to increase in size, and the eggs to increase in number, till they become mature, and that then the parent *Lernea* has played her part. Kroyer doubts this; and the opposite opinion holds better with the analogy of the other Entomostracous *Crustacea*. But upon this point direct experiments are wanting.

M. Milne-Edwards divides the *Lerneadæ* into three families, characterised by the manner in which these parasites attach themselves to their prey. Some fix themselves by means of great brachiform appendages, united together towards the end, and terminated by a horny median bouton. Others adhere by their jaw-feet, which are armed with very strong hooks. Others again attach themselves by the whole head, which is furnished for this purpose with horny prolongations of various forms. The first correspond to the *Lerneopoda* of M. de Blainville, and are designated as Lerneopodians; the second have the genus *Chondracanthus* for their type, and form M. Milne-Edward's family Chondracanthians; and the third he denominates Lerneocerians, because the genus *Lerneocera* belongs to that family, and the name recalls one of their principal characters. With regard to the establishment of generic divisions, and the characters of species, he can only, he observes, refer, in the greater number of instances, to the mode of organisation in the females; for the males are nearly entirely unknown to him, and, in his descriptions, the females are designated, unless the contrary is specified.

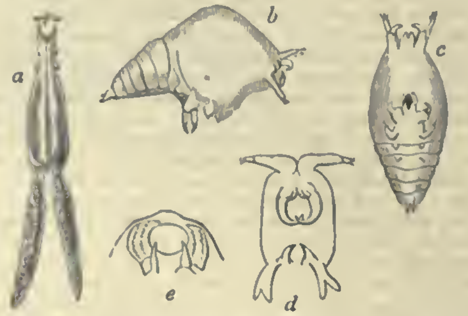
Chondracanthians.

The female Chondracanthians fix themselves upon their prey by the aid of small anchor-like jaw-feet inserted at the anterior extremity of the head and under the front. The thoracic appendages do not serve for the same use, and have the form of ordinarily two-oared feet of extreme smallness, or fleshy lobes, free at their extremity, and not prehensile. The head is in general tolerably distinct from the thorax, and nearly always carries a pair of antennæ and two pairs of unciform and anchor-like jaw-feet. On the sides of the mouth may be ordinarily perceived a pair of appendages, which represent the second pair of jaw-feet, and which are sometimes anchor-like, similar to the others, but are often rudimentary. The mouth is sometimes situated very far behind the anterior jaw-feet, and is armed with small appendages representing the mandibles. The number and disposition of the appendages corresponding to the thoracic feet vary; sometimes two pairs only are to be counted, sometimes three, and even four. The oviferous tubes spring from the posterior edge of the body, so that the abdomen is rudimentary, and is only represented by one or two small median tubercles. The male is often found attached under the anus of the female: he is extremely small, and does not resemble her in the least, but differs little from the males of the succeeding family. (Milne-Edwards.)

Genera, *Selius*, *Æthon*, *Clavella*, *Cycnus*, *Tucca*, *Peniculus*, *Lernanthropus*, *Chondracanthus*.

Selius consists of but one species (*S. bilobus*), found on the branchiæ of the dotted Polynöe; nor does *Æthon* comprise more, consisting only of *Æ. quadratus*, found on a *Serranus*, and about a line in length. *Clavella* has two species—*C. Hippoglossi*, found on the Holibut, and *C. Scari*. *Cycnus* has only one species (*C. gracilis*), found on the branchiæ of a cod-fish; and this is the case with *Tucca*, which has only one (*T. impressus*), found on *Diodon Hystrix*. *Peniculus* has but one (*P. Fistula*), found on *Zeus Aper*. *Lernanthropus* consists of two species, separated by M. Milne-Edwards into two sections—*L. pupa*, found on a Brazilian *Platax*, and *L. paradoxus*, found on the Mullets. M. Milne-Edwards remarks that *L. Musca* (De Blainville), found on a *Diodon* from Manilla, belongs to his first section.

Chondracanthus is separated by M. Milne-Edwards into two sections, with sub-divisions, and contains seven species:—*C. cornutus*, found on several flat-fish (*Pleuronectes*); *C. crassicornis*, found on a wrasse; *C. Soleæ*, found on soles; *C. Triglæ*, found on gurnards; *C. Merlucci* (from which the *C. Xiphiæ* of Cuvier does not appear to M. Milne-Edwards to differ, and to which he thinks *Lernæa radiata* of Müller, found in the buccal cavity of *Coryphæna rupestris*, appears to be very close); *C. Zei*; and *C. Delarochiana*, the last found upon the Tunny.



Chondracanthus cornutus.

a, female, magnified after Nordmann; *b*, male seen in profile, and more highly magnified; *c*, the same seen from below; *d*, head of the female seen from below; *e*, mouth still more highly magnified.

Lerneopodians.

In the females of this group the head is formed nearly as in the Chondracanthians, that is to say, distinct from the thorax, furnished with a pair of antennæ, and armed with two pairs of anchor-like jaw-feet; but the anterior jaw-feet are less proper for serving these small Crustaceans for attaching themselves to their prey, and the thorax, which carries neither feet nor fleshy appendages similar to those which represent the two first pairs of thoracic members in the preceding division, give origin to a pair of very large brachiform prolongations, which unite together, sometimes at their base, sometimes towards their extremity only, and terminate by a horny button, by the aid of which the parasite strongly adheres to the animal on which it has established its dwelling. These organs of adhesion appear to replace the first pair of thoracic limbs.

The male of only a small number of Lerneopodians is known, and where known differs extremely from the female. He has the body divided into two very distinct parts; one anterior, the cephalic, which carries the antennæ, a pair of anterior unciform jaw-feet, the sucker, and, farther back, two pairs of well-developed appendages, which represent the posterior jaw-feet and the arms of the female, but which have the form of stout hands carried on a cylindrical peduncle, and terminated by a small ill-formed pincer. The young undergo the ordinary metamorphoses. (Milne-Edwards.)

There are six genera:—*Basanistes*, *Achtheres*, *Brachiella*, *Tracheliastes*, *Lerneopoda*, and *Anchorella*.

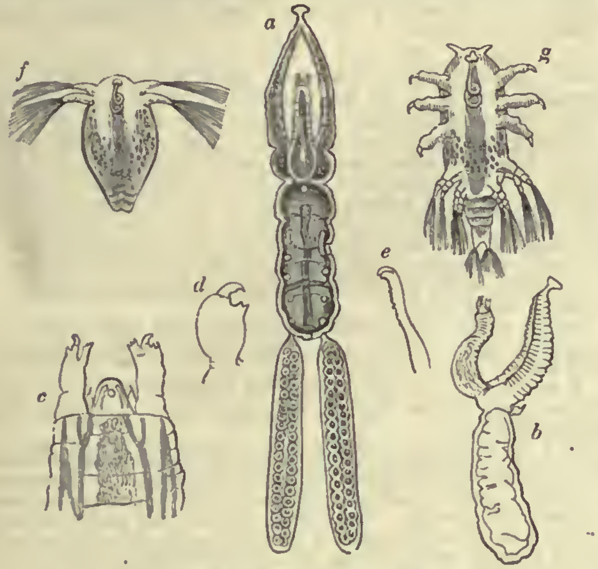
Basanistes comprises two species:—*B. Huchonis*, found on the gill-cover of the Huchen (*Salmo Hucho*), and *B. salmonea*, found on the Grayling. M. Milne-Edwards states that *Lerneopoda Brongniartii* (De Blainville) belongs to this genus.

Achtheres consists of but one species (*A. Percarum*), found on the fins of the river Perch and of the Sandra. Length about two lines.

Brachiella comprises five species, distributed into two sections, with subdivisions:—*B. Thynni* (length about ten lines, of male about half a line), found on the gills of the Tunny; *B. impudica* (length about four lines, of male about a third of a line), found on the gills of the

Haddock (*Gadus Æglefinus*); *B. bispinosa* (about three lines in length male unknown), found on the gills of the Sapphirine Gurnard (*Trigla Hirundo*); *B. rostrata*, closely approaching the preceding, found in the Greenland Seas upon *Pleuronectes pinguis;* and *B. Lophii*, found on the gills of the Sea-Devil, Toad-Fish, or Frog-Fish, at Naples.

Tracheliastes has three species, divided into two sections :—*T. polycolpus*, found on the fins of the Chub; *T. maculatus*, found on the scales of the Bream; and *T. Stellifer*, found on the branchial arches or within the mouth of *Silurus Glanis.*



Tracheliastes polycolpus. Milne-Edwards.

a, female magnified and seen from above; *b*, the same seen on the side, and deprived of the oviferous bags; *c*, anterior extremity of the body more highly magnified; *d*, appendage representing the second pair of jaw-feet; *e*, mandible; *f*, larva of the same; *g*, second age of the larva.

Lerneopoda consists also of five species, divided into two sections :—*L. stellata*, found on the fins of a Sterlet in Norway; *L. elongata* (about two inches in length), found fixed to the eye of a Shark in the Polar Seas; *L. Carpionis*, nearly approaching the preceding, found on the Salmon in the north of Europe; *L. Galei* (length about three lines, male about the same size), found on the fins of a Tope Shark (*Milandre*); and *L. obesa* (about two lines in length), found upon *Squalus Acanthias*, the Picked-Dog, or Hound-Fish.

M. Milne-Edwards thinks that *L. Dalmanni*, found on *Raia Batis*, the Skate; *L. bicaudata* (about two lines long), found on the Red Gurnard; and *L. salmonea*, belong to this genus. The last species does not seem to M. Milne-Edwards to be determinable specifically, and he makes the same remark on the *Lernæa* found by Hermann on the Dace.

Of *Anchorella* five species are recorded, distributed into two sections :—*A. emarginata* (about six lines long), found upon the gills of the Wolf-Fish (*Anarrhicas Lupus*); *A. brevicollis* (about four lines long), found fixed on the anal fin of the Variable Cod-Fish (*Gadus callarias*); *A. ovalis* (about two lines long), found upon the Red Gurnard; *A. rugosa* (about three lines long), found on the Wolf-Fish; and *A. uncinata*, found on the gills of divers *Gadi.*

M. Milne-Edwards is of opinion that *Lerneomyzon pyriformis* and *L. pinnarum* (De Blainville) belong to this genus, as well as *Lernæa adunca* of Strom and *L. anomala* of Abdilgaard.

Lerneocerians.

The female Lerneocerians, like the Chondracanthians, fix themselves to their prey by the anterior extremity of their body only, and have no brachiform thoracic appendages serving for this purpose, as may be seen in the Lerneopodians; but the arming of their mouth is far from having the form which this apparatus offers among the Chondracanthians, and the whole head of the parasite is plunged in the tissue of the animal on which it establishes its dwelling, and is there retained by horny prolongations, of varied form, which spring from its posterior or occipital part. In general the head is not very distinct from the thorax, and seems to be completely deprived of antennæ; the mouth is armed with but one pair of jaw-feet, which are simple and unciform. The feet, when they exist, are of extreme smallness, and sometimes no trace of them is to be perceived. The portion of the trunk which is situated behind the point where the oviferous tubes take their origin, and which represents the abdomen, is, in general, much more developed than in the other females of the same order.

The male of the Lerneocerians is unknown, except in very few species; and, where known, seems as imperfect as that of the Chondracanthians: his body is globular, offers no distinct thorax, and does not carry rudiments of feet behind the appendages which represent the jaw-feet. The metamorphoses which the young undergo are analogous to those of the other Lerneocerians. (Milne-Edwards.)

Genera.—*Penella, Lerneonema, Lerneocera, Lernæa.*

Penella consists of four species, divided into two sections :—*P. sagitta* (about four inches long), found on *Lophius marmoratus; P. filosa*, and *P. Blainvillii*, the last found on the Flying-Fish (*Exocœtus volitans*); and *P. Sultana* (about an inch long), found in the mouth of *Carenx Ascensionis.*

Lerneonema, also divided into two sections, comprises three species :—*L. Lesuerii* (about two inches long), found in the American Seas upon the Flying-Fish; *L. monilaris* (about an inch long), found fixed to the sclerotic coats of the eye of the Sprat (*Clupea Sprattus*); and *L. abdominalis* (about twenty lines long).

Lerneonema monilaris, magnified. Milne-Edwards.

M. Milne-Edwards states that *Lerneocera Surriraiis* (De Blainville) belongs to this group, and that it much resembles the preceding species, but is distinguished by the brevity of the abdominal portion of the body; and he is of opinion that the genus *Sphyrion* of Cuvier is too imperfectly known to enable him to determine its natural affinities, though it appears probable to M. Milne-Edwards that its place is between *Penella* and *Lernæa.*

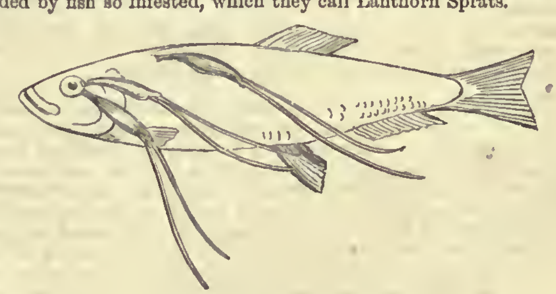
Lerneocera comprises four species, divided into two sections and sub-divisions :—*L. cyprinacea* (about eight lines long), found in Sweden on *Cyprinus Carassus; L. esocina, L. cruciata*, found in Lake Erie, on *Cichla ænea* (Lesueur); and *L. radiata*, found on *Clupea Tyrannus*, United States of America.

M. Milne-Edwards thinks that *Lernæa ocularis* of Cuvier belongs to the second section of the genus *Lerneocera.* It is found fixed to the eye of Herrings.

Lernæa consists of two species, each placed in a separate section :—*L. branchialis*, found on the gills of several species of *Gadi*, in the North Sea; and *L. multicornis.*

M. Milne-Edwards states that *L. cyclopterina* is distinguished from *L. branchialis* by certain tubercles about the head and neck. He remarks that M. Kroyer has represented it without horns, but he thinks that arose from the mutilation of the animal observed by M. Kroyer. This parasite is found in the Greenland Seas on *Cyclopterus spinosus.*

The subjoined cut, from Sowerby's 'Miscellany,' shows the external appearance of a sprat infested by these Lerneans. Mr. Sowerby names the parasite *Lernea Sprattæ* (*Lernæa Spratti*). These crustaceans are stated to be luminous at night; and the fishermen say that the shoal is often headed by fish so infested, which they call Lanthorn Sprats.



Lerneans in situ on a Sprat.

The following is Dr. Baird's arrangement of the British species of this family :—

Tribe I.—*Anchorastomacea.*

Females.—Attached to their prey by means of their foot-jaws, which are stout and armed with strong hooks. One pair of antennæ; generally very distinct. Thoracic feet nearly rudimentary, or represented by appendages of considerable size, but differing in form from ordinary feet.

Males.—Free and unattached; very small, and differing totally in appearance from the females.

Family *Chondracanthidæ.*

Organs representing thoracic feet, in form of considerable-sized, cartilaginous-looking, not articulated appendages; generally three pairs in number. Three pairs of foot-jaws.

Genus 1.—*Chondracanthus.*

Two pairs of foot-jaws prehensile, the third nearly rudimentary. Appendages of thorax representing the feet, in form of digitated, but not articulated, and not setiferous lobes or tubercles. Oviferous tubes very short, broad, and flattened.

C. Zei. Body short, and rather thick. Head rounded; antennæ short, and rather broad; neck narrow, short. Thorax carrying on the under surface two pairs of small appendages, each consisting of three divisions or fingers, and furnished laterally with three pairs of longer prolongations, of many divisions, the terminal one on each side larger than the others, and embracing the oviferous sacs; the upper part of the thorax is covered with short, conical, sharp-pointed spines. Abdomen rudimentary. Oviferous sacs flattened, containing many small ova.

It is found adhering to the gills of the *Zeus faber.*

Genus 2.—*Lernentoma.*

Foot-jaws and thoracic appendages as in *Chondracanthus.* Oviferous tubes long, either club-shaped and stout or slender and twisting.

1. *L. cornuta.* Female:—Head oval, rather elongated; antennæ flattened, of considerable size, and projecting. Thorax elongated, club-shaped; anterior portion narrow for about a third of its length, the other two-thirds much broader, and terminating posteriorly in two sharp lateral tubercles of moderate length, and a middle one representing the abdomen, which is nearly quite rudimentary. Two pairs only of thoracic appendages are visible, occurring at the upper portion of the narrow part, each divided into two digitations, and situated at a short distance from each other. The oviferous sacs are of considerable size, cylindrical, and about two-thirds the length of the body. Length nearly 3 lines.

Male:—Somewhat pyriform in shape. Head very large, swollen. Thorax conical, divided into five segments, and terminated by a rudimentary abdomen armed with two small hooks. Antennæ slender, setaceous, projecting from the anterior extremity of the head, and underneath them a pair of hook-shaped foot-jaws. Mouth situated far back, and provided with mandibles; and behind the mouth two other pairs of foot-jaws are visible. Following these we observe two pairs of setiferous tubercles representing the feet. Length, a quarter of a line.

It is found on the branchiæ of a sole.

2. *L. asellina.* Female:—Body somewhat square-shaped. Head small, and situated at the end of a long and slender neck; it is rounded at the anterior extremity, and a little below the antennæ exhibits on each side a round lobe or tubercle. The antennæ and foot-jaws are very small. The neck nearly equals in length the rest of the body. The thorax is broad, and of a somewhat quadrangular shape, with a deep indentation on each side about the middle of its length. On the upper half we see two pairs of prolongations or appendages, each divided into three digitations; and on the lower half there are three smaller appendages, but simple, not digitated. The posterior angles of the thorax are prolonged also into short horns or appendages, which are also simple. The abdomen is in form of a short tubercle, with a rounded blunt point. The oviferous sacs are of about the length of the whole animal, of considerable size, and cylindrical.

The male is similar, according to Milne-Edwards, to that of *Chondracanthus* (*Lernentoma*) *cornutus.*

It is found attached to the branchiæ of the *Triglæ.*

3. *L. Lophii.* Female:—Body rather elongate, and somewhat gibbous. Head small, having on each side a small horn-shaped appendage directed a little obliquely backwards. Antennæ small, conical, and slightly curved. Thorax divided into four portions by as many contractions. The first narrow like a neck, having on the upper portion a short spine, and on the under surface a pair of appendages or prolongations of two divisions or digitations; the second is somewhat quadrilateral, with on the middle line of the back two conical tubercles and on the sides two others, the upper pair the longer, and having on the under surface a pair of appendages of two digitations; the third part is larger than the preceding, and has the same tubercles and prolongations, and in addition a small spine on the superior portion, and in the mesial line of the under surface; the fourth portion is rather the largest, with two horns or tubercles on the upper surface, a third on the median line of the under surface, and on each side a long terminal prolongation, rather blunt. Abdomen in form of a short tubercle in the centre of the posterior part of the thorax. Oviferous tubes very long, slender, and twisted. Length, 6½ lines; breadth, 2½ lines.

The male is very similar to that of the *Chondracanthus cornutus* already described.

It is found on the *Lophius piscatorius,* in the pouches.

Tribe II.—*Anchoracarpacea.*

Attached to their prey by means of two long appendages which arise from the thorax. They unite together either at the base or near the tip only, and terminate there in a rounded knob like a button, by means of which the animal maintains its hold of the part to which it has attached itself. No thoracic feet, or they are represented by these arm-shaped appendages.

Males in general differ very much in appearance from the females, being greatly smaller and unattached.

Family I.—*Lerneopodadæ.*

Arm-shaped appendages long, wide apart from each other at their base, and united only at the tip.

Genus *Lerneopoda.*

Female.—Body generally elongated, oval. Head short and thick. Two pairs of foot-jaws, well-developed, and placed near each other. External ovarics of moderate length and cylindrical.

Male.—Body divided into two nearly equal portions of an ovoid shape; one representing the head, the other the thorax. Much smaller than the female.

1. *L. elongata.* The head is very distinct, of a horny texture, ovate, depressed, broad at the base, and obtusely pointed in front, resembling very much the shape of the body of the common Spider-Crab. The second pair of foot-jaws is large and well developed, consisting of a large rounded oval basal joint, and a more slender curved hooked terminal one, with a pretty strong tooth on its inner edge. The head is united to the body by a short narrow neck; the thorax is long and narrow, of a somewhat club-shaped form, and gives origin to two long cylindrical arms, which considerably exceed the length of the body. At the posterior portion, which is somewhat truncate, we see two small lobes; and on each side of these spring the ovaries, which are about the length of the entire body, thick, straight, and cylindrical.

Length of whole animal nearly 3 inches. Head, one line and three-quarters. Body, 7½ lines. Arms, one inch and one line. Ovaries, one inch and one line and a half.

A specimen of this arctic species was found attached to the eye of a shark caught on the English coast, and brought to London in the winter of 1848.

2. *L. galei.* Female:—The head is oval, depressed, and of a hard horny substance; the thorax is long, rather slender, and somewhat cylindrical, narrow where it is attached to the head, and broadest at its posterior extremity. The arms are slender, and nearly the length of the thorax. At the posterior extremity of the body are two small lobes, between which, on the middle line, is a small tubercle representing the abdomen. Ovarian tubes of moderate length, not quite equal to the length of the thorax.

Length of the whole body, including arms, about three-fourths of an inch.

Male:—Body divided into two portions, of an ovoid form, and nearly of equal size; the upper half represents the head, and carries a pair of antennæ, and two pairs of foot-jaws of considerable magnitude; the lower half, representing the thorax, has at its posterior extremity two sub-globular appendages a little longer than those in the female.

The female was found attached to the cavity posterior to the vent of the *Squalus galeus.*

3. *L. salmonea.* Linnæus's description of this species, as far as it goes, is very good:—"Body ovate; thorax obcordate; the two arms linear, approximated." The head is rather small, somewhat bulging out at the back part, broader there, and rather sharp-pointed at the anterior extremity. From the base of the head spring the two arms, which are rounded, and slightly shorter than the body. The thorax is pyriform and short, and at its lower extremity we see two minute eminences. The ovarian tubes are of considerable thickness, cylindrical, and about the same length as the whole animal.

The colour of the animal is white. Length about half an inch.

It is found in the gills of the Salmon, in the London markets.

Family II.—*Anchorelladæ.*

Arm-shaped appendages very short, and united to each other from the base, so as to resemble a single organ.

Genus *Anchorella.*

Female:—Body in general short, and somewhat swollen. Head small, and situated at the extremity of a long neck, which is generally curved backwards. Two pairs of foot-jaws well developed, and a third rudimentary. Antennæ rudimentary. Ovarian tubes of moderate length, and cylindrical.

The male differs in appearance very much from the female, and is very small.

1. *A. uncinata.* Female:—The body of the animal is thick, oblong, of a milk-white colour, smooth, and opaque. Head very small, situated at the extremity of a long slender neck, which has a wrinkled appearance, and is nearly the length of the thorax. The arms spring from the upper portion of the thorax, and are rather short, terminating in a rounded knob or button. At the posterior portion of the thorax there is on the middle line a small protuberance representing the abdomen. The ovarian tubes are cylindrical, straight, smooth, and about the length of the body. Length from 6 to 8 lines.

Male:—Body globular, terminated in front by a small conical eminence, at the extremity of which is the mouth, and having at its base one pair of rudimentary appendages, and a pair of rudimentary foot-jaws. On the middle of the body, on the inferior surface, there are two pairs of large hooked claw-like members. Length, one-fourth of a line.

The female fixes itself to the fins and gill-covers of the Cod and Haddock, and is most probably the most common species of our seas. (Johnston.)

2. *A. rugosa.* Body nearly of a square shape, a little emarginated on each side. Head small; neck slender, and nearly cylindrical. A rounded tubercle on the middle line represents the abdomen. Ovaries rather larger than the thorax, nearly cylindrical, or slightly club-shaped. Length, about 3 lines.

Found in the mouth of the *Gadus cellarius.*

Tribe III.—*Anchoraceracea.*

Females:—Attached to their prey by the anterior extremity of their body only, thrusting the entire head into the tissues of the animal to which they adhere, and being retained there by means of a kind of horns, which are various in form, and spring from the posterior part of the head. No antennæ. Only one pair of foot-jaws, which is simple and hooked. Feet either very small or often wanting altogether.

Males:—Very small. Body globular, and more imperfect than in the preceding tribes, having no distinct thorax, and no rudiments of feet behind the appendages which represent the foot-jaws.

Family I.—*Penelladæ.*

Several pairs of feet situated on the under surface of the body near the head, but very small and rudimentary.

Genus *Lerneonema.*

Body long, slender, narrowed anteriorly in the form of a neck, which is terminated by a swollen head furnished with two or three simple curved horn-shaped appendages. Abdominal portion of body of inconsiderable length, and simple. Oviferous tubes long and slender.

1. *L. spratta*, the Eye-Sucker. Body slender, considerably larger at the posterior extremity. Head of tolerable size, rounded, and provided with two narrow rather hooked horns at its back part, directed backwards. The head is connected to the body by means of a long and very slender cylindrical neck, which is furnished with about a dozen constrictions, which make this part of the body appear as if it were beset with an equal number of rings or knobs.

A short distance beneath the head it is very narrow, gradually increasing in size as it joins the body. Abdominal portion small, blunt, and obliquely truncate. The ovarian tubes are very long and slender, about as long again as the whole body of the animal. Length of the body about an inch; ovaries one inch and a half.

It is found attached to the eyes of Sprats.

2. *L. encrasicoli.* Body cylindrical, shorter than the preceding, and of about the same size at both extremities. The neck is long and slender, quite smooth, and destitute of the constrictions which mark so decidedly the preceding species. The neck is white, and the body is of a brown horny colour.

The abdomen is like that of the preceding, and the ovarian tubes are long and slender, at least twice the length of the body. Turton describes the ovaries as "clear white." Perhaps they may be so in the living animal, but in the specimens preserved in spirits they are of exactly the same colour as the body. In one specimen however one of the tubes is broken, and the ova have escaped, and in this the tube is white. Length of the body about half an inch; ovaries fully one inch.

It is found attached to the bodies of the *Clupea encrasicolus* and *C. sprattus.*

Family II.—*Lerneoceradæ.*

No vestiges of feet on under surface of body, nor any appendages representing them.

Genus I.—*Lerneocera.*

Body long and slender; head furnished with horn-shaped appendages, which are simple and symmetrical in form. Ovarian tubes straight, and of moderate length. Abdomen very small.

L. cyprinacea. Head furnished with four horn-shaped appendages, which are somewhat long and slender. The two outer or posterior are bifurcated; the anterior simple.

The thorax is very slender anteriorly, forming a long neck, but becomes much broader posteriorly, and when it terminates in the small abdomen appears obliquely truncate. The oviferous tubes are cylindrical, and rather long. The length of the whole animal is about 8 lines.

It is found on the sides of the Carp, Bream, and Roach, in many of our ponds and rivers, in great abundance.

Genus 2.—*Lernea.*

Body more or less twisted, and outré in appearance. Head furnished with horn-shaped appendages, which are irregularly branched. Ovarian tubes twisted into round masses, and placed under the posterior portion of the body. Abdomen of considerable size.

The genus *Lernea* is now restricted within very small limits. Established by Linnæus upon the *L. branchialis*, it is at the present day confined to that species and one or two others.

L. branchialis. Head rounded, and furnished with three horn-shaped appendages, each of which is divided at the tip into three short branches.

The anterior portion of the thorax is long, cylindrical, and very slender, like a long narrow neck, while the body itself is very much swollen in the middle, and abruptly twisted upon itself in the form of the letter S.

The abdominal portion of the body is long, blunt at the extremity, and of considerable size. The ovarian tubes are slender, and very much twisted.

The whole animal is about an inch and a half in length, and is of a very firm consistence, being hard and horny.

It is found on the gills of the Cod.

(Baird, *History of British Entomostraca;* Milne-Edwards, *Histoire Naturelle des Crustacés.*)

LESTRIS. [LARIDÆ.]

LETTUCE. [LACTUCA.]

LEUCÆTHIOPES. [ALBINOS.]

LEUCHTENBERGITE, a Mineral occurring in large but not perfectly developed crystals in the form of the rhomboid. Colour yellowish in masses, but in thin laminæ white. The texture lamellar. Lustre pearly. Transparent in small crystals. Hardness between calc-spar and selenite; is impressed by the nail. Feels greasy. Specific gravity 2·71. It is found in the Schischminsk mines in the district of Slatonst. The following is its analysis by Komonen:—

Silica	34·23
Alumina	16·31
Magnesia	35·60
Peroxide of Iron	3·33
Lime	1·75
Water	8·68
	99·90

LEUCI'SCUS, a genus of Fishes of the family *Cyprinidæ*, and section *Abdominales.* This genus, which was established by Klein, contains numerous species, of which the Roach, Dace, and Bleak afford familiar examples. The characters which distinguish them from others of the *Cyprinidæ*, or Carp tribe, consist in the comparative shortness of the dorsal and anal fins, and the want of strong spiny rays at the commencement of either, the simple lips, and deficiency of barbules about the mouth. The various species of *Leuciscus* are divided into two sections, according to the position of the dorsal fin. Firstly, those in which this fin is situated immediately above the ventral, as in the Roach, Dace, &c., and, secondly, those species in which the dorsal fin is placed above the space intervening between the ventrals and anal, as in the Chub, Rud, Bleak, &c.

L. rutilus, Cuvier, the Roach, is common in most parts of Europe, swims in large shoals, and frequents rivers, lakes, &c.; preferring somewhat still and deep waters, feeding upon worms and aquatic vegetables. It usually attains from 12 to 15 inches in length. The length of the head, compared with the whole length of the fish is as one to five; the depth, at the commencement of the dorsal fin, is to the body alone (without the head or tail) as two to five. The number of the fin-rays are—dorsal, 12; pectoral, 17; ventral, 9; anal, 13; and caudal, 19. The scales are large, and the number forming the lateral line is 43; the number of scales in the oblique line is 11; the colour of the back and upper part of the head is bluish-green or dusky green, becoming lighter on the sides of the body, and shaded into silvery-white on the belly. The dorsal and caudal fins are dusky, tinged with red; the anal, pectoral, and ventral fins are bright-red; the irides bright-yellow.

L. vulgaris, Cuvier, the Dace, is more slender and elongated than the Roach; the scales are proportionately smaller; the mouth is more deeply cleft, and the eye is not so large. The length of the head compared with that of the head and body, not including the tail, is as two to nine; the depth of the body, compared to the whole length, is as one to five. The number of scales composing the lateral line is 52: there are eight scales in the oblique line above it, and below the lateral to the ventral fin there are four. The dorsal fin commences rather behind the middle of the body, whereas in the Roach it is exactly half way between the nose and the base of the tail fin. The colouring of the upper part of the head and back is dusky-blue, becoming paler on the sides of the body, and shaded into silvery-white on the belly. The dorsal and caudal fins are pale-brown; the pectoral, ventral, and anal are almost white, but tinted with pale-red. The fin-rays are—dorsal, 9; pectoral, 16; ventral, 9; anal, 10; and caudal 19. The habits of the Dace are very similar to those of the Roach. It is found in Italy, France, and Germany, as well as our own country, generally frequenting the deep clear water of quiet streams.

"*L. Dobula*, Cuvier, the Dobule," says Mr. Yarrell, "is found in the Oder, the Elbe, the Weser, and the Rhine, as well as in the smaller streams which run into them." As yet however but one specimen has been found in this country, and was fortunately caught by the author of the 'History of British Fishes,' while fishing, in the month of August, 1831, in the Thames, below Woolwich. It is of a slender form, and the scales are of moderate size, 50 forming the lateral line, above which there are 7 in an oblique line under the dorsal fin, and below the lateral line there are 4. The length of the head, compared with that of the head and body alone, is as two to nine, and the depth of the body is equal to the length of the head. The dorsal fin commences about half-way between the anterior edge of the eye and the base of the tail-fin. The colouring is the same as in the Dace, excepting that the pectoral, ventral, and anal fins are pale orange-red. In the number of the fin-rays it agrees with the Dace.

L. Lancastriensis, Yarrell, the Graining. Pennant appears to be the first author who noticed this fish, but its characters were never clearly defined until Mr. Yarrell's account appeared in the 'Transactions of the Linnæan Society,' vol. xvii., p. 7, pl. 2, fig. 1. M. Agassiz having examined the species when in England, immediately recognised it as an inhabitant of some of the lakes of Switzerland. In this country it appears to be chiefly, if not wholly, confined to the Mersey and some streams connected with that river, where it is met with in considerable abundance.

The adult Graining is from about 7 to 9 inches in length: the length of the head, compared to the whole length of the body and tail, is as one to six; and the depth of the body, compared to the whole length, as one to five; the nose is more rounded than in the Dace, the eye is rather larger; the pre-operculum is less angular, the dorsal line is less convex, and the scales are rather larger and wider. The dorsal fin commences exactly half-way between the point of the nose and the base of the tail-fin. There are 48 scales in the lateral line, those in the oblique line from the dorsal fin to the lateral line are 8 in number, and below this line to the ventral fins there are 4. The top of the head, the back, and upper part of the sides are of a pale-drab colour tinged with bluish-red, separated from the lighter-coloured inferior parts by a well-defined boundary-line. The irides are yellowish-white; cheeks and gill-covers shining silvery-white, tinged with yellow; all the fins pale yellowish-white. The fin-rays are—dorsal, 9; pectoral, 17; ventral, 10; anal, 11: and caudal, 19.

L. Idus, Cuvier, the Ide, a species which is found in Norway, Sweden, Denmark, Russia, and some other parts of Europe, is said to have been taken at the mouth of the Nith. Its form is somewhat bulky, compared with the other species here described. "The head is large, and appears somewhat truncated; the muzzle blunt; the mouth small, without teeth, as is the case also with the other species of this extensive family; the upper jaw rather the longer; the eye of moderate size; the dorsal line convex; abdominal line almost straight; the scales of the body large; the lateral line curved in its descent from the upper edge of the operculum to the centre of the body. The fin-rays in number are—dorsal, 10; pectoral, 17; ventral, 11; anal, 13; caudal, 19; vertebræ, 41.

"In colour the irides are straw-yellow, the pupils black; forehead, nape, and back, very dark bluish-black; the sides bluish-gray; the belly white; pectoral fin orange; ventrals immediately under the dorsal fin, red in the middle, the first and last rays white; base of the anal fin white, the other part red; dorsal fin and tail gray; all the rays branched." (Yarrell.)

L. Cephalus, Flem., the Chub, is of a moderately elongated and thick form. The greatest depth of the body is contained four times and a half in the entire length, and the thickness is equal to two-thirds of the depth. The muzzle is somewhat obtuse, and the gape large. The scales are large; the number forming the lateral line is 44. Above this there are 6 scales in the oblique line to the dorsal fin; and below the lateral line there are 3 in the oblique line to the ventral fin. The dorsal fin commences half-way between the point of the nose and the base of the tail-fin; and the ventral commences in the same vertical line as the dorsal. The fin-rays are—dorsal, 10; pectoral, 16; ventral, 9; anal, 11; and caudal, 19. The colour of the upper parts is dusky-green, the sides of the body and belly silvery-white; the lateral scales are dotted with black: on the cheeks and gill-covers there is a golden hue; the irides are very pale yellow; dorsal and caudal fins dusky; pectorals pale; anal and ventral fins tinged with red, with the exception of the two or three last rays.

The Chub is common in many of the rivers of this country, often frequenting holes near the roots of trees. It lives upon insects and worms, spawns in April and May, and rarely attains a weight exceeding five pounds.

The remaining species of *Leuciscus* belong to the second division; that is to say, they have the dorsal fin placed above the intervening space between the anals and the ventral.

L. erythophthalmus, Cuvier, the Rud, or Red-Eye, somewhat resembles the Roach in form; its body however is higher and thicker, and is distinctly raised at the fore part of the dorsal fin, so as to form an obtuse angle. The greatest depth of the body is rather more than one-fourth of the entire length, and the head is one-fifth; the thickness is not half the depth. The snout is obtuse, the mouth small, the lower jaws slightly exceeding the upper in length. The scales are large: the number contained in the lateral line is about forty. In an oblique line ascending to the dorsal fin there are seven, and below the lateral line to the ventral there are four. The dorsal fin commences half-way between the point of the nose and the end of the shorter tail-rays. The fin-rays are—dorsal, 10; pectoral, 15; ventral, 9; anal, 13; caudal, 19. The upper parts are of an olivaceous colour tinged with green and blue; the sides and the belly golden-orange; irides orange-red; dorsal and caudal fins dusky; pectorals pale; anal and ventrals tinged with red, excepting two or three of the last rays.

The Rud is found not uncommonly in rivers and other deep waters in various parts of England. It spawns in April or May, and feeds upon worms, *Mollusca*, and vegetable substances.

L. cæruleus, Yarrell, the Azurine, a beautiful species, first described by Mr. Yarrell, from specimens received from Knowsley in Lancashire, approaches the Roach in shape, but is more tapered anteriorly and posteriorly, and is at once distinguished by its colour, which is slate-blue above and on the sides of the body, with the lower parts silvery-white, and by the position of the dorsal fin. This commences half-way between the eye and the end of the fleshy portion of the tail. The fins are white, the dorsal and caudal inclining to dusky. The greatest depth of the body is rather more than the entire length, and the head is equal to one-fifth of the length. The scales are rather large; the number contained in the lateral line is about forty-two. In an oblique line, from the dorsal fin to the lateral line, there are seven scales, and below the lateral line to the origin of the ventral there are three. The fin-rays are—dorsal, 10; pectoral, 15; ventral, 9; anal, 12; caudal, 19.

The only locality in England in which this fish is found is in the township of Knowsley. Mr. Yarrell however is informed by M. Agassiz that it is an inhabitant of some of the Swiss lakes.

L. alburnus, Cuvier, the Bleak, is of a more slender and elongated form than either of the preceding. The tail is very long and deeply forked. The greatest depth of the body is equal to one-fifth of the entire length, and the greatest thickness is about half the depth: the lower part projects beyond the upper. The scales are of moderate size, the number contained in the lateral line being about forty-eight. The dorsal fin commences half-way between the anterior edge of the eye and the end of the short central rays of the tail: the anal fin commences in a vertical line under the base of the last ray of the dorsal, and occupies half the space between its commencement and the base of the tail. The number of fin-rays are—dorsal, 10; pectoral, 17; ventral, 9; anal, 18; caudal, 19. The general colour is silvery-white, which is shaded into an olivaceous green on the upper parts; all the fins are whitish; the irides are silvery.

The Bleak is a small species, rarely attaining eight inches in length, and is usually about six or seven inches long. It is common in many parts of Europe, as well as of this country, usually occurring in the same streams as the Roach and Dace; it swims in great shoals, and spawns in May. The position of the fin, and colour of the eye and fins, render it easy to distinguish the species from the Dace, which it approaches nearest in general appearance.

L. phoxinus, Cuvier, the Minnow, or Minim. This pretty little fish, a well-known inhabitant of most of our running streams, appears to depart somewhat from the typical species of *Leuciscus*. Its form is slender and rounded, the greatest depth being about one-fifth of the entire length, and the thickness equal to half the depth. The fins are proportionately large, especially the dorsal, anal, and caudal. The last is not very deeply forked, and has the extremities somewhat rounded. The dorsal fin commences about half-way between the anterior edge of the eye and the end of the fleshy portion of the tail. The lateral line is straight from the tail to above the origin of the ventral fin, when it rises gradually to the upper edge of the operculum. The fin-rays are—dorsal, 9; pectoral, 16; ventral, 8; anal, 9; and caudal, 19. The top of the head and back are of a dusky olive colour; the sides of the body are paler and mottled; the belly is white and of a fine rosy pink tint in the summer, varying in intensity according to the vigour of the fish; the irides and gill-covers are silvery; the dorsal fin is pale brown; the other fins are paler, excepting the tail, which is light brown, with a dark brown spot at the base of the rays.

The scales of several of these fishes have been used in the manufacture of artificial pearls. "On the inner surface of roach, dace, bleak, whitebait, and other fishes," writes Mr. Yarrell, "is found a silvery pigment which gives the lustre those scales possess. Advantage has been taken of the colouring matter thus afforded to imitate, artificially, the oriental pearl. When this practice was most in fashion, the manufactured ornaments bore the name of patent pearl, and the use was universal in the bead-trade for necklaces, ear-drops, &c. At present it seems confined to ornaments attached to combs, or small beads arranged with flowers for head-dresses. So great was the demand formerly at particular times, that the price of a quart-measure of fish-scales has varied from one guinea to five. The Thames fishermen gave themselves no trouble beyond taking off the side scales, and throwing the fish into the river again; and it was the custom for hawkers, regularly, before selling any White-Fish, as they were called, to supply the bead-makers with the scales. The method of obtaining and using the colouring matter was, first carrying off the slime and dirt from the scales by a run of water; then, soaking them for a time, the pigment was found at the bottom of the vessel. When thus produced, small glass tubes were dipped in, and the pigment injected into thin hollow glass beads of various forms and sizes. These were then spread on sieves, and dried in a current of air. If greater weight and firmness were required, a further injection of wax was necessary. Of this pigment, that obtained from the scales of roach and dace was the least valuable; that from the bleak was in much greater request; but the white-bait afforded the most delicate and beautiful silver, and obtained the highest price, partly from the prohibitory regulations affecting the capture of this little fish, the difficulty of transmission, and rapid decomposition." (Yarrell, 'History of British Fishes.')

LEUCITE (*Amphigene*), a Mineral which occurs imbedded in lava, in trapezoidal crystals and massive. The primary form is a cube. The cleavage is parallel to the planes of the cube and the rhombic dodecahedron. Fracture conchoidal, undulating, shining. Hardness 5·5 to 6. Scratches glass with difficulty. Colour yellowish, grayish, or reddish-white. Streak white. Lustre vitreous. Transparent, translucent, opaque. Specific gravity 2·483.

Massive variety amorphous, granular. Reduced to powder, it renders vegetable blues green. Before the blow-pipe alone it is infusible; with borax difficultly forms a clear glass.

Analysis by Klaproth, from Vesuvius (No. 1), and by Arfwedson, from Albano (No. 2):—

	No. 1.	No. 2.
Silica	53·75	56·10
Alumina	24·62	23·10
Potash	21·35	21·15
Oxide of Iron		0·95
	99·72	101·30

LEUCO'JUM, a genus of Plants belonging to the natural order *Amaryllidaceæ*. It has a 6-parted perianth, bell-shaped; the segments all equal, and thickened at their points; the stamens equal.

L. æstivum, the Summer Snow-Flake, has a many-flowered spathe; a style thickened upwards. The height is from 2 to 2½ feet. The flowers are white and drooping; the tips greenish. Leaves broadly linear, keeled; scape 2-edged; spathe usually as long as the flowers. It is found in wet meadows in Great Britain.

LEUCOPHANE, a Mineral occurring crystallised in four-sided prisms, but is seldom regularly crystallised. Cleavage imperfect in three directions. Colour pale dirty-green and deep wine-yellow. Transparent and colourless in thin fragments. Lustre vitreous on cleavage surface. Hardness 3·50 to 3·75. Specific gravity 2·974. It is found at Langesundfiord in Norway. Its analysis by Erdmann gives—

Silica	47·82
Glucina	11·51
Lime	25·00
Fluorine	6·17
Sodium	7·59
Protoxide of Manganese	1·01
Potassium	0·26
	99·36

LEUCOSIA. [OXYSTOMA.]

LEVYNE, a Mineral occurring crystallised. Primary form an acute rhomboid. Cleavage parallel to its planes. Fracture conchoidal. Hardness 4·0. It scratches carbonate of lime. Colour and streak white. Lustre vitreous. Translucent. Specific gravity 2·15. When heated it yields water, and becomes opaque; swells up when heated on charcoal; with phosphoric salt gives a transparent globule, which contains a nucleus of silica, and becomes opaque on cooling. It is suspected to be merely a variety of *Chabasite*. It is found in Ireland, Faröe, and some other places. Analysis by Berzelius:—

Silica	48·00
Alumina	20·00
Lime	8·35
Soda	2·75
Potash	0·41
Magnesia	0·40
Water	19·30
	99·21

LEYCESTE'RIA, a genus of Plants belonging to the natural order *Rubiaceæ*, named after the late W. Leycester, Esq., of the Bengal Civil Service, who paid much attention to horticulture in India. The genus consists of only a single species.

L. formosa is a native of the Himalaya Mountains, at elevations of from 6000 to 7000 and 8000 feet, in Nepaul and Sirmore, where it grows among oaks and pines, and is therefore well suited to the climate of England, where indeed it may be seen growing in great luxuriance in some gardens, and showing that many others from the same situations are equally suitable to this climate, which is not the case with many shrubby Rubiaceous plants. It forms a large and very showy shrub, with numerous luxuriant smooth and cylindric fistulous shoots issuing from the root, which are of a purplish colour. The leaves are opposite, ovate-lanceolate, and glaucous; the flowers white, with a tinge of purple, arranged in drooping racemes, which are furnished with coloured foliaceous bracts.

LI'ALIS, a genus of Reptiles.

LIAS, in Geology, the name of a series of argillaceous and calcareous strata, forming the basis of the Oolitic System. The term was originally applied, in the south of England, to the calcareous beds which are at the bottom of the thick argillaceous deposits, now ranked in the Lias Formation. The lime burnt from the lias of Aberthaw, Bath, and Barrow-on-Soar, has the valuable property of setting in water. [OOLITIC SYSTEM.]

LIBELLULA. [LIBELLULIDÆ.]

LIBELLULIDÆ, a family of Neuropterous Insects, of which the Common Dragon-Fly is the type. The Dragon-Flies have horny strong mandibles and maxillæ, covered by the labrum and labium; their tarsi are 3-pointed; their wings are equal; the posterior extremity of the abdomen is furnished with hooks or peculiar appendages. The size, beauty, and habits of these insects have rendered them favourite objects of study with the entomologist. In the larva state they live entirely in the water, engaged in unceasing war with other insects, which by singular devices they entrap and devour. Their pupa state is also passed in water, and, contrary to the usual habit of insects, is a period of activity and locomotion. They are then furnished with an extraordinary mask, formed out of that part of the head which replaces the lower lip, and by which they cover the jaws and the whole under part of the head. They use it to alarm and seize their prey, projecting it at will. When perfect insects they become inhabitants of air, and are endowed with extraordinary power of flight and precision of movement, performing astonishing evolutions. Their habits continue as ferocious as they were before. When taken and imprisoned they have been known to devour their own bodies! Several valuable monographs have been published on these interesting insects by De Geer, Roesel, Vander Linden, and Charpentier; but the most important is that of M. de Selys Longchamps, entitled 'Monographie des Libellulidées d'Europe.' In this work 61 species are described, arranged under the genera *Libellula*, *Cordulia*, *Lindenia*, *Gomphus*, *Cordulegaster*, *Æshna*, *Anax*, *Calepteryx*, *Lestes*, *Sympecma*, and *Agrion*.

In the arrangement of Westwood ('Introduction to the Modern Classification of Insects') the genera of *Libellulidæ* inhabiting Great Britain are grouped under two sub-families, *Libellulides* and *Agrionides*. The following table exhibits the chief characters of the British genera:—

Sub-Family 1.—*Libellulides*.

A. Ocelli in a row	*Anax* (1 species); anal angle of posterior pair of wings rounded. *Æshna* (7 species); anal angle of posterior pair of wings more or less angulated in the male. *Cordulegaster* (1 species); anal angle of posterior wings strongly angulated.
B. Ocelli in a line; eyes remote	*Gomphus* (2 species).
C. Ocelli in a triangle	*Cordulia* (3 species); anal angle of posterior wings angulated in the male. *Libellula* (15 species); anal angle of posterior wings rounded in both sexes.

Sub-Family 2.—*Agrionides*.

A. Wings membranous	*Agrion* (13 species); stigma rhomboidal; areolets mostly quadrangular. *Lestes* (3 species); stigma oblongo-quadrate; areolets mostly pentagonal.
B. Wings coriaceo-membranous; stigma obsolete	*Calepteryx* (4 species).

LI'BER, the inner bark of a plant, is a layer consisting of woody tissue, cellular substance, and vessels of the latex, forming a compact zone immediately applied to the wood. The woody tissue of which it is composed quickly becomes thick-sided, by the addition of internal ligneous strata, the consequence of which is that such tissue in this part is more tough than elsewhere. Hence it is usually from the liber that are extracted the fibres employed in making cordage or linen-thread: this at least is its source in hemp, flax, the lime-tree, the lace-bark, and the many other Exogens which furnish thread; but in Endogens, which have no liber, as the Cocoa-Nut, it is the ordinary woody bundles of the leaves, stem, and husks of the fruit from which the fibre used for ropes is procured. It is said that certain Exogens, such as *Menispermaceæ*, have no liber. ('Comptes Rendus,' v. 393.) In many plants a new layer of liber is formed annually, comtemporaneously with a new layer of wood, but this is by no means universal; on the contrary, the oak and the elm increase their liber slowly and irregularly. [BARK.]

LIBETHENITE, *Phosphate of Copper*, a Mineral occurring in small octohedral crystals and in radiated masses. Primary form a right rhombic prism. Colour dark green. Streak green. Fracture uneven. Hardness 4·0. Transparent, translucent. Lustre resinous. Specific gravity 3·6. It is found at Libethen in Hungary. Its analysis by Berthier gives—

Phosphoric Acid	28·7
Oxide of Copper	63·9
Water	7·4
	——100

LIBI'NIA (Leach), a genus of Brachyurous *Crustacea*. [MAIIDÆ.]

LICHANO'TUS (Illiger), a genus of Cheiropeds, or *Quadrumana* (*Indri* of Lacépède, Geoffroy, and others), belonging to the family *Lemuridæ*.

The Indris are inhabitants of Madagascar, and two species only seem generally recognised, namely, *Indri brevicaudatus* of Geoffroy, *Lemur Indri* of Gmelin; and *I. longicaudatus* of Geoffroy, *L. laniger* of Gmelin, *I. laniger* of Fischer. Cuvier indeed recognises but one species, namely, that first above named, and says in a note that the other requires consideration ("a besoin d'être revu").

Dr. Fischer adopts both under the names of *I. brevicaudatus* (Geoff.) and *I. laniger*, marking however the latter as doubtful.

M. Lesson, in his 'Manuel,' also gives both species under the generic name of *Indri* (Lacépède), and the specific names of *I. brevicaudatus* Geoff. (L'Indri, Sonnerat), and *I. longicaudatus*, Geoff. (Le Maki Fauve, Buffon; Le Maki à Bourre, Sonnerat); with the following dental formula:—Incisors, $\frac{4}{4}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{5-5}{5-5} = 32$; the same number recorded for both species by Fischer. M. Temminck ('Mammalogie') notices only one species.

Dr. Gray places *Lichanotus* and *Indris* in his sub-family *Lichanotina*, between *Lemurina* and *Loridina*, in his third family *Lemuridæ*, which is the first in his second or Quadrupedoid section of his order *Primates*. ('Annals of Philosophy,' 1825.)

Mr. Swainson confines the generic term *Indris* (Lacépède) to the *Lemur laniger* of Gmelin, and that of *Lichanotus* to the *Lemur Indri* (Gmelin). To both Mr. Swainson assigns the same number of incisors and grinders as that above stated; but he gives canine teeth $\frac{1-1}{1-1}$ to *Lichanotus* only. He places these two genera between *Lemur* (Linn.) and *Scartes* (Sw.), in the family *Lemuridæ*. ('Classification of Quadrupeds,' 1835.)

M. Geoffroy ('Magaz. Encyclopédique') observes that there are four cutting teeth in the upper jaw, not two, as mentioned by Sonnerat.

F. Cuvier states that the dental system of *Indri* is only known to him from the extremity of the jaws, which offers in the upper jaw incisors like those of the Red Lemur, a canine tooth very much curved and entirely like two false molars which are found immediately next to it, and which have only a single point; in the lower jaw two incisors only, the first very narrow, and the second wider, but both couched forwards ("couchées en avant"), like those of the Makis or True Lemurs, the canine small, and resembling a false molar which follows it, which has only a single point, and which is much wider before than behind, thickening from the external to the internal edge.

The figures and descriptions of these two species are given by Sonnerat in his 'Second Voyage,' and seem to be the source whence the subsequent accounts have been principally taken.

Black or Tailless Indri.

The first, noticed by Pennant as the Indri (under the title Maucauco), is described as a large animal 3½ feet high, entirely black, except on the face, which is grayish, on the lower part of the abdomen, where a grayish cast prevails, and on the rump, which is white. The face is stated to be of a lengthened dog-like form, the ears rather short but much tufted, the hair or fur silky and thick, curly in some parts. The nails are said to be flat but pointed, and there is no appearance of a tail. Like most other *Lemuridæ* it is a native of Madagascar.

The animal is described as gentle and docile, and as being trained when young for the chase, as dogs are. Its note is stated to resemble a child's crying, whence not improbably its Madagascar name Indri, which is said to signify Man of the Wood.

The other species, Flocky Lemur of Shaw, is stated to be 1 foot 9 inches from nose to end of tail, the tail being 9 inches. The colour pale yellowish ferruginous above, and white beneath; the tail bright ferruginous. The fur extremely soft, and curled deepest about the loins. Face black; eyes large and greenish-gray. The animal is described as having two fore-teeth in the upper jaw and four in the lower, and pentadactyle feet, with long claws, except the thumbs, which are furnished with rounded nails.

Dr. Shaw observes that Pennant, in the last edition of his 'History of Quadrupeds,' seems to think this animal no other than the *Lemur Mongooz*, or Woolly Maucauco; but the Doctor adds, that if Sonnerat's description be just, the species must certainly be a different one from *L. Mongooz*.

Flocky Indri.

Dr. Shaw is of opinion that Le Petit Makis Gris (Buffon, 'Supp.,' tom. vii. p. 121, pl. 34) and the Autre Espèce de Maki (Buff., 'Supp.,' tom. vii. p. 123, t. 35) are smaller varieties of the Flocky Lemur; but this view does not seem to be adopted by the more modern zoologists. Skeletons and skins of the Indris would be an acquisition to our museums, and would clear up doubtful points. [LEMURIDÆ.]

LICHAS, Dalman's name for a group of *Trilobites*, forming a division of the great genus *Asaphus* of Brongniart. [TRILOBITES.]

LICHEN ISLANDICUS. [CETRARIA.]

LICHENIN, a peculiar vegetable product, sometimes called Lichen Starch. It is obtained from the *Cetraria Islandica*, the Iceland Moss, which is to be cut small and infused in eighteen times its quantity of cold water, in which about a quarter of an ounce of carbonate of potash is dissolved for every pound of the liverwort employed. After remaining twenty-four hours the infusion is drained from the liverwort without pressure: it is then to be repeatedly washed with cold water, and afterwards boiled in nine times its weight of water down to six; the decoction is strained and the liverwort squeezed while hot; a gelatinous white substance is soon formed, which, after being dried gently on cloth, becomes of a dark colour and hard. Being redissolved in boiling water and again strained, it gelatinises.

When pure it is white, and it retains water; but on drying it becomes yellowish. In thin plates it is transparent. It is tough, tasteless, nearly inodorous, swells up when put into cold water, but dissolves sparingly in it. With hot water a gelatinous solution is obtained, which is decomposed, and yields a precipitate with di-acetate of lead, and with solution of iodine gives either a dingy green colour, or, as is stated by some authors, a blue one, as starch does.

LICHENO'PORA. The Fossils ranked under this title by Defrance are thought by De Blainville to be young *Retepora*. ('Actinologie,' p. 407.)

LI'CHENS, or LIVERWORTS, a large and important natural order of imperfectly organised Plants, belonging to the class *Cryptogamia*. The species are numerous, and are employed in the arts as pigments, and as articles of food. It is principally in the former respect that they are of economical interest, in consequence of the great consumption of Orchall, or Archil [ARCHIL, in ARTS AND SC. DIV.], Cudbear (*Lecidea tartarea*), and others by the dyer; the estimated value of the annual imports of these plants being from 60,000*l.* to 80,000*l.* [CUDBEAR, in ARTS AND SC. DIV.]

Lichens are perennial plants, requiring free access to light and air, of the most simple organisation, forming irregular patches upon the surface of stones, trees, the earth, and other bodies. Their structure is imperfectly cellular, without any trace of vascularity. The cells of which they consist are spheroidal or cylindrical, tubular or fibrous, empty or filled with a grumous matter, in a loose and indefinite state of aggregation, but generally consolidated into two strata, the one external or cortical, the other internal or medullary. The membranous or other expansion, which in these plants consists of a combination of stem and leaf, is of the most unequal and uncertain degree of development, in some species appearing like misshapen leaves spreading over the surface on which it grows, in other cases rising up as a stem of various figures; but always more or less unsymmetrical, and in many instances constituting little more than a stain upon the face of a tree or rock; this body is a frond, or, as it is technically called, a Thallus. The fructification of Lichens consists of a round or linear, convex or concave cup, called Apothecium, or Shield, at first closed, but afterwards expanding and producing a nucleus (stratum proligerum) in which are embodied the spores. The shield is surrounded by a border (excipulus) which originates either from the substance of the thallus (thallodes) or from the base of the shield itself (proprius), or from both (thallodes and proprius).

The prevalent principles found in Lichens are a peculiar kind of starch called Lichenin [LICHENIN], a bitter secretion, and a resin combined with an unctuous colouring matter, yielding purple, yellow, and brown dyes. In consequence of their bitterness some have been employed as febrifuges, as *Variolaria faginea*, *Parmelia parietina*, and several others.

The following cut shows the various stages of development in the Lichens of this country.

Lichens in fructification, in various stages of development.

1, *Usnea barbata*, with a stem and rudimentary leaves; 2, 3, *Cladonia pyxidata*, in the same state, but with its leaves disappearing; 4, *Ramalina calicaris*, with the stem nearly lost, and the shields borne upon irregular unsymmetrical expansions; 5, *Sticta herbacea*, with the stem entirely lost, and the leaves spreading over the surface of the ground; 6, *Parmelia pallescens*, with the stems and leaves consolidated, and forming only a crust with a definite margin; 7, *Opegrapha scripta*, in which nothing is formed except the letter-like fructification.

Lichens are distributed over all parts of the world, forming in the polar and similar regions a food for animals and man. *Cladonia rangiferina* supports the Rein-Deer; *Cetraria Islandica* furnishes the nutritious Iceland Moss of the druggists' shops; and various species of *Gyrophora*, under the name of Tripe de Roche, form a part of the supply of food scantily furnished by nature for the Canadian hunter. In warmer countries they acquire a firmer consistence, and appear to form secretions of a peculiar kind in much greater abundance than in the northern parts of the world. Orchall, for example, grows in Great Britain and the Canaries, and botanists can detect no external differences between the plants of these two countries; yet in the former its dyeing matter is secreted so abundantly that Canary samples fetch from 250*l.* to 350*l.* a ton in the market, while the English are unsaleable.

The order consists of between 50 and 60 genera, with about 2400 species, which are divided by Fries into 4 sub-orders—*Hymenothalami*, *Gasterothalami*, *Idiothalami*, and *Coniothalami*: to these some systematists add *Byssaceæ*. [BYSSACEÆ.] These are again subdivided into several tribes, each tribe comprising several genera.

The tribe *Usneaceæ* is characterised by having an open disc, and being destitute of an hypothallus. It embraces the genera *Usnea*, *Everina*, *Roccella*, *Ramalina*, and *Cetraria*. Several species of *Usnea* are known by the common names of Jupiter's Beard, Tree-Beard, &c., on account of their hair-like appearance. They are amongst the most common of the Lichens which cover the trunks of aged trees, and give to them a picturesque appearance. *Usnea plicata* is a common species on old trees, park-palings, &c., and has been recommended as a remedy in hooping-cough.

The species of the genus *Everina* are common in Great Britain. One of them, *E. prunastri*, has a peculiar power of imbibing and retaining odours, and on this account is in much request as an ingredient in perfumed cushions and sweet-pots. It has been recommended as a remedy in pulmonary affections. It is frequently found on the oak and other trees. Evelyn says of it:—"This very moss of the oak that is white composes the choicest cypress-powder, which is esteemed good for the head; but impostors familiarly vend other mosses under that name, as they do the fungi for the true agaric (excellent for hæmorrhages and fluxes), to the great scandal of physic." It is said that *E. vulpina* is poisonous to wolves, hence its name, but little is known of its real properties.

The genus *Ramalina* is found associated with the last two on the trunks and branches of trees, especially of the fir, the birch, the ash, the oak, the sloe, and the hawthorn. Lightfoot says that the *R. scopulorum* "will dye a red colour, and promises in that intention to rival the famous Lichen *Roccella*, or Argol, which is brought from the Canary Islands."

For the properties and uses of the species of *Roccella* and *Cetraria* see ARCHIL, in ARTS AND SC. DIV., and CETRARIA.

The tribe *Parmeliaceæ* is characterised by a horizontal thallus. To it belong the genera *Peltigera*, *Sticta*, *Borrera*, *Parmelia*, &c.

Two of the species of *Peltigera*, *P. canina* and *P. aphthosa*, have been used in medicine: the former as a remedy in hydrophobia; the latter is boiled in milk and administered in the thrush.

The species of *Parmelia* are exceedingly numerous; one of the most common throughout Europe is the *P. parietina*, Yellow Moss. The thallus and shields are both of a yellow colour; and Lightfoot says, "It is affirmed to dye a good yellow or orange colour if mixed with alum." It has also a very bitter taste, which has caused it to be used as a tonic in medicine, and it has been recommended as a remedy in intermittent fever. *P. tartarea* (*Lecanora tartarea*) yields the dye known by the name of Cudbear. [PARELLA.] *P. Parella* (*Lecanora parella*) affords the substance known as Litmus, or Lacmus. [LITMUS, in ARTS AND SC. DIV.]

One of the species of the genus *Sticta*, *S. pulmonacea*, has been used as a substitute for the Iceland Moss. [CETRARIA.] It is used in Siberia for giving a bitter flavour to beer. It is a native of Great Britain, and is found on the trunks of trees in mountainous districts, almost entirely covering them with its large shaggy fronds.

A species of *Borrera* [BORRERA], *B. furfuracea*, is reputed to be astringent and febrifuge. It is found on the trunks and branches of old trees, especially when decaying, and on old pales.

The tribe *Lecidinæ* embraces the important genus *Cladonia* [CLADONIA], and also *Cenomyce* and *Scyphophorus*, which are often only regarded as subgenera of *Cladonia*. The *S. pyxidatus* and *S. cocciferus* are elegant lichens, having their apothecia elevated above the thallus in the form of little cups, those of the latter species being coloured scarlet. They have both been used in medicine as astringent and febrifuge.

The tribe *Sphærophoreæ* contains the genera *Sphærophoron*, *Plocaria*, and *Isidium*. They are an exceedingly elegant group of Lichens, but the species have not been much used for economical purposes. *Isidium corallinum* is said to be rich in colouring matter.

The genera *Endocarpon* and *Porina* belong to the tribe *Endocarpeæ*. The species of the former genus are found on rocks and stones, whilst those of the latter are interesting as forming distinguishing marks between various kinds of barks used in medicine. Fée, in his 'Méthode Lichénographique,' has endeavoured to apply a knowledge of the various species of Lichens to the distinguishing not only between the bark of different species of *Cinchona*, &c., but also between good and bad barks of the same species.

The principal genus of the tribe *Verrucarinæ* is *Verrucaria*, of which the species are very numerous. [VERRUCARIA.]

The tribe *Graphideæ* is remarkable for the forms which the apothecia assume, bearing a resemblance to the letters of Eastern alphabets. This may be seen in *Opegrapha scripta* in *fig.* 7. As an indication of the value of the Lichens in distinguishing the various species of Cinchona Bark, Fée states that the *Graphis interrupta* is only found on the bark of *Cinchona lancifolia*. Although the study of the Lichens on the officinal barks has not produced all the advantages anticipated by Fée, there can be no doubt of its value in many cases. Referring to this subject, Burnett observes:—"Until the publication of Fée's memoir on the Cryptogamic Epiphytes of the officinal barks, the study of the Opegraphas and their allies seemed to be one rather of speculative amusement than of practical utility. But now the case is wholly changed, since these graphic plants, these living letters, written by nature's hand, are shown to constitute inscriptions legible by men. Always curious indeed, and admirable even to the least tutored eye, did the examination of these mimic characters appear; and as fancy traced the likeness to various Oriental signs, so were these little plants called Scripture-Worts, some Hebrew (*Opegrapha Hebraica*), some Chinese (*Arthonia Sinensigraphia*), and so forth. But, like the hieroglyphics of the Egyptian fanes, their meaning was buried in obscurity, and so little guessed at, that it often was doubted whether they had any secrets to reveal. They were sources of wonder rather than wisdom, until the Young and the Champollion of the vegetable world arose, and by means of a natural Rosetta-Stone deciphered these hitherto unknown manuscripts, and taught us to peruse this part of the sacred Scriptures of creation." The tribes *Calycidæ* and *Pulveraridæ* embrace several genera, amongst which are *Lepraria*, *Coniocybe*, &c.

(Burnett, *Outlines of Botany;* Lindley, *Natural System;* Lindley, *Flora Medica;* Fries, *Lichenographia Europæa Reformata*.)

LI'CINUS (Latreille), a genus of Coleopterous Insects included in the great group *Carabus* of the older authors. The genus *Licinus* is placed by Dejean in his section *Patellimanes*, and, together with the genera *Dicælus*, *Rembus*, and *Badister*, constitutes a little section or sub-family, distinguished from other Patellimanes by the want of the tooth-like process in the emargination of the mentum.

In the genus *Rembus* (Latreille) the three basal joints of the anterior tarsi are dilated in the male sex: the terminal joints of the palpi are elongated, somewhat ovate, and truncated at the apex; the mandibles project but little, are slightly arched, and pointed; the thorax is narrower than the elytra, which are almost parallel.

But two or three species of this genus (the *Carabus politus*, and *C. impressus* of Fabricius) are known; they are found in the East Indies, and are of a black colour.

Genus *Dicælus* (Bonelli) may be distinguished by the following characters:—terminal joint of the palpi securiform; labrum emarginated and having a longitudinal impression; mandibles projecting but little, without internal denticulations, slightly arched and pointed; thorax nearly square; elytra moderately long, parallel or somewhat ovate; the three basal joints of the anterior tarsi are dilated in the male sex. The species of *Dicælus* appear to be confined to North America, and about 12 or 15 are described. They are in general of a tolerably large size, averaging perhaps about three-quarters of an inch in length, or rather less. Some of the species are of a beautiful purple or bluish tint; they are however most commonly black.

Genus *Licinus*. In this genus the head is broad, short, and rounded; the thorax is generally of a rounded form, and the body depressed and ovate; the labrum is short, and emarginated in front; the terminal joint of the palpi is securiform; the mandibles are stout, short, obtusely pointed, and dentate internally; the two basal joints of the anterior tarsi are dilated in the male sex. In Dejean's 'Catalogue des Coléoptères' there are 12 species of the present genus enumerated, nearly all of which inhabit Europe. Three species inhabit this country. (Stephens's 'Illustrations of British Entomology.')

The genus *Badister* (Clairville) is distinguished by the mandibles being short and obtuse; the three basal joints of the anterior tarsi dilated in the male sex; the terminal joint of the palpi elongated, oval, and somewhat pointed; the head rounded, and the thorax cordiform. Of this genus five species are enumerated by Dejean, all of which inhabit Europe. Their small size however renders it probable that very many more will be discovered; already as great a number as that given by Dejean has been found in this country, some of which are certainly unknown to that author. The genus *Trimorphus* of Mr. Stephens appears not to be sufficiently distinct from *Badister*.

LICUALA, a genus of Palms of the tribe *Coryphinæ* of Martius, so named by Rumphius, from the Maccassar name of the species *L. spinosa*, figured by him in 'Herb. Amboin.,' i. t. 9, and which is found in the islands of Maccassar and of Celebes. Another species, *L. peltata*, is described by Dr. Roxburgh as a native of the mountainous and woody parts near Chittagong, which separates that province from the Birman territories. Both species are small, with palmate somewhat fan-shaped leaves, but of little use. Rumphius describes the narrow leaves of his tree as being formed into pipes for smoking tobacco, while the broader are employed for wrapping up fruit, and for other domestic uses.

LIEBIGITE, a Mineral containing carbonate of uranium and lime. It is found near Adrianople in Turkey, and occurs in mammillary concretions of an apple-green colour.

LIEVRITE. [IRON.]

LIFE. [VITALITY.]

LIGAMENTS, in Anatomy, the organs by which the various articulations of the animal body are held together. [ARTICULATION.] They are generally very strong membranes, and in their structure and composition resemble tendons. [TENDON.] They are in most instances attached to two bones, and assist in the formation and strengthening of the joints. Ligaments are of various forms: some completely enclose the joint as in a case or capsule, and are then called Capsular Ligaments, as is seen in the knee, hip, and shoulder joint; others form straight bands passing from one bone to another; whilst others, again, are inserted into the heads and cavities of bones within the joints. The ligaments are principally composed of the modification of areolar tissue called Fibrous Tissue. [AREOLAR TISSUE.]

LIGIA. [ISOPODA.]

LIGNIN is the substance which remains after a plant or a portion of it has been treated with water, weak alkaline and acid solutions, with alcohol, and ether, in order to dissolve all the matters soluble in these agents.

Lignin, properly speaking, constitutes the skeleton of the trunk and branches of the tree. It varies, in different kinds, as to its colour, hardness, texture, and specific gravity; and it is probable, on account of these differences, that its composition also varies. The texture of lignin is always porous, because it contains longitudinal vessels, and it is easy to split it in the direction assumed by them. The pores of lignin, when fresh, contain the juices of different substances. During the drying of lignin the water evaporates, and leaves the matters dry which it held dissolved. It is on this account that wood contracts, in drying, in breadth, but preserves its length. It is commonly admitted that timber in general consists of ninety-six parts of lignin and four parts of the substances which were held in solution by the evaporated moisture.

When lignin has been dried, it is a non-conductor of electricity; but on account of its porous nature and the deliquescent substances which it contains, it acquires moisture when exposed to the air, and then becomes a conductor: this absorption may be prevented by varnish. It is well known that wood swims in water: but when deprived of air it becomes heavier and sinks in it; its specific gravity then varying from 1·46, which is the specific gravity of fir, to that of 1·53, the specific gravity of oak and beech. Wood is gradually decomposed when exposed to the simultaneous influence of light, air, and water; but under water it may be preserved for an almost indefinite period, as is proved by the trunks of trees which have been found in a perfect state buried in the bottom of peat-mosses, and which must have been there from a period anterior to history: also when it is kept perfectly dry it is not subject to decay. The wood inclosing Egyptian mummies is found in good preservation, although some of it must be about 3000 years old.

When wood or lignin is treated with chlorine, it becomes white, but does not dissolve. Concentrated sulphuric acid in the cold converts it into gum; and if the mass thus obtained be boiled with water, it is changed into grape sugar. When treated with sulphuric acid, it is decomposed, becomes black owing to the separation of charcoal, while sulphurous and carbonic acid gases are evolved. When treated with strong nitric acid, oxalic acid is obtained; when boiled in concentrated hydrochloric acid, it becomes first reddish, then brown, and afterwards black, without being soluble either in the acid or in water.

The caustic alkalis dissolved in a large quantity of water act but feebly on wood; but if sawdust be treated with an equal weight of hydrate of potash dissolved in a little water, it swells, yields water with an empyreumatic smell, and a homogeneous liquid is formed; when this has cooled, it is of a blackish brown colour, and contains oxalic and acetic acids, with a substance resembling soot treated with an alkali. When wood is heated in iron cylinders with the necessary arrangements for the condensation of the volatile products, a great variety of important substances are obtained, besides charcoal: in this way are procured acetic acid, commonly called, till purified, pyroligneous acid, pyroxilic spirit, creasote, and tarry matter.

Some botanical and chemical writers distinguish from this substance cellulose, but as they both form the investing walls of the cells of plants it is probable they are modifications of the same chemical compound.

Cellulose may be procured from all the parts of plants without exception, by dissolving (by certain re-agents) the other substances associated with it. Pure cellulose is easily obtained from the pith of the elder-tree, or from very young roots. The substances most commonly associated with it are, starch, gum, fats, resins, vegetable alkalies, salts, sugar, and the peculiar woody matter termed by Payen matière incrustante, or lignin of the other writers. After the removal of these substances by extraction with alcohol, ether, dilute potash, hydrochloric acid, and water, the cellulose, which was previously solid and dense, assumes a spongy appearance. As a proof of its constant composition, it is worthy of mention that the following substances, previously purified in this matter, gave similar results, namely, the ovula of almonds, of apples, of the *Helianthus annuus*, the sap of cucumbers, the tissue of the cucumber, the pith of the elder-tree, the pith of the *Æschynomene paludosa*, cotton-wood, the leaves of endive and of *Aylanthus glandulosa*, the tracheæ of the *Musa sapientum*, films from the pith of oak-trees, cellulose from cow-dung (the cow fed with meadow-grass), the internal tissue of the leaves of *Agave Americana*, the skeleton of a wasp's nest, the perisperm of the *Phytelephas*, extracted lichen, membranes of the *Chara*, &c. From these and various other substances, the purified cellulose always gave a result approximating to the formula $C_{24} H_{21} O_{21}$. It is thus apparent that the proper tissue of all plants leaves a substance which is identical for all of them,—a substance which contains carbon and the elements of water, which is isomeric with inulin, and therefore easily convertible into starch and sugar; and that in its turn it may easily be produced from dextrine [DEXTRINE; STARCH], the change consisting only in the loss or gain of the elements of water. It has been shown by Von Baumhauer that sulphuric acid or diastase will convert cellulose into dextrine. It is also by the same process converted into starch. Hence it is concluded that the cellular substance is closely allied to starch, dextrine, gum, and sugar, causing their production in the vegetable kingdom, and no doubt being itself produced from one of them, namely, from dextrine. It is therefore of great importance to the animal body. It explains the nourishing power of those plants in which the incrustation of the cellulose is prevented by artificial means, as of greens, endive, sea-kale, &c. The cellulose of these plants, being easily converted into dextrine, may fairly be reckoued amongst the substances which are most serviceable in maintaining the vital functions of animals.

Further, as cellulose exists ready formed in the youngest parts of plants, it belongs, together with protein, to the first vegetable products of the food of plants; and, further, it follows that from cellulose, or from vegetable substances similarly formed, especially from one soluble in water, namely, dextrine, starch, gum, and sugar are occasionally formed. In many parts of plants we find starch, especially in the Lichens, which consist for the most part of cellulose. In many fruits containing a large proportion of cellulose, there is much sugar. These different substances may be produced from the same cellulose, simply by a change in its physical character and a new chemical arrangement of its constituents. On the other hand we observe that fleshy fruits, from being sugary, become mealy when kept through the winter; this being a converse change of sugar into cellulose. Hence, as Mulder remarks, "we may consider the cellular plants as consisting chiefly of cellulose and of protein-compounds; the vascular plants containing in addition the incrusting or real woody matter. These together are the most indispensable constituents of plants; they are found everywhere and in all their organs. Cellulose is to plants what gelatin is to animals; they form together the cells in these two kingdoms. In the cells both of plants and animals protein-compounds are either deposited in solid particles or are dissolved in the liquids with which their organs are permeated. In plants the cell-walls are thickened by the woody matter; in animals the cells contain fat and other substances; in animals, as well as in plants, the cellular substance is the chief agent in connecting all the other existing organs."

Mohl and Schleiden have shown that the cellular membrane of many parts of plants is coloured blue by iodine, just as if it contained starch. This apparent identity of reaction would lead us to infer that cellulose can often be modified as it were into starch, though still retaining the appearance of cellular membrane. The similarity of the chemical constitution of these two substances renders their conversion apparently easy. For 1 eqiv. cellulose ($C_{24} H_{21} O_{21}$) = 2 eqiv. starch ($C_{24} H_{20} O_{20}$) + 1 eqiv. water (H O). Hence, by a separation of water and a re-arrangement of the molecules, cellulose may be converted into starch; and conversely, by the absorption of water, starch may be converted into cellulose. Cellulose is the basis of the substance called Gun Cotton, which again on being dissolved in ether forms Collodion.

(Mulder, *Chemistry of Animal and Vegetable Physiology*; Gregory, *Organic Chemistry*.)

LIGNITE. Fossil wood carbonised to a certain degree, but retaining distinctly its woody texture, is thus designated. A greater degree of change constitutes Cannel and Common Coal, in which the original structure of the constituent plants can only with difficulty be traced; a less change belongs to Peat.

Dr. M'Culloch observes:—"In its chemical properties Lignite holds a station intermediate between peat and coal; while among the varieties a gradation in this respect may be traced; the brown and more organised kinds approaching very near to peat, while the more compact kinds, such as jet, approximate to coal." ('On Rocks,' p. 636.)

His synopsis of Lignite runs thus:—

A. Jet. Hard, compact, with pitchy lustre.

B. Surturbrand. Less compact and more brittle than jet.

C. Moor Coal of some authors. Friable.

D. Bovey Coal. Fibrous, the vegetable texture very apparent, colour brown or brownish-black.

E. Cologne earth, earthy and pulverulent mass. The thickness said to be 50 feet.

F. Basaltic Coal. Of variable structure; some parts like wood, others like coal.

Lignite often occurs in beds of considerable thickness and extent, and supplies to particular districts a bad substitute for coal. It is often accompanied by iron pyrites (Alum Bay), lies in alternating series with arenaceous and argillaceous beds, and is sometimes covered by fresh-water limestone (Käpfnach), and presents many analogies with coal; but in general Lignite is most plentiful in the tertiary strata, and Coal among the older rocks of the secondary series.

In the Isle of Wight (Alum Bay) Lignite beds (the wood coniferous) occur amidst the sands and clays of the lower part of the (Eocene) tertiary strata; in a depression of the surface near Bovey Tracey, Devon, a more considerable deposit of like nature occurs under several alternating beds of clay and gravel of considerable thickness. (De la Beche, 'Geol. Manual.') These deposits deserve attentive comparison with the peat moors of high and low situations in England, with and without buried forests, with the Lignite Coal of the Sussex Wealden, the Coal of the Yorkshire Oolites derived from *Equiseta*, and the Coal of the older rocks in which coniferous wood appears an abundant ingredient.

According to Brongniart ('Tableau des Terrains'), at least three deposits of Lignite of different geological ages may be distinguished in the series of tertiary strata, namely, the Lignite of Switzerland, of Mont Rouge, and of Aisne (all of Eocene date, according to Lyell's classification). Among the secondary strata one deposit is noticed by Brongniart, namely, in the Isle of Aix, belonging to the Lower Greensand, and occurrences of less importance in the Wealden of Sussex, the Kimmeridge Clay, Lias, and Grès Bigarré. Hardly any of the clays of the Cretaceous or Oolitic formations are deficient of jet, which sometimes forms considerable floors (as near Whitby), but generally lies in small portions.

The plants occurring in all these deposits are terrestrial; in the Swiss and French Lignites there are remains of palms; in the Meissner there are coniferous woods. *Mammalia* occur, especially in the Swiss Lignites, at Käpfnach, near Zürich, where *Mastodon angustidens*, *M. Turicense*, Beaver, *Rhinoceros tichorhinus*, and other remains are mentioned by different writers. One of the most characteristic genera of the animals found in Lignite (Tuscany, Styria) is the *Anthracotherium*.

LIGULATE FLOWERS are such as have a monopetalous corolla slit on one side, and opened flat, as in the Dandelion Lilac.

LIGURITE, a Mineral. Its primary form is an oblique rhombic prism. Colour apple-green. Streak grayish-white. Fracture uneven. Hardness above 5·0. Lustre of the surface of fracture between vitreous and resinous. Transparent and translucent. Specific gravity 3·49. It is found on the banks of the Stura, in the Apennines of Liguria. Its analysis, by Viviani, gives—

Silica	57·45
Alumina	7·36
Lime	25·30
Magnesia	2·56
Oxide of Iron	3·00
Oxide of Manganese	0·50
	96·17

LIGUSTRUM, a genus of Plants belonging to the natural order *Jasminaceæ*. It has a fleshy fruit, the berry containing two membranous 1-seeded nuts. The calyx is short, tubular, and 4-toothed; the limb of the corolla 4-parted, and spreading; stamens two, with short filaments. The species are shrubs or low trees, natives of Europe and Asia.

L. vulgare, Common Privet, has elliptic lanceolate glabrous leaves; compound racemes; sweet-scented flowers, white at first, but soon changing to a reddish-brown. The berries are dark purple, almost black. It is a bushy sub-evergreen shrub, growing in hedges and thickets in Great Britain, and native of the south-west of England. This plant was formerly called Prim, or Primwort, from its being used for verdant sculptures, or topiary-work, and for primly cut hedges. The common English name Privet seems to have been given to it from its being frequently planted to conceal private places. In German, Dutch, Danish, and Swedish it is called Ligster; in French, Troêue; in Italian, Ligustro; in Spanish, Alhena; and in Portuguese, Affena. It is probably the Σπίραια of Theophrastus, 'Hist. Plant.' i. 14. In point of utility and ornament few shrubs exceed the privet. Its chief use is to form hedges either for shelter or ornament. It bears cutting well, and is not liable to be disfigured by insects; having fibrous roots, it robs the ground less than almost any other shrub. It is one of the few plants that will grow in the smoke of London; it also thrives under the dripping of other trees. The wood is hard and fit for timber. From the pulp of the berries a rose-coloured pigment may be prepared; with the addition of alum they dye wool and silk of a good durable green. The following varieties are those found chiefly in our gardens:—

L. v. leucocarpum, the White-Berried Privet.
L. v. xanthocarpum, the Yellow-Berried Privet.
L. v. chlorocarpum, the Green-Berried Privet.
L. v. sempervirens, the Italian or Evergreen Privet.
L. v. variegatum, the Variegated-Leaved Privet.
L. v. angustifolium, the Narrow-Leaved Privet.

L. Sinense has lanceolate tomentose leaves, white flowers, and very small brown berries. It is a native of China, near Canton.

L. Japonicum is a native of Japan, with oblong ovate grooved leaves, and white flowers growing to the height of 6 or 8 feet.

L. spicatum has elliptic acute leaves, hairy beneath, as well as the branchlets. Flowers crowded, almost sessile, spicate, disposed in a thyrse, having the axis very hairy, and minute bracteas. It is an evergreen shrub, native of Nepaul, on mountains, growing from 6 to 8 feet in height.

All the species of Privet are of easy culture, and will grow in any kind of soil. Cuttings root without difficulty. *L. lucidum* requires some protection in the winter.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Fraas, *Synopsis Floræ Classicæ*; Loudon, *Encyc. of Trees and Shrubs.*)

LI'GUUS, De Montfort, a genus of terrestrial Testaceous *Mollusca* belonging to the family *Helicidæ*. Dr. J. E. Gray ('Zool. Proc.,' 1834) describes a species from Africa (*L. tenuis*), and observes that in shape it is most like to the young of *Helix flammigera* of Férussac, but differs in colour, in tenuity, and in the shape of the front of the pillar-lip.

LILAC. [SYRINGA.]

LILIA'CEÆ, *Lilyworts*, an important natural order of Endogenous Plants, containing many of the most beautiful of that class of the vegetable kingdom. A large proportion, especially of those of cold countries, consists of bulbous plants, producing annually a stem which perishes after having produced its leaves and flowers; others have an annual duration with perennial fleshy roots; and a few acquire, in warm countries, a stem of very considerable size, as the Dragon-Tree (*Dracæna Draco*), of which there is an ancient specimen in Teneriffe with a stem many feet in diameter.

The flowers of Liliaceous Plants are generally large and showy, especially in those with annual stems, as the Lily itself, the Fritillary, Hyacinth, Star of Bethlehem, &c.; but when they acquire an arborescent stem the size of the flowers contracts, so that the largest trees among them have the smallest flowers. Their leaves are always quite simple and undivided, and usually have the veins of the leaves running straight from the base to the apex; but in some Dracænas they diverge from the midrib to the margin, as in the Plantain. Among other Endogens they are readily known by having a flower of 6 coloured pieces, 6 stamens with the anthers opening inwards, and a superior 3-celled ovary changing to a 3-celled fruit.

Tulipa sylvestris.

1, a magnified view of the stamens and pistil; 2, the pistil; 3, a transverse section of a ripe fruit, showing the cells and seeds.

This order is divided into several sections, of which Dr. Lindley gives the following account in his 'Vegetable Kingdom:'—

Tulipeæ are the *Lilia* of Jussieu, and they may be justly regarded as the type of the order of Lilies. Bulbs: annual stems little or not at all branched; flowers usually large and gaily coloured, without membranous spathes, but axillary to leaves but little changed, the calyx and corolla and their parts scarcely united, although often arranged in a tube; anthers swinging lightly by the fine-drawn point of a stiff filament; and finally a dry seed-vessel—separate the group from all that follow. They are amongst the gayest of our garden flowers, as Tulips, Fritillaries, and Dog's-Tooth Violets testify. One of them, the *Lilium chalcidonicum*, a plant that covers the plains of Syria with its scarlet flowers, is most memorable from having been selected by our Saviour as the subject of allusion in his Sermon on the Mount.

The *Hemerocalleæ*, or Day-Lilies, differ from the last in nothing except their calyx and corolla being so joined to each other as to form a tube of conspicuous length, and in their want of a bulb in many instances. The *Agapanthus* and the fragrant Tuberose are the more remarkable among them; but *Funkia*, *Hemerocallis*, *Blandfordia*, and the Veltheimias and Tritomas, are also species of familiar occurrence. *Phormium*, which yields the celebrated flax of New Zealand, with its hard perennial leaves and panicles of yellow flowers, must be considered to connect the present division with that of Aloes. There is so little to separate *Aloineæ*, or Aloes, from the Day-Lilies, that scarcely anything can be named except their succulent foliage, and even that disappears in *Yucca*, which has the hard leaves of *Phormium*, with which however its distinct sepals and petals forbid its being associated.

With the *Scilleæ*, or Squills, we reach a division of the order abounding in beautiful species, all of which are bulbous, with annual stems. Their peculiarity consists in the anthers not being so lightly attached to the filaments as in *Tulipeæ*, and in the leaves from whose axils the flowers proceed acquiring a membranous condition.

Conanthereæ are Squills with the ovary partially adhering to the calyx and corolla, and springing from tubers, not bulbs. They offer a direct transition to Amaryllids.

Anthericeæ, or Asphodels, agree with the last in having tubers or fleshy fascicled roots, and not bulbs, but their ovary is free; they are therefore tuberous fibrous-rooted Squills. *Chrysobactron*, a genus gathered by Dr. Joseph Hooker in Auckland and Campbell's Islands, is described as diœcious, but apparently is polygamous. The fruit in these three last orders is a capsule.

Aphyllantheæ are plants with the habit of Rushes, and the bracts so membranous and closely imbricated as to give the appearance of Xyrids when the flowers are past. They seem to form a connection between Lilies and some plants of the Juncal or Xyridal Alliances. The genera have been very insufficiently examined. Xanthorrhæas, called Grass-Trees in Australia, are very different in habit from the remainder: their shrubby stems, which emulate small palm-trees in appearance, bear tufts of long wiry foliage at their extremities, from the midst of which rise very long cylindrical spikes of densely-compacted flowers, resembling Bullrushes. [TYPHA.]

Asparageæ are Lilies with a succulent fruit. They consist of plants extremely dissimilar in appearance, the Common Asparagus and the Lily of the Valley being associated under this title. In general their leaves are broad; in the genus *Cordyline* they even acquire the expanded form and diverging veins of the Amomal Alliance: their stems, although among the dwarfest that the Lilies comprehend, are in the Common Asparagus branched and of considerable size, and in the Dragon-Trees they acquire the dimensions and age of large trees. A tendency to the separation of sexes occurs here on the part of the genus *Ruscus*, but it is not carried so far as to constitute a diclinous structure.

With respect to *Aspidistreæ*, concerning whose structure we have very insufficient information, they are principally known by a large mushroom-shaped stigma. Their foliage is that of *Zingiberaceæ*. Their flowers are dingy purple or green, with a campanulate perianth, on whose sides the stamens are inserted. In many respects they are very like *Orontiaceæ*, to which perhaps they ought to be referred.

In like manner the *Ophiopogoneæ*, or Teat-Worts, have a foliage hardly belonging to Lilies, *Peliosanthes Teta* resembling a Ginger more than a plant of this order. They are remarkable for their seeds bursting through the sides of the ovary at a very early period, growing freely though exposed to air, and finally acquiring the succulent appearance of a tuber. It is very uncertian whether they have any claims to the rank of Lilies.

The geographical limits of this order are as wide as its differences of structure. Upon the whole however the species are much more abundant in temperate climates than in the tropics, where they chiefly exist in an arborescent state. Aloes are mostly found in the southern parts of Africa; one species is a native of the West Indies, and two or three more of Arabia and the East. Dracænas, the most gigantic of the order, attain their largest size in the Canaries; a *D. Draco* there is described as being between 70 and 75 feet high, 46½ feet in circumference at the base, and was known to have been a very ancient tree in the year 1804. The northern flora comprehends for the most part plants of the genera *Scilla*, *Hyacinthus*, *Allium*, and *Ornithogalum*. In the East Indies Lilyworts are rare; in Australia they form a distinctly-marked feature of the vegetation; and in New Zealand they are represented by the *Phormium*, or Flax-Bush. A very considerable number are employed for useful purposes. Among them are those whose fibre is strong enough to furnish cordage, such as *P. tenax*, New Zealand Flax. The Onion, Garlic, and Leek, long known as articles of diet, Chives, Shalots, and Rocambole, are species of the genus *Allium*. [ALLIUM.] Aloes and Squills indicate the value of some *Liliaceæ* in medicine. As purgatives the Aloes are in extensive use. Resinous matters are yielded by some species, whence they have been useful in dysenteries. Of these the most celebrated is Dragon's Blood, a tonic astringent resin. The roots of *Asparagus racemosus* and *A. adscendens* are both employed medicinally in Northern India. *Polianthes tuberosa*, or the Tuberose, is well known for its delicious fragrance. Other species are found to contain special properties, which render them serviceable to man in various ways.

There are 133 genera in this order, and 1200 species.

(Lindley, *Vegetable Kingdom.*)

LILIALES. [ENDOGENS.]

LI'LIUM (the Latin *Lilium* and Greek Λείριον), a genus of Plants the type of the natural order *Liliaceæ*. It has a perianth of 6 leaves spreading or reflexed, with a longitudinal nectariferous furrow at the base of each; an undivided style, capitate stigma, and flat seeds. The colour of the flowers is either white, yellow, or red.

L. candidum, Common White Lily, has lanceolate scattered leaves attenuated at the base; a bell-shaped smooth corolla; the petals of a beautiful shining white on their inside, ridged and not quite so transparent or luminous on their outside. The flowers are large, white, and in a cluster at the top of the stem. It blossoms early in the summer, and has been cultivated in our gardens from time immemorial. Great doubts had existed respecting the native habitat of this species, till Mr. Hawkins, the friend and companion of Dr. Sibthorp, found it growing wild in that classical and celebrated spot the Vale of Tempe. It is the κρίνον of Theocritus ('Id.' 23) and of Dioscorides (3, 106). Both Pliny and Ovid have added their testimony to the general admiration in which this plant has been universally held. The flowers have a pleasant sweet smell, and were formerly used for medicinal purposes, particularly as an anti-epileptic and anodyne. A water distilled from them had reputation as a cosmetic, but the odorous matter they contain is so exceedingly volatile that it is impossible to preserve it, as it is wholly carried off by evaporation. The roots only are found available in medicine, and they are frequently employed as emollient poultices, owing to the mucilaginous matter which they contain. It is however doubtful whether they are more efficacious than poultices formed of bread or farina. Gerard prescribes the lily-root internally in dropsies, and for this purpose bread was made of barley-meal with the juice of the roots instead of water, and eaten for a considerable length of time. This species, as well as others, is cultivated in Siberia, and eaten as the potato. The scent of the Lily is exceedingly powerful, and peculiarly distressing in some cases. Murray mentions an instance of death ensuing from exposure to the odour of this plant.

L. bulbiferum, Bulb-Bearing or Orange Lily, has linear-lanceolate scattered leaves; a bell-shaped erect corolla, glandular and rough on the inside, downy without. The flowers are large and handsome, of a beautiful red or orange colour, pale on the outside, and without any scent. The bulb is composed of numerous thick white loosely-imbricated scales. This species, and *L. chalcedonicum*, is probably the κρίνον of Theophrastus ('Hist. Plant.,' 6, 6), and undoubtedly the ἡμεροκαλλὶς of Dioscorides (3, 127). It is a native of Italy, Austria, and North America.

L. superbum, Superb Martagon Lily, has a revolute corolla, the lower leaves whorled, the rest scattered. The flowers form a branched reflexed pyramid, and are large and handsome, one at the end of each branch, red or yellow with dark spots; their smell is disagreeable. The bulb is as white as ivory. It is a native of North America, whence it was imported by Mr. Peter Collinson in the year 1738.

L. Martagon, Turk's-Cap Lily, has whorled elliptic lanceolate leaves, a pubescent scabrous stem, nodding flowers, and a reflexed perianth. Though not a native of Great Britain it is naturalised in copses in many places.

The species enumerated are those most commonly cultivated in our gardens, each of which has many varieties and sub-varieties. They are capable of being propagated by planting the offsets of the roots and by sowing seeds to obtain new varieties. Every year the roots produce many offsets, which however, unless greatly wanted, are better left on for two or three years. The proper time for separating them is in summer and autumn, when the winter is past and the stalks decayed, either by taking them from the mother-bulbs in the ground, or removing the whole and dividing the offsets from the main bulb when uncovered; they should then be planted in beds a foot asunder and three inches deep, to remain a year or two; the large roots set again in the borders singly. The sowing of seed is chiefly practised to obtain new varieties of Martagons; it should be done in the autumn, soon after the seed is ripe, in pots or boxes of rich light sandy earth, with holes in the bottoms half an inch deep. The pots or boxes should be placed in a sheltered position during the winter, and refreshed often at first with water. The plants will appear in the spring; in August they should be transplanted into nursery-beds in flat drills an inch deep and three or four inches asunder. After having grown in this situation till the August or September following they should be again transplanted into another bed, and at greater distances; after which they may be finally removed into the pleasure-ground. The bulbs should be planted singly, as they soon increase by offsets into large bunches. All the species and varieties of *Lilium* are valuable as plants of ornament for the beauty of their flowers, which have a noble appearance. They are proper for the pleasure-ground, and if planted with judgment succeed each other in blooming upwards of three months. The Common White Lily, the Orange-Lily, and Martagon will thrive under trees. The Orange-Lily also answers well for small gardens and confined situations in towns and cities.

(Babington, *Manual of British Botany;* Fraas, *Synopsis Plantarum Floræ Classicæ;* Rees, *Encyclopædia.*)

LILY. [LILIUM.]

LILY-BEETLE. The *Crioceris merdigera*, a species of *Coleoptera*, is thus named. [CRIOCERIDÆ.]

LILY-ENCRINITE. [ENCRINITES.]

LIMA. [PECTINIBRANCHIATA.]

LIMACELLA. [LIMAX.]

LIMACIDÆ. [LIMAX.]

LIMACINA. [HYALÆIDÆ.]

LIMACI'NEA, M. De Blainville's name for his third family of *Pulmobranchiata*, the first order of his second sub-class, *Paracephalophora Monoica*. M. de Blainville thus defines the family, which comprises the genus *Helix* of Linnæus:—

Animal very variable in form; the head provided with two pair of tentacula completely retractile into the interior, the posterior pair longest, carrying the eyes on their extremities; one tooth in the upper lip; the lingual mass small, and covered with a skin beset with microscopic teeth.

Shell of a form as variable as the body of the animal, rarely sub-ampullaceous, often normal, oval, or globular, sometimes turriculated, pupaceous, or discoid, almost constantly without an epidermis, rarely hairy (velue), with the summit always blunt; the aperture round, semilunar, oval or angular, but never notched.

M. De Blainville adds, as an observation, that all the animals of this family are terrestrial; and that, with the exception of *Testacella*, all feed on vegetable substances.

The following are the genera comprehended under the *Limacinea* in the 'Malacologie' of the author above quoted:—

Succinea, comprehending also *Amphibulimus* of Lamarck.

Bulimus, comprehending also *Bulimulus* of Leach.

Achatina, comprehending also the genera *Liguus* of Denys de Montfort, and *Polyphemus* of the same author.

Clausilia.

Pupa, comprehending also the genera *Chondrus* of Cuvier, *Gibbus* of Denys de Montfort, *Vertigo* of Müller, and *Partula* of De Férussac.

Tomogeres of De Montfort (*Anostoma* of Lamarck).

Helix, comprehending the genera *Carocolla*, Lamarck; *Iberus*, De Montfort; *Caracolus*, De Montfort; *Acavus*, De Montfort; *Helicella*, Lamarck; and *Zonites*, De Montfort.

Helicolimax (Vitrine), including the genus *Helicarion* of De Férussac; *Testacella, Parmacella, Limacella.*

Limax, including the genera *Arion*, De Férussac; Philomique of Rafinesque; and Eumèle of the last-named author.

Onchidium, including *Veronicella*, Blainville. [HELICIDÆ; LIMAX.]

LIMAX, the Latin name for those air-breathing naked Gastropodous Molluscs, so injurious to the agriculturist and horticulturist, vernacularly known by the name of Slugs.

Linnæus employed the term *Limax* as a generic appellation for the Naked Slugs, placing the genus at the head of his (*Vermes*) *Mollusca*, and comprehending under it eight species, all terrestrial excepting the last, namely, *L. papillosus*, to which he assigns the European Ocean as a locality, adding that the animal is submarine, and should probably be rather referred to the genus *Doris.*

The following is the definition given by Linnæus:—

Body oblong, repent, with a fleshy shield above and a longitudinal flat disc below. A dextral lateral foramen for the genitals and excrements. Four tentacles above the mouth. ('Systema Naturæ,' ed. 12, 1767.)

In addition to this employment of the term, Linnæus used the word *Limax* to designate the soft parts of most of the genera of his (*Vermes*) *Testacea*, indeed of all that progress upon a flattened disc or foot, marine as well as terrestrial; for the very imperfect information of the time when he wrote did not enable him to make those distinctions which modern zoologists have pointed out, aided by more copious materials, and by the labours of accurate zootomists and observers bestowed upon those materials. Thus we find in the 'Systema Naturæ:'—"*Conus.* Animal Limax."—"*Cypræa.* Animal Limax."—"*Bulla.* Animal Limax."—"*Voluta.* Animal Limax." In short, the animal of each genus of his 'Univalvia spirâ regulari,' with the exception of *Argonauta* and *Nautilus*, is stated to be a *Limax;* and the same animal is also assigned to *Patella*, which stands at the head of his 'Univalvia absque spirâ regulari.'

Cuvier, in the first edition of his 'Règne Animal' (1817), places the 'Limaces' (*Limax*, Linn.) at the head of his Pulmonés Terrestres, nearly all of which he describes as having four tentacles; two or three only of very small size not having exhibited the lower pair—"n'ont pas laissé voir le paire inférieure." Those among them, he adds, which have no apparent shell formed, according to Linnæus, the genus *Limax*, which Cuvier subdivides into the groups of the Limaces, or Slugs properly so called (*Limax*, Linn.); the Testacelles (*Testacella*, Lam.); and the Parmacelles (*Parmacella*, Cuv.). In the last edition of the 'Règne Animal' (1830), he adds under *Limax* the subdivisions distinguished by De Férussac, namely, *Arion* and *Vaginulus*.

In both editions he describes the 'Limaces proprement dits' as having an elongated body, and for a mantle a fleshy compact disc, which occupies the anterior part of the body alone, and covers the pulmonary cavity only. This disc contains, he adds, in many species, a small oblong and flat shell, or at least a calcareous secretion in lieu of it. The orifice of respiration is on the right side, towards the front, and the anus is pierced at its posterior border. The four tentacles are put forth and withdrawn by unrolling themselves (en se déroulant) like the fingers of gloves, and the head itself can be withdrawn in part under the disc of the mantle. The organs of generation open under the right upper tentacle. There is but one jaw (upper), in the form of a dentilated crescent, which serves them to gnaw with much voracity the herbs and fruits to which they do so much damage. Their stomach is elongated, simple, and membranous.

Lamarck ('Histoire Naturelle des Animaux sans Vertèbres,' tom. vi. part. ii. 1822) thus defines his Limaciens:—Branchiæ creeping (rampantes), under the form of a vascular net upon the wall (paroi) of a particular cavity, the aperture of which is a hole which the animal contracts or dilates at its pleasure. They respire the free air only.

The same zoologist remarks that the Limacians constitute a natural family and a very remarkable one, inasmuch as the animals which compose it are the only ones among the Gastropods whose respiratory organ, which is truly branchial, breathes nothing but free air, and he thence names them Pneumobranchea. These mollusca, he continues, are naked or nearly naked. Their body is elongated, creeping upon a ventral disc which is not separated from it, and bordered on the sides by a mantle which is most frequently very narrow. Originally from the waters (originaires des eaux), they live habitually in their neighbourhood; but some inhabit, nevertheless, places which are at a distance from the water, but nearly always in cool and humid localities. They have accustomed themselves (ils se sont accoutumés) to breathe air with their branchiæ; so that this habit has become a necessity to them. Here it is, for the first time, as regards the mollusca, that the free air is the fluid breathed. This fluid penetrates by a hole, and without either trachea or bronchiæ into a particular cavity which is not divided into many partitions (loges) or cellules, but on the walls of which little lace-like vessels or a vascular network (des cordonnets ou des lacis de vaisseaux) creep in divers forms and receive the influence of the respiration. A similar or analogous cavity is found in a great number of the Trachelipods; but in those which respire air only, the influence of this fluid, being very superior to that of water, requires in the organ presented to it only a very small surface. Thus the vascular lace-like work (cordonnets vasculaires) which creeps over the walls of the cavity, and which in that respect resembles the same parts in the Limacians, projects very little; whilst in those which respire water only the cavity offers very projecting and vascular parts (such as pectinated laminæ of different sizes) to the influence of the fluid respired. The branchial cavities of which we are speaking, even that which is adapted for breathing air only, cannot be reasonably confounded with a lung, which is a respiratory organ of a particular fashion, adapted to organisations of a superior order, an organ which is essentially cellular, and into which the fluid respired is introduced at least by an internal trachea, and often by bronchiæ besides. This modification, then, of the respiratory organ has peculiar characters which branchiæ or gills, whatever be their form and situation, never offer. If, in order to determine the name or the kind (espèce) of a respiratory organ, that organ is considered only with reference to the fluid respired, then all animals which respire free air may be said to possess a lung; but if, in order to facilitate the study of the different modifications of organs which serve for respiration, and in order to seize the means which nature has employed to effect the progressive composition of the animal organisation as well as its perfection, one considers the characters proper to each sort of respiratory organ, it will then be evident that no mollusc nor any other invertebrate animal respires by means of a lung, although many among them respire the free air. Besides, independently of the particular and well-known structure of every lung, the air never penetrates except by the mouth of the animal, whilst in every respiratory organ distinct from a lung the fluid respired, whatever it be, is always introduced by another passage. To confound objects so different, each of which is appropriated to the degree of organisation to which it belongs, and can only exist in an organisation of that degree, is, in our opinion, to render the knowledge of the order of nature in her productions impossible. In fact, in the course of the animal kingdom, such a function could not be executed except by an organ or system of organs differently modified, because it must be in relation with the state of organisation of which it forms a part.

To return, continues Lamarck, to the particular object before us, I will say that branchiæ, although they present themselves under a multitude of forms and different situations, never resemble, notwithstanding, a lung. This respiratory organ, then, is peculiar; and we know that it has the power of habituating itself to respire air. In fact many Crustaceans which live nearly constantly on land respire there this last fluid only with their branchiæ. If the Colimacés, as well as the Limneans, have a branchial cavity similar to that of the Limacians, and breathe the free air only, this cavity is also the same as that of the Melanians and other Trachelipods which breathe water only. But in the first the respiratory organ presents a small surface only to the fluid respired; whilst in the second the organ in question offers a much larger extent of surface. In each case these organs are always branchial, but adapted to the power of the influence of the fluid respired, and situated in analogous cavities.

Thus far Lamarck, who concludes by comprehending under his Limacians the following five genera:—*Onchidium*, *Parmacella*, *Limax*, *Testacella*, and *Vitrina*.

The second section of the Limacineans of M. De Blainville, or those which have the anterior border of the mantle enlarged into a species of buckler, the shell being null or nearly membranous, consist of the genera *Vitrina*, or *Helicolimax*, *Testacella*, *Parmacella*, *Limacella*, *Limax*, and *Onchidium* [LIMACINEA]. With regard to the marine species, which Cuvier has approximated to these, M. De Blainville observes that they constitute his genus *Peronia* in his order of Cyclobranchians. [NUDIBRANCHIATA.]

M. Rang arranges the Limaces of Férussac (Limaciens of Lamarck, Limacinés of De Blainville, Nudilimaces of Latreille) as the first family of the Pulmonés Inoperculés of De Férussac (Pulmobranches of De Blainville), and makes it consist of the genera *Onchis*, Fér.; Onchidie, Cuv.; *Peronia*, De Blanv.; *Onchidium*, Buchanan; *Veronicella*, De Blanv.; *Vaginulus*, De Fér.; having a general cuirass.

The genera *Limacella*, Blainv.; *Limax*, Lam. (including *Arion*, Fér.); *Parmacella*, Cuv.; which have a partial cuirass: and

The genus *Testacella* (including the Plectrophoro) of Férussac, which is without any cuirass.

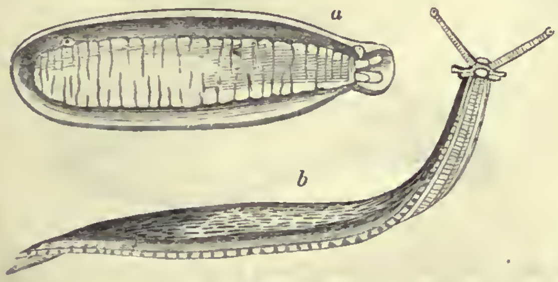
M. Deshayes makes the following remarks on Lamarck's classification of this group of *Mollusca*:—"We have already censured in the method of Lamarck the separation of the Gastropods and the Trachelipods—a separation artificial and useless, especially as regards the grand series of molluscs, where this division is the less tolerable, because there it is that the passage of the Gastropods, properly so called, and of the Trachelipods is effected in the most imperceptible manner and by means of a curious series of modifications. Cuvier, who, in his memoir on the *Limaces* and *Helices*, has justly advanced the proposition that there scarcely exist any zoological characters proper for the distinction of these two genera, could not coincide in the opinion of Lamarck, and in this he was wisely imitated by the greatest number of zoologists. M. de Férussac collected into two orders all the air-breathing molluscs, according as they were or were not provided with an operculum. Those which are operculated are few, and consist of two genera only, which we find among the Trachelipods of Lamarck. Those which are not operculated comprise a considerable number of genera grouped in families. The first is that of the Limaces, corresponding exactly enough with the family of Limacians of Lamarck. It comprehends however twelve genera, whilst that of Lamarck only contains five; but when we come to examine attentively these different genera admitted by M. de Férussac, we soon perceive that many are too uncertain to be definitely adopted. M. De Blainville himself has rejected many of the genera of this family which he had at first adopted; and in his 'Treatise on Malacology' he has reduced them to five. M. Cuvier, in the last edition of the 'Règne Animal,' has not adopted more than the genus *Vaginulus*, to which M. De Blainville has given the name of *Peronia*, which occasions a sad confusion in nomenclature. It will suffice then to add the genus *Vaginulus* to the family of *Limacians* of Lamarck, to render it as complete as the most positive observations require."

Dr. J. E. Gray is of opinion that at present only a few genera, as *Arion* and *Helicarion*, Fér., *Nanina*, Gray, and *Stenopus*, Guilding, can be referred with certainty to the *Arionidæ*, though he thinks it very probable that, when the animals of other shells are known, many of them may be found to belong to that family. In this state of our information we shall confine ourselves in this article to those forms of the naked truly terrestrial *Limacidæ*, which are for the most part popularly known under the name of Slugs, and shall notice the genera with external shells under their respective titles, though we quite agree in the principle of the general similarity of the zoological characters of the *Limaces* and *Helices*, and the almost imperceptible gradation of form among them. [HELICIDÆ.]

Vaginulus (Férussac). Animal oblong, elongated, often very slender in its state of extension, convex above; a cuirass covering the whole of the body, extending beyond it, and forming in front a sort of hood, wherein the head can be withdrawn; mouth armed with an upper jaw; four contractile tentacles, the two upper ones long and oculiferous, the anterior short, and, as it were, palmated or bifurcated at their extremity; the foot oblong, elongated; the respiratory cavity towards the middle of the body having its orifice behind, at the extremity of a long canal, and separated from the anus by a membrane only: organs of generation very distinct on the right, the male organ being near the small tentacle, and the orifice for the eggs towards the middle; no terminal mucous pore.

Shell null, there being neither rudimentary internal shell nor calcareous concretion. (Rang.)

V. Taunaisi (*Onchidium lœve*, Blainville), may be taken as an example.



Vaginulus.

a, the animal contracted (under side); *b*, the animal extended and in progression.

The genus *Vaginulus* is found in East and West Indies. M. Rang, who remarks that they have been said to be both terrestrial and fresh-water, states that he never met with them in Bourbon and Martinique, except in the woods and gardens under old fallen trunks.

There is great confusion about the nomenclature of *Onchidium*, *Peronia*, *Veronicella*, and *Vaginulus*. Cuvier observes that *Vaginulus* is different from *Onchidium*, with which M. De Blainville has united it, at the same time that he has detached the true *Onchidia*, to form his genus *Peronia*. It appears in fact, as M. Deshayes observes, that M. De Blainville has made of the marine *Onchidia* of Cuvier his (De Blainville's) genus *Peronia*, which he places in his family *Cyclobranchiata* near *Doris*, and that he collects the fresh-water species under the genus *Vaginulus*, to which he unites his genus *Veronicella*, which last he has himself rejected.

Limacella (De Blainville).—Animal elongated, sub-cylindrical, provided with a foot as long and as large as itself, from which it is separated only by a furrow; enveloped in a thick skin, forming at the anterior part of the back a sort of buckler for the protection of the pulmonary cavity, the orifice of which is at its right border; the orifices of the generative apparatus distant, that of the oviduct at the posterior part of the right side, and communicating by a furrow with the termination of the male organ, situated at the root of the right tentacle.

L. Elfortiana is a good example.

Limacella Elfortiana.

Limax.—Animal oblong, more or less elongated, demi-cylindrical, furnished with a cuirass at the anterior part; head sufficiently distinct, retractile under the cuirass, carrying two pairs of tentacles equally retractile, terminated in a rising (bouton), the upper pair long and oculiferous, the lower pair short; foot great and oblong, the pulmonary cavity situated under the cuirass, and opening under its right border; orifice of the anus at the posterior border of that of the respiratory cavity; organs of generation united and showing themselves at the right side anteriorly, near the great tentacle; sometimes a terminal mucous pore. A rudimentary internal shell, or calcareous concretions in the thickness of the cuirass.

Such is the general definition of *Limax* by M. Rang. He observes that M. De Férussac seized on certain anomalies in the characters of these molluscs, which led the latter to separate a certain number, out of which he forms his genus *Arion*. M. Rang observes that this distinction has not been adopted by M. De Blainville, excepting for the establishment of two sections; but M. Rang thinks it better to form the whole into two sub-genera, namely, *Arion*, Férussac, and *Limax*, the latter consisting of the slugs properly so called.

M. De Blainville divides the genus *Limax* into four sections: the 1st consisting of those species in which the pulmonary orifice is very anterior, the tail carinated, and the rudiment of the shell most evident. This section consists of the Gray Slugs; *Limax griseus* is given as an example.

The 2nd section consists of species whose pulmonary orifice is more posterior; the tail not carinated, hollowed at its extremity into a blind sinus, and the rudiment of the shell granulous. This section consists of the Red Slugs (genus *Arion*, De Férussac). The example given is *L. rufus*.

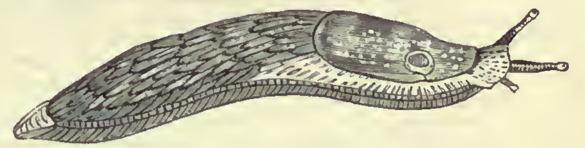
The 3rd section consists of species whose buckler is not distinct, and which have the ocular tentacles club-shaped, and the others lateral and oblong (genus Philomique of Rafinesque). The example given is *L. Oxyurus*.

The 4th section comprehends those species whose buckler is not distinct, and which have the two pairs of tentacles cylindrical, nearly on the same line, the smaller ones being between the greater (genus *Eumeles*, Rafinesque). The example given is *L. nebulosus*.

The two last sections are not noticed by M. Rang; and Cuvier is of opinion that the two genera recorded by M. Rafinesque are too imperfectly indicated to be admitted into his (M. Cuvier's) work. M. Raug also declines to admit them till there is more informatiou ou the subject.

Sub-genus *Arion*.—Respiratory orifice situated comparatively forward, towards the anterior part of the buckler, which is rough (chagrinée) aud contains small calcareous concretions. There is a terminal mucous pore.

A. rufus, De Fér., *Limax rufus*, Linn. This species is sometimes nearly quite black.



Red Slug (*Arion rufus*).

Sub-genus *Limax*.—Respiratory orifice situated comparatively backwards; the buckler is marked with fine and concentric striæ, containing a testaceous rudiment which is solid but without any volutatory impression. There is no terminal mucous pore.

L. antiquorum, De Fér., *L. maximus*, Linn., Gray Slug.

Gray Slug (*Limax antiquorum*, De Fér.; *Limax maximus*, Linn.).

a, internal shell; *b*, the same enlarged; *c*, internal view of the shell from another individual.

The geographical distribution of this genus is very wide; but the northern and temperate countries of both continents seem to be plagued with a greater number than those of the torrid zone. They are found in Africa, and have been noticed at each extremity of that quarter of the globe. Messrs. Quoy and Gaimard describe some from Australia, and M. Rang saw them in Iudia and in the island of Mauritius.

The species of this genus can hardly be of any direct utility to man, with the exception of the supposed virtues of a decoction or 'bouillon' of Red Slugs in disorders of the chest, whilst the injury which they inflict on the gardeu and the field is most devastating, notwithstanding the number of birds which prey upon them. Gardeners are constantly racking their invention to free themselves from these devouring hosts. Quicklime, soot, fine coal ashes, and saw-dust have been used as defences for young and tender plants. The virtue of the first is soon exhausted and the slugs do not care much for the second after a while, but if the soot be plentifully and frequently renewed it will keep them away in great measure. Coal-ashes, not too coarse, and saw-dust annoy them by sticking to their foot and impeding them. A stout coarse horsehair line, such as is used for hauging clothes out to dry, coiled round the stems of wall fruit-trees and stretched along the wall, will operate as a protection to the fruit from both snails and slugs, in consequence of the bristly surface presented to them, and which they shrink from encountering. Care must of course be taken that they do not get under it. Watering evening and morning with strong fresh lime-water is said to have a good effect, for it penetrates about the roots of the plants and into the earth, where they lie hid. Thin slices of any vegetable of which they are more fond than of the crop to be protected will allure them, and they may be thus killed by scores early in the morning by dividing them suddenly with a sharp instrument. The dead bodies should be left on the spot as a bait, for we have seen the living slugs preying upon the exposed bowels of the dead ones, most probably attracted by the half digested vegetable matter. Ducks destroy great numbers of these pests, whilst they improve themselves, but they are apt to trample down a young and delicate crop of vegetables.

M. Deshayes, in his edition of Lamarck, remarks that the great genus *Limax* is not so easy to study as might be supposed; the colour of the species is easily modified, and everything leads to the belief that they have been multiplied by those authors who have attached too much importance to these characters. M. Deshayes presumes that the European species are less numerous than some naturalists suppose. In passing from the north to the south the *Limaces* undergo modifications similar to those undergone by other Molluscs; and when we have under our eyes a series of modifications impressed upon a species which has lived under different circumstances with regard to temperature, and when we remark that these modifications are capable of being reduced to constant laws, we may believe that modifying agencies which have acted with so much power on certain races have had an equal effect on others; and we may foresee, by an induction not at all forced, the future results of observation on this subject. If we see, in fact, species of *Helices* modified we may believe that similar modifications have taken place in the *Limaces*. These modifications are doubtless less easily recognised in the last-mentioned genus; for there is no solid shell by means of which they may be traced. In this state of things M. Deshayes is of opinion that the only means which science offers for the distinction of the different species of *Limax* coming from the warm and cold regions of Europe are to be found in a minute dissection. A comparison resting on the form and disposition of certain internal organs would lead, he doubts not, to satisfactory results. Cuvier, continues M. Deshayes, in his anatomical memoir on the *Helices* and *Limaces*, has demonstrated all the analogy which exists between these two genera. Thus those zoologists whose habits of observation enable them to discover the ordinary march of nature might expect to see filled up the considerable interval, in reference to the shell, which would seem to exist between the two genera. The Marine Molluscs have already offered, if not in the same family, at least in the same group, a phenomenon sufficiently similar to that which is exhibited among the *Limaces* and *Helices*. In many of the species of *Limax* we find no trace of a shell; in others some calcareous grains are observed in a sac included in the thickness of the buckler, placed above the heart and branchia. These grains agglutinated constitute in a considerable number of species a flat calcareous plate, entirely internal; soon we find this plate coming out and showing some of its parts externally, while the remainder is still embedded in the thickness of the mantle, but its free extremity begins to be twisted spirally. This sub-internal shell, quite incapable of containing the least part of the animal, increases gradually, changes its place when the organ of respiration changes its situation, and finishes by possessing by very insensible degrees a development sufficiently considerable to contain the entire animal, as in certain *Vitrinæ* and in all the *Helices*. Of the different degrees which exist between these two extremes of the series of these different modifications zoologists have made so many genera.

M. Deshayes concludes his observations by remarking that the history of the *Limaces* is at the present day become very considerable, and he finds it impossible to exhibit a complete view of it; for even the greatest brevity would lead him to overstep the limits which he necessarily imposed on himself in editing the work from which we have quoted. He refers the reader particularly to the memoirs of Cuvier for the anatomical part, and to the great work of De Férussac for the history of the genus, the distinction of the species, and the discussion of their characters.

The reader will find parts of the organisation of some of the *Limaces* in the Museum of the Royal College of Surgeons. Numbers 2297 to 2302 (Gallery), both inclusive, exhibit the generative system of the Slugs. Numbers 2303 to 2311, both inclusive, illustrate the same system in the Snails (*Helix*). No. 2315 is a specimen of the spiculum amoris or calcareous dart of a Snail; and Numbers 2846 to 2849, both inclusive, are illustrative of the coitus in *Helix aspersa*.

Parmacella.—Animal elongated, oblong, demi-cylindrical, covered on the middle of the back by a rounded oblong fleshy cuirass, which is to a great extent free in front; head sufficiently distinct, carrying two pairs of retractile tentacles, the one superior, long and oculiferous, the other anterior and short; foot large and oblong; respiratory cavity under the posterior part of the cuirass, opening, as well as the anus, by a common solution of continuity under its right border, a little backwards; orifice of generation single, near the right tentacle.

Shell flattened, calcareous, with a membranous epidermis, oval, slightly bent in the direction of its width, with a summit marked by a deep sinus on the right side posteriorly, placed in the thickness of the cuirass, above the respiratory cavity. Cuvier remarks that the shell exhibits behind a slight commencement of a spire.

De Blainville divides the genus into two sections: the first consisting of species whose tail is not carinated and whose shell is subspiral (example, *P. Taunaisi* and *P. Palliolum*, De Fér.); the second species which are more depressed, the tail carinated, and the shell scutiform (example, *P. Olivieri*.)

De Blainville ('Malacologie') observes that only two species are known, one from South America, the other from Persia. Cuvier, in his 'Règne Animal,' notices the species first known, *P. Olivieri*, and says that there is another from Brazil (*P. Palliolum*, De Fér.), and some others from the Indies, meaning probably the East Indies. M. Rang, who remarks that the *Parmacellæ* form a very natural genus, very closely approximating to the Slugs, states that in Brazil they inhabit the woods, but that at Bourbon and Madagascar he never found them except upon rocks near fresh-water torrents. He adds that Olivier brought the first specimen from Mesopotamia, and that it was this which served for the anatomical researches of Cuvier, under the name of *P. Olivieri*; that De Férussac has described another under the name of *P. Palliolum*; and that he (M. Rang) brought back from his voyage in the Indian Seas two others, one of which, *P. Rangianus*, has been described by M. De Férussac as an Arion ('Bull. des Sciences,' February 1827); this was from the Isle of Bourbon and Madagascar.

P. Olivieri may be taken as an example. It is a native of Mesopotamia.

Parmacella Olivieri.

M. Deshayes (2nd ed. Lam., tome vii., 1836) does not add to the single species given by Lamarck, namely, *P. Olivieri*, Cuvier, (*P. Mesopotamiæ*, Oken); but he states that an animal coming from Brazil had been sent to M. De Férussac, and anatomised by M. De Blainville; and had been assigned by those authors to the genus *Parmacella*. This animal, according to M. Deshayes, offers nevertheless remarkable differences in the disposition of the organs of generation; but he thinks that these characters do not appear sufficient for the establishment of a genus. Since then, he adds, Messrs. Webb and Bertholet, who have explored the Canaries with such scrupulous attention, have observed there a mollusc closely approaching the *Parmacellæ*, and especially that from Brazil, and in their synoptic *Prodromus* ('Ann. des Sci. Nat.,' March 1833) they have proposed to establish for it a genus under the name of *Cryptella*; but M. Deshayes states that he waits for the description and figure before he pronounces on its admission or rejection.

The little fish the Lancelet was at first referred to the genus *Limax*. [BRANCHIOSTOMA.]

LIMBILITE, a Mineral so called by Saussure, which occurs in the volcanic hill of Limburg. It is found in irregular grains. Structure compact. Hardness 6·0 to 7·0. Scratches glass easily. Colour honey-yellow. Melts into a black enamel.

LIME, one of the Earths, an oxide of a metal called Calcium. It combines with various acids, forming conspicuous materials of the earth's surface. With the exception of nitrate of lime, none of the native salts of lime are soluble except in minute proportions. They give no odour and no metallic re-action before the blow-pipe. The principal native salts are—Sulphate of Lime [GYPSUM; ANHYDRITE], Carbonate of Lime [CALCAREOUS SPAR; ARRAGONITE], Magnesian Carbonate of Lime [DOLOMITE], Phosphate of Lime [APATITE], and Fluoride of Calcium, or Fluate of Lime [FLUOR-SPAR].

In addition to these the following salts of lime have been observed:—

Oxalate of Lime. It occurs crystallised. Its primary form an oblique rhombic prism, and from one-tenth to one-fourth of an inch long. Colourless. Fracture conchoidal. Hardness rather less than calcspar. Very brittle. Lustre similar to that of sulphate of lead. Transparent to opaque. Specific gravity 1·833. Supposed to have come from Hungary. Its analysis, by Sandell, showed its composition to be oxalate of lime with one equivalent of water.

Hayesine, or Hydrous borate of Lime, found in South America.

Hydroboracite, a Hydrous borate of Lime and Magnesia.

Nitrate of Lime, found in the form of a white delicate efflorescence. It occurs in caverns in many parts of the world, and is used for the manufacture of gunpowder.

LIME. [CITRUS.]

LIME, OXALATE OF. [LIME.]

LIME-TREE. [TILIA.]

LIMESTONE. This term is applied to a great variety of earthy compounds, in which carbonate of lime is the predominant ingredient. The chemical, molecular, and structural characters of limestone are extremely interesting to mineralogy, and deserve from geologists a greater share of attention than has usually been given to them. In regard to the chemical composition of limestones, we may notice that some, as statuary marble, are nearly pure carbonate of lime; others, as the dolomitic rocks of the Alps, contain a certain proportion of carbonate of magnesia; and some are penetrated by bituminous matter, as the black marbles of Yorkshire. Limestones also vary in quality, and become debased by admixture with sand, clay, oxide of iron, pyrites, &c.; so that there is in fact a real gradation from limestone to schist, to sandstone, to shale, to ironstone, &c. Limestones have a crystalline aggregation, as statuary marble, and generally the limestones mixed with primary systems of strata; or they are composed of small crystalline grains, as the magnesian limestone of Mansfield in Nottinghamshire; full of round concretionary parts, as the oolites of Portland, Bath, and Oxford; earthy, as chalk and some magnesian limestones; or compact, as the lithographic stone of Solenhofen. The limestone rocks of Building Hill, Sunderland, resemble a coral reef. The beds of calcareous rocks are of every thickness, from a mere lamina to some yards thick; they are traversed by divisional planes more or less regular, and very thick beds assume a prismatic structure, as in Yorkshire. The colours of limestone vary indefinitely. When argillaceous matter is mixed with the calcareous basis of the rock, the colour generally approaches to blue; magnesian and oolitic limestones are often yellow; primary limestone and chalk are generally white; the Tiree marble is red; some of the Derbyshire and Kilkenny marble is black; and there are many veined and parti-coloured marbles, as those of Babbacombe, Sienna, &c.

Limestones contain a very large proportion of the organic bodies which diversify the stratified rocks, few except the early primary limestones being wholly deficient of shells, corals, fishes, &c. Occasionally shells and zoophytes contribute to the beauty of particular marbles, as the shell marble of Carinthia, Purbeck, &c., the crinoidal marble of Derbyshire, and the coralliferous limestone of Weardale. [MOUNTAIN LIMESTONE FORMATION.]

LIMNÆA. [LIMNÆADÆ.]

LIMNÆADÆ, a family of fresh-water Testaceous *Mollusca*, consisting of the genera *Planorbis*, *Limnæa*, *Physa*, and *Ancylus*.

Two of these forms (*Planorbis* and *Limnæa*) were included by Linnæus under his great genus *Helix*; the third was arranged by him among the heterogeneous assemblage of testaceous animals, which he placed under his genus *Bulla*. *Ancylus* is placed in this family by Forbes and Hanley. Müller separated the first of these under the name of *Planorbis*, and the second under the name of *Buccinum*, a name already pre-occupied by Linnæus for a genus of Marine Testaceous Gastropods entirely different, and Lamarck changed the name to *Lymnæa*, or, as it should be more correctly written, *Limnæa*. Adanson appears to have been the first who established the genus afterwards named *Physa* by Draparnaud, and the former gave it the appellation of *Bulin*. Bruguières followed Müller as far as regards *Planorbis*, but he placed the other two forms under his genus *Bulimus*. [BULIMUS.]

Lamarck collected these three genera in the following order, *Planorbis*, *Physa*, and *Limnæa* under one family, his Lymnéens, with the following definition:—

Amphibian Trachelipoda, generally deprived of an operculum, and having flattened tentacles. They live in fresh-water, and come to respire the air at the surface.

Their shell is spirivalve, most frequently smooth on the external surface, and always having the right edge of its aperture sharp, and not reflected.

The general opinion seems to be that these three genera are well associated in forming the family *Limnæadæ*.

Cuvier, though he gives them no common family name, places the three genera together, observing that the *Planorbes* are the faithful companions of the *Limnææ* in all our stagnant waters.

M. De Blainville makes his first family of *Pulmobranchiata* (*Limnacea*) consist of these three genera; and M. Rang, retaining Lamarck's name, places the Limnéens, consisting of the same genera, as the fourth family of the Pulmonés Inoperculés of Férussac (Pulmobranches of De Blainville).

Mr. G. B. Sowerby however is of opinion that the genera *Physa* and *Limnæa* ought not to be separated. He observes ('Genera. *Limnea*,' No. 8), that he finds himself obliged either to unite two genera which have appeared distinct to Lamarck and Draparnaud, and which have been adopted by some succeeding writers, or, contrary to his wishes, and, as he thinks, to the interests of conchological science, we must not only separate the *Physæ* from the *Limnææ*, but we must also adopt Dr. Fleming's *Aplexa*, and Dr. Leach's *Myxas*, each of which would, as far as we yet know, only contain one species. These, he adds, are all fresh-water shells; and the only describable difference in the shells, except mere specific differences, consists in the *Aplexa* and *Physa* being heterostrophe shells, while the *Limnæa* and *Myxas* are dextral. Greater differences he acknowledges are found in the animals, chiefly in their tentacula and in their mantles; the *Myxas* of Leach and the *Physa* of Draparnaud having the power of extending the edges of their mantle over a large portion of the external part of their shell, which the *Limnæa* of Lamarck and the *Aplexa* of Fleming have not, while the tentacula of all but *Physa* are compressed and triangular, and even in *Physa* they are compressed according to Lamarck, though filiform: in all of them the eyes are found at the internal base of the teutacula, supported on very short tubercular pedicles. He concludes by uniting the whole of these genera under the generic appellation of *Limnæa*, and divides them into four sections, thus:—

1. Shell very thin, subglobose, polished; internal lip dilated; aperture ovate, dextral. Animal with the mantle reflected; the tentacles short and trigonal. *Myxas*, Leach's manuscript; *Helix glutinosa*, Mont.; *Limnæa glutinosa*, Drap.

2. Shell thin, obovate, polished; internal lip dilated, the aperture ovate or ovato-lanceolate, sinistral. Animal with the mantle reflected; the tentacles subulate. *Physa*, Lamk.; *Bulla*, Linn.

3. Shell thin, oblong, polished; the iuternal lip equalling the external, the aperture lanceolate and sinistral. Animal with the mantle not reflected; the tentacles trigonal. *Aplexa*, Fleming; *Physa*, Drap.; *Bulla hypnorum*, Linn.

4. Shell thin, generally oblong, rather solid; the aperture oval and dextral, the inner lip equalling the external one. Animal with the mantle not reflected, the tentacles compressed and trigonal. *Lymnæa*, Lam.; *Helix*, Linn.

M. Deshayes rejects this opinion, and retains *Physa* as a genus, for reasons which the reader will find under that head in this article.

Returning to Lamarck, we find him remarking upon the cause which led to the peculiar organisation of his Lymnéens, in accordance with one of his favourite fanciful theories. It would seem, says he, that those fluviatile Trachelipods, which inhabited waters of little depth, such as those of small rivers, ponds, and marshes, which are exposed to the accident of beiug dried up, were often reduced to live in mud more or less desiccated. They then found themselves forced to habituate themselves to the air, to breathe it. This habit having modified their branchiæ, like those of the Colimacés, is become to them a matter of necessity; so that though living in the water, they are now obliged to come from time to time to its surface in order to breathe the free air. This circumstance in their manner of life seems to have had its influence in rendering an operculum useless to them; and they are in general deprived of one. Those fluviatile Trachelipods, on the contrary, which we know to be unable to respire anything but water, have all an operculum.

It is only necessary to reflect for a moment on the principle involved in these suppositions, to reduce them to their true value.

Leaving his theoretical views for his practical observations, we find Lamarck thus neatly pointing out a leading character for distinguishing the family. "The Limneans have only two tentacles; they are flattened, and never oculated at their summit."

M. De Blainville thus defines his family *Limnacea*:—

Body very variable in form; two tentacles eminently contractile, carrying sessile eyes at the internal side of their base.

Shell delicate, with the external border constantly trenchant.

He further observes that the animals of this family are always found in fresh waters, stagnant or running, often at their surface, and sometimes in their depths. The shell he remarks, presents very variable forms. He arranges the genera in the following order:—*Limnæa*, *Physa*, *Planorbis*.

M. Rang gives a more exteusive definition of the Limnaceans of Lamarck (*Limnacea* of De Blainv.; Limnocochlides, without a collar, of Latreille), thus:—

Animal elongated, having the body distinct from the foot, and twisted spirally backwards; never any buckler (or cuirass), but a collar formed all round the neck by the edge of the mantle; head surmounted by a sort of veil which is very large; teutacles two in number, the eyes differently situated at their base; pulmonary cavity showing its orifice upon the collar; organs of generation separated; anus near the orifice of the lung.

Shell always complete, very much rolled up (très enroulée), delicate, and with the external border or lip trenchant.

All fluviatile.

M. Rang arranges the genera in the following order:—*Planorbis*, *Limnæa*, *Physa*. This is the order given by Cuvier, and, as far as these three genera are concerned, by Draparnaud, who however makes *Ancylus* intervene between *Planorbis* and *Limnæus*.

Planorbis.—Animal elongated, compressed, slender, and very strongly rolled up; head furnished with two tentacles, which are contractile, setaceous, very long, and oculated at their iuternal base; mouth furnished superiorly with a crescent-shaped tooth, and below with a lingual mass armed with small hooks, and surmounted by a sort of veil which is short and notched; foot oval and rather short; respiratory orifice on the left, upon the collar, and approximated by that of the anus; organs of generation separate, on the same side; the male organ near the tentacle, and the ovary at the base of the collar.

Shell rather delicate, sinistral, very much rolled or coiled up on the same plane; concave on each side, the spire re-entrant (rentrant); aperture rounded with a sharp border, and interrupted by the convexity of the whorl which precedes it. (Rang.)

Planorbis. Shell and Animal, and eggs.
a, *Planorbis carinatus*; *b*, mass of eggs of *Planorbis corneus* on a leaf.

The species are widely diffused. Very few fresh waters, either running or stagnant, are without some of the species.

M. Rang remarks that the genus *Planorbis* offers a curious anomaly, namely, that the animal as well as the shell is sinistral, and consequently the orifices, instead of being situated on the right side, as in other Gastropods, are placed on the left.

Mr. Sowerby (Genera, No. 4) remarks that the principal peculiarity in this genus appears to him to consist in the fact that the shells of the genus are what are called reversed, a fact doubted by some, who have described the species as umbilicated above. A careful examination of many of the species in a living state satisfied Mr. Sowerby that the animals carry their shells in a direction opposite to that of the generality of turbinated molluscs, and that the heart is placed in the *Planorbes* on the right side, and the respiratory orifice on the left, exactly the reverse of their position in most others. But, he further observes, the knowledge of the animal is not indispensably necessary to prove this, as the shell itself carries the demonstration, it being only needful to observe on which side of the shell the very apex of the spire is to be seen; if we take that side for the upper, in conformity to the strict rules of analogy, it will, he remarks, be evident that the aperture is on the left-hand side. Mr. Sowerby had for a long time entertained great doubt about the identity of some of the fossil species, which he is now satisfied are reversed shells, in the same manner as the other *Planorbes*, although the lower part of the disk is almost flat and carinated at its edge, and therefore bears a considerable resemblance to the flattened spire of some land shells, particularly the *Helix albella*.

Mr. Sowerby thus defines the genus *Planorbis*:—Shell discoid with a depressed spire, whose apex is always distinct: its whorls turn from right to left, so that when the spire is held upwards and the aperture seen, it is on the left-hand side. The shells are ventricose, frequently carinated, either above or below; the aperture is entire, its breadth equal to its length, sometimes greater but (Mr. Sowerby believes) never less; sometimes the peritreme, or lip, is thickened and expanded, and its lower part is always extended forwards: the umbilicus is very much expanded, and there is no operculum.

Mr. Sowerby further remarks that some species, particularly when young, are covered with a hairy epidermis.

M. Deshayes (ed. Lamarck, tom. viii., 1838) does not make any allusion to Mr. Sowerby's observations; but he comes to a very different conclusion. The *Planorbes*, says he, as all naturalists know, are discoid shells, generally delicate and fragile, found in abundance in stagnant waters. Some of the species are so much flattened that they seem perfectly symmetrical, so that it is difficult, in these last at least, to distinguish the upper surface from the lower. This difficulty brings with it another, namely that of determining whether the species are dextral or sinistral. These interesting questions had not been deeply discussed when M. Desmoulins published (1831), in the 'Transactions of the Linnean Society of Bordeaux,' a well executed and very extensive memoir, in which he examines these different questions. "In my preceding works," continues M. Deshayes, "I have not perhaps attached sufficient importance to those researches for which it was necessary to examine the living animals, but nevertheless in 1824 I disposed conchologically of a part of the difficulty by saying, in my work on the fossils of the Paris basin, that the upper side of the *Planorbes* may be distinguished from the lower by means of the obliquity of the aperture, the upper part of which is most prominent (avancé). This mode of distinguishing the upper surface from the lower, and of placing the shell in its normal position, once granted, it becomes easy to recognise which species are dextral, and which sinistral. By these means we perceive, as M. Desmoulins has very well demonstrated, that nearly all the known species of *Planorbes*, both living and fossil, are dextral; even those which the most esteemed authors had judged to be sinistral, from the depth of the umbilicus. But if by the observation of the aperture we come to the conclusion that the shell of the *Planorbes* is dextral, a difficulty presents itself, namely, that the animals which inhabit these dextral shells are sinistral, if we judge by the position of the three orifices which the pulmoniferous molluscs exhibit exteriorly. Thus Cuvier has well remarked this transposition of the orifices in *Planorbis corneus*, and has not hesitated to declare this species sinistral, contrary to the opinion of Linnæus, of Müller, and of Draparnaud, who state that the species is umbilicated above. Cuvier corroborates his opinion by an important fact, namely, that the heart is on the right side in *Planorbis*, whilst it is on left in dextral shells of other genera; but Cuvier did not pay attention to the organs of digestion: finding the heart on the right and the orifices on the left, he came to the conclusion that *Planorbis corneus* is sinistral; he ought nevertheless to have seen, before he delivered this definite judgment, in what real position the organs are. It is to this point that M. Desmoulins has especially applied himself, and he saw that all the organs of digestion and generation remain in the position which they hold in the dextral molluscs, and that the orifices only have an anormal position. Thus the observations of M. Desmoulins explain how, in the genus *Planorbis*, appearances place a sinistral animal in a dextral shell (a phenomenon which we cannot conceive) and how, in reality, the animal is dextral as well as its shell, and that there is no other derangement in the relationship of these organs excepting in regard to the heart, and the termination of the digestive organs and those of generation."

The species are numerous. Lamarck recorded twelve recent species, including *P. Cornu Arietis*, which is not a *Planorbis*, but a discoid *Ampullaria*, as its animal and operculum testify. M. Deshayes adds ten more in the last edition of Lamarck; Conrad, Troschel, and Broderip have each described one in addition; and new species are brought home by almost every expedition. M. Rang states that he has known individuals of *P. leucostoma* collected at Seize near Bordeaux, by M. Durieu, where the animals had closed the shell by a kind of epiphragma analogous to that of the *Helices*.

P. corneus (*Helix cornea*, Linn.). Shell opaque, plano-depressed above, widely umbilicated beneath; of a horny or brown-chestnut colour; the whorls transversely striated.

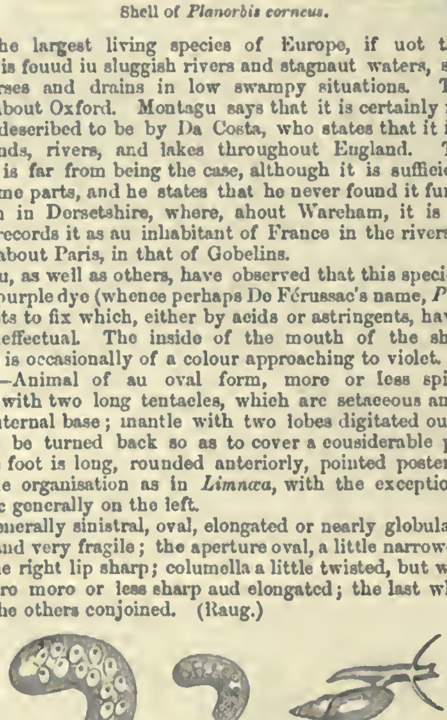
Shell of *Planorbis corneus*.

This, the largest living species of Europe, if not the largest generally, is found in sluggish rivers and stagnant waters, such as old water-courses and drains in low swampy situations. Thus it is plentiful about Oxford. Montagu says that it is certainly more local than it is described to be by Da Costa, who states that it is common in all ponds, rivers, and lakes throughout England. This, adds Montagu, is far from being the case, although it is sufficiently plentiful in some parts, and he states that he never found it further westward than in Dorsetshire, where, about Wareham, it is abundant. Lamarck records it as an inhabitant of France in the rivers, and very common, about Paris, in that of Gobelins.

Montagu, as well as others, have observed that this species yields a beautiful purple dye (whence perhaps De Férussac's name, *P. purpura*), all attempts to fix which, either by acids or astringents, have hitherto proved ineffectual. The inside of the mouth of the shell in fine specimens is occasionally of a colour approaching to violet.

Physa.—Animal of an oval form, more or less spiral; head furnished with two long tentacles, which are setaceous and oculated at their internal base; mantle with two lobes digitated on the edges, which can be turned back so as to cover a considerable part of the shell; the foot is long, rounded anteriorly, pointed posteriorly; the rest of the organisation as in *Limnæa*, with the exception that the orifices are generally on the left.

Shell generally sinistral, oval, elongated or nearly globular, smooth, delicate, and very fragile; the aperture oval, a little narrowed behind; edge of the right lip sharp; columella a little twisted, but without any plait; spire more or less sharp and elongated; the last whorl larger than all the others conjoined. (Rang.)



Physa. Shell and animal, with eggs.
a, *Physa hypnorum*; *b*, mass of eggs, natural size; *c*, the same, magnified.

The geographical distribution of the species is very extensive. Species have already been found in the tranquil fresh waters of all the four quarters of the globe. Europe has several species, and the form occurs in America, in Africa (there being little doubt that the *Bulin* of Adanson is a *Physa*), in Australia, where it was found by M. Quoy, and in the isles of Bourbon and Mauritius, whence it was brought by M. Rang. Dr. Gray has named two species from the East Indies and one from Peru.

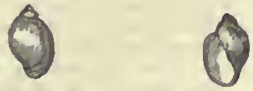
Mr. G. B. Sowerby, as we have already seen, unites *Physa* and *Limnæa*, making the latter include the former for the reasons above given. M. Rang, who notices their inhabiting the same places as the *Limnæa*, and their resemblance in organisation, observes that the animal of *Physa* is distinguished from that of *Limnæa* by the form of its tentacles, as is the shell by its generally sinistral disposition like that of the *Planorbes*. He also notices the observation of M. De Blainville that there exist dextral species.

M. Deshayes, in his edition of Lamarck, remarks that the genus *Physa*, established at first by Adanson under the name of *Bulin*, was not definitely introduced till Draparnaud presented it anew under the name which it still bears. Adanson, he continues, had too much sagacity not to perceive the relationship of his *Bulin* with the *Planorbes*, and fails not to insist upon this point, although he points out the characteristic differences of the two genera. After some observations on the doubts of naturalists as to the analogy presented by the animals of *Planorbis* and those of *Physa* and *Limnæa*, and the absence of doubt as to the distinguishing characters of the two last-mentioned genera, M. Deshayes thus continues:—

"Certainly, if we consider the shells only, there is a very great resemblance between a *Physa* and a *Limnæa*, but all the *Physæ* are sinistral—the *Limnææ* are dextral; the *Physæ* have a polished and shining shell, because the animal has its mantle lobated and turned back upon the shell, which is not the case in *Limnæa*; the animal of *Physa* carries on its head elongated and narrow tentacles, like those of *Planorbis*, and not triangular and thick ones, like those of *Limnæa*. These characters seem sufficient to retain the two genera in the system, and consequently to reject the opinion of Mr. Sowerby, who unites them in his genera."

Lamarck recorded four species of *Physæ* (recent). M. Deshayes, in the last edition of the 'Histoire,' increases the number to ten; and he regrets that M. Michaud has given no detail with regard to some species indicated as found in France, but which do not appear to live there. He observes that Lamarck has recorded two *Physæ* (*P. castanea* and *P. subopaca*), the first from the Garonne and the last from the environs of Montpelier, which M. Michaud does not mention. M. Deshayes adds, that we must probably conclude, from the silence of M. Michaud, that these species have not been found, and that Lamarck, deceived by a false indication, has given them a habitat not theirs. Conrad has described an additional species.

P. fontinalis, Drap. (*Bulla fontinalis*, Linn.). Shell sinistral, oval, diaphanous, smooth; of a yellowish-horn colour; spire very short and rather pointed.



Shell of *Physa fontinalis.*

It is found in England, France, and North America (Claiborne, Alabama). Conrad.

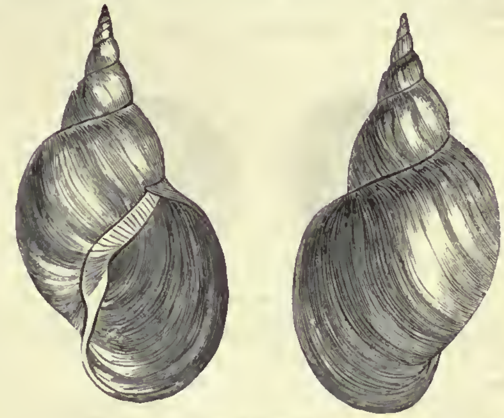
Colonel Montagu ('Testacea Britannica') notices the species as not uncommon in stagnant pools, as well as running waters, in many parts of the kingdom, and as most frequently found on the under part of the leaves of aquatic plants. He gives a description of the animal, and says that when in motion it covers a great part of the shell with a thin pinnated membrane, thrown out on the right side, extending quite behind and partly on the left side, covering the smaller volutions: this membrane (mantle) is, he says, very deeply divided, or digitated, the points of which meet and sometimes intersect on the back of the shell, and it is so transparent as scarcely to be distinguished but by the assistance of a glass. The foot he describes as long and narrow, and the foramen on the left side, "as must be the case with all the animals of this kind inhabiting heterostrophe shells." Colonel Montagu concludes his remarks on this species as follows:—"It has a very considerable locomotive power, and transports itself by adhering to the surface of the water, with the shell downwards, against which it crawls with as much apparent ease as on a solid body; and will sometimes let itself down gradually by a thread affixed to the surface of the water, in the manner of the *Limax filans* ('Linn. Trans,' iv. 85, t. 8) from the branch of a tree. The property of crawling under water against its surface is not wholly confined to this species; but we know of no other testaceous animal capable of suspending itself under water in the same way except a species of *Litiopa*. [LITIOPA.] It has the power of throwing its shell about in an extraordinary manner, either in defence or to remove obstructions, continuing at the same time fixed by its foot. Probably this singular motion is sometimes occasioned by a minute species of *Hirudo* (*Gordius inquilinus*, Müll., 'Verm.') which infests this and many other fresh-water testaceous animals; twenty or more may be seen adhering to its sides like slender white filaments."

Limnæa (*Limneus*, *Limnæus*, *Lymnæa*).—Animal of oval form, more or less spiral; head furnished with two flattened triangular tentacles, carrying the eyes at their base, on the internal side; mouth furnished with an upper piece for mastication, surmounted by a sort of very short veil; foot oval, bilobated anteriorly, narrowed posteriorly; orifice of the pulmonary cavity on the right side, on the collar, in form of a furrow, and capable of being covered by a fleshy appendage which borders it below; anus on the side; organs of generation distant, the orifice of the male intromissive organ being under the right tentacle, and that of the vagina at the entry of the pulmonary cavity.

Shell delicate, fragile, of an oval oblong, with a spire more or less sharp and elongated, and an aperture longer than it is wide, oval, sometimes very large, with a sharp edge, not continuous, on account of the convexity of the preceding whorl; on the columella an oblique plait. (Rang.)

M. Deshayes observes (last edition of Lamarck), that the animal of *Limnæa* presents peculiar characters. On the head are two triangular tentacles very much enlarged at the base, and having the eyes rather projecting on the upper and internal part of that base. The head is large and flattened, separated from the foot by a shallow furrow. The foot inclines to oval, terminated in a point posteriorly, and delicate and flattened on the sides. The mantle, closed anteriorly and narrow, forms a sort of collar, as in the *Helices*. There is a great cavity behind its border. The upper wall of this cavity, delicate and transparent, is covered on its internal surface by a very well-developed vascular net-work, destined for respiration: it is near the aperture of the mantle, and a little below it, that the orifice of the anus is seen.

The *Limnææ* appear to occur in almost all parts of the world, but the form is most seen in the temperate and northern regions.



Limnæa stagnalis.

Fresh waters, especially those which are stagnant, are the resort of the *Limnææ*; in such situations they abound, feeding on the aquatic plants on whose stems they creep, and coming to the surface to respire the air. Here they may often be seen in a reversed position, and probably maintained in it by the air in the branchial cavity. Like the *Physæ* they have the power of locomotion when so situated, and may be observed moving their ventral disc, as if they were employing it against a solid surface, whereas the animal only touches an extremely thin lamina (so to speak) of water, which offers sufficient resistance for its progression. In the reproduction of the species the animals are employed somewhat differently from the *Helicidæ* and *Limacidæ*, though, like them, each individual is furnished with both male and female organs of generation; for the same *Limnæa* is capable of serving at the same time as a male for a second and as a female for a third, and by this connection of one individual with two others a continuous chain of some length is not unfrequently produced. No. 2313 of the fifth or allotriandrous series of preparations illustrating the principles of generation, in the museum of the Royal College of Surgeons in London ('Catalogue,' vol. iv., 'Physiological Series'), exhibits the soft parts of the generative, anal, and respiratory orifices of *Limnæa stagnalis*, and shows how this Gastropod differs from the *Limacidæ* and *Helicidæ* in the separation of the abovementioned orifices from one another. The number of eggs is very great, and they are deposited on stones, stems of vegetables, &c., in elongated masses enveloped in a glairy substance, which is said to increase in proportion to the development of the embryoes. For details on the reproduction and embryogeny of these Molluscs we refer the reader to the works of M. Pfeiffer and of M. Dumortier; also a paper by Mr. Hoff in the 'Transactions of Microscopical Society,' 1854.

The recent species are numerous: Lamarck recorded twelve, including *L. columnaris*, which is considered to be an *Achatina*; Deshayes, in the last edition of Lamarck's 'Histoire,' has added eight more; Bean and Troschel have each added one.

L. stagnalis. This is *Helix stagnalis*, Linn.; *Buccinum stagnale*, Müll.; and *Bulimus stagnalis*, Brug.—Shell ovate-acute, ventricose, thin, pellucid, substriated longitudinally, of a horny colour; the last whorl subangulated above; the spire conico-subulate; the aperture large.

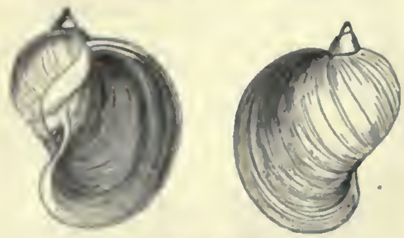
Limnæa stagnalis.
a, the animal in the shell; *b*, mass of eggs, magnified.

Montagu observes that it is frequently covered with a green epidermis, and sometimes a concreted stony matter that almost obliterates the upper volutions; he adds that some authors have made this shell into two or three species, apparently from size only.

It is found in the fresh sluggish or stagnant waters of England, France, &c.

L. auricularia. This is *Helix auricularia*, Linn.; *Buccinum Auricula*, Müll.; *Bulimus auricularius*, Brug.—Shell ampullaceous, ventricose, ovate, thin, transparent, of a horny colour, marked with very delicate close-set longitudinal striæ; the spire very short and acuminated.

It occurs in the same places with *L. stagnalis.*



Limnæa auricularia.

The following is a list of British species of *Limnæadæ* from Forbes' and Hanley's 'British Mollusca:'—

Physa:—
- *P. fontinalis.*
- *P. hypnorum.*

Planorbis:—
- *P. corneus.*
- *P. albus.*
- *P. glaber.*
- *P. nautilus.*
- *P. carinatus.*
- *P. marginatus.*
- *P. vortex.*
- *P. Spirorbis.*
- *P. contortus.*
- *P. nitidus.*
- *P. lacustris.*

Limnæus:—
- *L. pereger.*
- *L. auricularius.*
- *L. Burnetti.*
- *L. stagnalis.*
- *L. trunculatus.*
- *L. glaber.*
- *L. palustris.*
- *L. glutinosus.*
- *L. involutus.*

Ancylus:—
- *A. fluviatilis.*
- *A. oblongus.*

Fossil Limnæadæ.

Planorbis.—M. De Blainville ('Malacologie') mentions the number of fossil species as four or five, adding that Defrance, who increases the number to eighteen, acknowledges that the fossil state of some of them is doubtful; he notices four as analogues. Mr. G. B. Sowerby ('Genera') states that several fossil species abound in the distinctly fresh-water strata of the Isle of Wight and the neighbourhood of Paris, where they are very abundant, and accompanied by as great a profusion of *Limnææ* and some other decidedly fresh-water shells.

Lamarck records only three fossil species, nor does he mark any of the recent species as occurring in a fossil state. M. Deshayes, who in his Tables (Lyell) makes the number of species 23 living and 26 fossil (tertiary), records in the same place the *Planorbis corneus, P. marginatus, P. carinatus, P. spirorbis*, and *P. nitidus* as both living and fossil (tertiary). We cannot find *P. marginatus* in Lamarck's first edition nor in that edited by M. Deshayes (tom. viii.) in 1838, except as a synonym to *P. complanatus.* In this last work the following recent species are marked by M. Deshayes as occurring in a fossil state:—*P. corneus, P. spirorbis, P. vortex, P. contortus, P. nitidus, P. complanatus*, and *Leucostoma*, on the authority of M. Bouillet; and the number of fossil species is made to amount to nine. Dr. Fitton, in his 'Stratigraphical and Local Distribution of Fossils,' in the strata below the chalk, notices an indistinct species of *Planorbis* (Purbeck, Oxfordshire and Bucks).

Physa.—M. De Blainville, in his 'Malacologie,' states that it would appear that no *Physæ* had at the time of his publication been found fossil. M. Deshayes in his Tables (Lyell) gives the number of species as nine living and one fossil (tertiary): in the last edition of Lamarck the number of recent species given is ten; but the number of fossil species is the same as that stated in the Tables.

Limnæa.—M. de Blainville ('Malacologie') remarks that if it were clear that the species of this genus established by geologists, and among others by Messrs. Lamarck, Brard, Brongniart, Sowerby, and De Férussac were true, there would be at least twenty fossil species in France alone; but he adds that M. Defrance does not carry the number further than ten, two of which (from the Plaisantin) are analogues according to Brocchi. Mr. G. B. Sowerby, who unites the genera *Physa* and *Limnæa*, observes ('Genera') that several fossil species of this genus occur abundantly in company with various *Paludinæ* and *Planorbes* in the fresh-water formations; these, he adds, occur in the neighbourhood of Paris, and in the upper and lower of these formations at Headen Hill, and in other parts of the Isle of Wight. He also found them sparingly "in the mixed stratum commonly called the Upper Marine Formation, between the two," but he believes that they do not occur in any other. Lamarck noticed but one species as fossil, namely, *Limnæa palustris*, this being in his opinion really the analogue of the recent species of that name. M. Deshayes in his Tables (Lyell) gives the number of *Limnææ* as fifteen living and twenty-seven fossil (tertiary), and the species *L. peregra, L. auricularis, L. rivalis*, and *L. palustris* as both living and fossil (tertiary). In the last edition of Lamarck the following recent species are marked by him as also occurring in a fossil state:—*L. palustris, L. ovata, L. peregra*, and *L. minuta.* *L. auricularia* is not marked as fossil in this edition, and we do not find *L. rivalis* as a species in either. The number of strictly fossil species recorded in the last edition of Lamarck is eleven, and in that edition M. Deshayes remarks that a sufficiently great number of *Limnææ* are found in a fossil state, but that up to the time when he wrote no species was recorded in the beds below the tertiary, and even in these the *Limnææ* only appear in the lower fresh-water strata. They show themselves, he adds, in the upper beds of the Paris Calcaire Grossier, and are also recognised in nearly all the Lacustrine deposits, not only of the Parisian epoch, but also in the two great tertiary groups that surmount it. Dr. Fitton, in the table above quoted, records a *Limnæa* (with a note of interrogation) as occurring in the Purbeck strata, Oxfordshire, in the malm, Garsington.

Dr. Lea, in his 'Contributions to Geology' (8vo. Philadelphia, 1833), notices the tufaceous lacustrine formation of Syracuse, Onandaga county, New York. He found the substratum which lined the side of the canal to consist of a calcareous marl of a whitish colour, bordering on that of ashes, friable, and rather soft to the touch. A subsequent analysis by Professor Vanuxem proved it to be nearly pure carbonate of lime. Numerous perfect specimens of the genera *Limnæa, Physa, Paludina*, and *Ancylus* were obtained, all being analogous to the species inhabiting at that time the fresh-waters of that region; and Dr. Lea states that it was evident that the deposit was caused by the drainage of the lake. The specimens were found to be completely bleached, and were generally in an unbroken state. "A lacustrine formation of so recent a nature," says Dr. Lea in continuation, "as this appears to be, is not, I believe, of frequent occurrence. It is the result however of one of those causes which are now in action; and another instance might be mentioned, in which the effect of this cause, though striking, has not advanced to that period when it would make a finished deposit; I mean the small lake, or pond, in in Sussex county, New Jersey, well known by the descriptive name of Milk Pond. Here countless myriads of bleached shells of the families *Lymnæana* and *Peristomiana*, analogous to the species now inhabiting the adjacent waters, line and form the shores of the whole circumference of the lake, to the depth and breadth of many fathoms. Not having visited this interesting lake myself, I repeat what has been communicated to me by intelligent scientific friends who have examined it, and on whose report the most implicit reliance may be placed. Such is the quantity of bleached shells now remaining there, that thousands of tons of these small species, in a state of perfect whiteness, could be obtained if any useful purpose required the removal of them. For agricultural purposes this mass might prove of great utility. One friend, I remember, mentioned to me that he had obtained a sharp pointed pole, which he inserted ten or twelve feet perpendicularly into the mass, on the shore, near to the edge of the water, without its having passed through it. As far as can be ascertained, this mass seems to form the whole basin of the lake, and it may at some future and perhaps not far distant period form a tufaceous lacustrine deposit similar to that of Syracuse."

LIMNORIA. [ISOPODA.]

LIMO'NIA, a genus of Plants belonging to the natural order *Aurantiaceæ*, so called from the original Indian names, Neemoo and Leemoo, of the Lemon. Several of those described under this genus by Dr. Roxburgh have been referred to *Atalantia* and *Glycosmis.* The species still included are rather heterogeneous in nature, and will probably require further separation. As most of the family abound in essential oil, so the leaves of some of the Limonias are fragrant, and the fruit, though small, of *L. acidissima* and *L. crenulata* is very acid. *L. laureola*, referred to this genus by Dr. Wallich, in his 'Plantæ Asiat. Rar.' t. 245, is remarkable as the only plant of this family found on the tops of cold mountains. The people of the Himalayas, remarking its highly fragrant leaves, fancy that it is by feeding on them that the musk-deer acquires its strong and peculiar flavour.

LIMONITE. [IRON.]

LIMOSA. [SCOLOPACIDÆ.]

LIMPET. [PATELLIDÆ.]

LIMPET, FRESH-WATER. [ANCYLUS.]

LIMULUS, a genus of Animals belonging to the order *Crustacea*, and which, on account of its anomalous characters, M. Milne-Edwards placed in a family by itself, which he called *Xiphosura.* He arranged these at the end of his system, next to the suctorial Crustaceans. He observes that the singular animals which compose this small group are so remote from all the other Crustaceans that some naturalists have been inclined to exclude them altogether from that class, and arrange them among the *Arachnidæ*, and that in entirely rejecting this opinion it becomes necessary to isolate them as much as possible, and to form a particular sub-class, which is connected with that of the *Branchiopoda* and that of the *Trilobites*, but is distinguished from those Crustaceans and all the other animals of the same class by the character of its organisation. The natural position then of these Xiphosures should, in the opinion of M. Milne-Edwards, have been near the Branchiopods, but he has preferred the place which he has assigned to them, in order that he might not break the connection which unites all the Maxillated Crustaceans.

The body of these animals is described by M. Milue-Edwards as composed of three portions—a cephalo-thorax, an abdomen, and a tail: the two first portions are each covered by a horny shield, and the third assumes the form of a long stiletto. The cephalo-thoracic buckler, which represents the carapace of *Apus* [BINOCULUS] and of the superior Crustaceans, is the largest: it is convex above, concave below, and rounded in front and on the sides, whilst posteriorly it is deeply notched for the reception of the base of the abdomen. On its upper surface is an unequal space, slightly or not at all convex, which is circumscribed in front and on the sides by two curved crests, and occupies behind the whole length of the straight portion of the posterior border articulated with the abdomen. This space, which may be termed the occipital region, is subdivided longitudinally into three lobes by two furrows which curve inwards anteriorly; and on the median lobe may be also remarked a median ridge or elevation more or less distinct, at the anterior extremity of which is a small smooth tubercle having the aspect of a stemma, and on each side of which in fact is a very small smooth eye. This conformation led Latreille and others to attribute three stemmata to these animals. Towards the middle and on the outside of the lateral ridges which circumscribe the occipital region on each side are situated the composite eyes, which are of an oval form, and exhibit hexagonal divisions on their transparent cornea. The anterior and lateral or marginal region of the cephalo-thoracic buckler forms in front and on the sides a very inclined plane, and presents nothing remarkable; the only point that requires notice is, that posteriorly it is prolonged beyond the occipital region, so as to constitute on each side a sort of horn directed backwards.

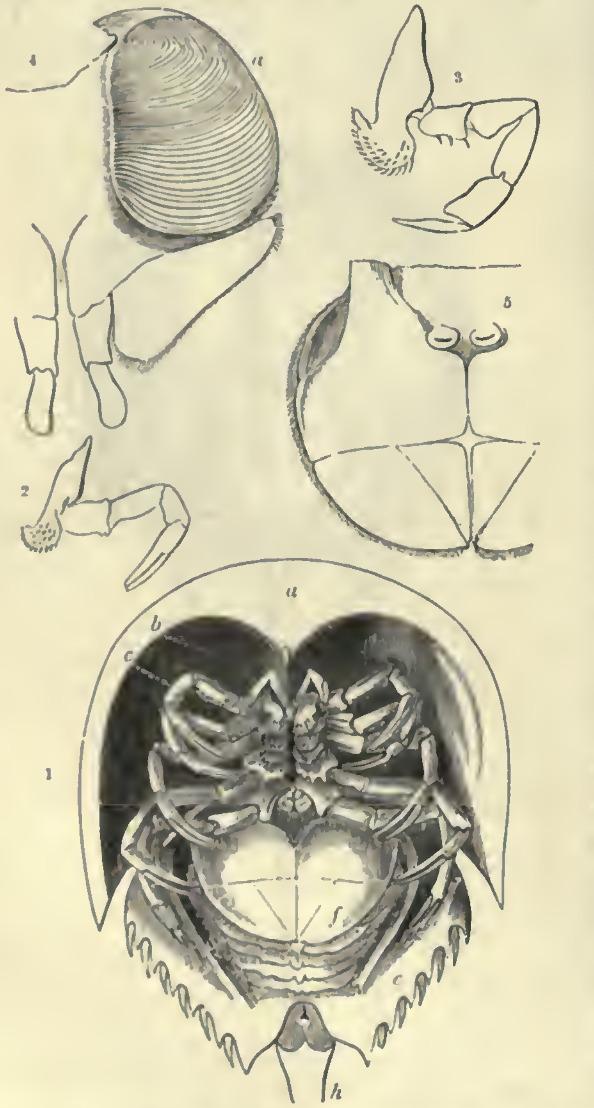
The second buckler, or abdominal portion of the body, is much less wide than the preceding, but long also, and of an inequilateral hexagonal form, whose posterior border is more or less concave. Its anterior border is articulated with the posterior border of the occipital region of the carapace, and its latero-anterior edges correspond to the oblique borders by which the marginal region of the same buckler is terminated behind. The latero-posterior borders, which are in general longer than the preceding, form with these last a very obtuse angle, and present a series of eight teeth separated from each other by six depressions, in each of which is inserted a large moveable spine whose point is directed backwards. Above, this abdominal buckler is convex and divided into three lobes, of which the two lateral are very large, and the median lobe narrowed behind and separated from the preceding by two rows of small depressions. From the middle of the posterior border of this second portion of the body springs a long styliform piece, which, being situated above and behind the anus, should be considered as the analogue of the caudal ring.

On the lower aspect of the body appears anteriorly a flat and triangular surface, which is on a level with the frontal border; but in the rest of its extent the cephalo-thoracic buckler is deeply excavated for the lodgment of the feet. These last immediately surround the buccal aperture, and are so disposed that their basilary joint performs the functions of the mandibles and jaws of the ordinary crustaceans, whilst their internal branch is elongated in order to constitute an ambulatory and prehensile member: there are six pairs of these feet. The first, termed Mandibles by Fabricius and Latreille, and Palps by Cuvier, are much smaller than the others, and situated before the mouth, near the median line: they are inserted on an unequal membranous eminence which fulfils the functions of a labrum, and are composed of three joints, the two last of which are disposed so as to constitute a claw. The four following pairs of feet, or rather jaw-feet, much resemble each other, and are each composed of six joints: the first of these joints is very large, and terminates on the inside by a lamellar prolongation, armed with strong spines, and performing the function of a jaw: there is also, under its internal and anterior angle, a small moveable piece. The succeeding joints constitute an elongated and slightly-compressed foot; and in the females the penultimate joint is prolonged below the last, so as to form with it a claw with equal branches: this is sometimes the same in the male; but in some species of *Limuli* this sort of hand is wanting in the feet of the second and third pair, the prolongation representing the immoveable finger not being developed. The sixth pair of feet differs much from the preceding: their basilary joint is larger, terminates on the internal side in a toothed surface bearing some resemblance to that of a grinding mandible, and carries at its external angle a flabelliform appendage. Sometimes there exists a small lamellar appendage at the extremity of the fourth joint, and the next joint carries on its anterior border many of those subfoliaceous and elongated laminæ which hide nearly entirely the succeeding joint, as well as the small didactylous hand which terminates it. Lastly, between the base of these feet, at the posterior part of the thorax, are two small lamellar pieces which are obtuse at the end, and furnished with spines, which seem to be the vestiges of a seventh pair of limbs. The abdomen is hollowed out into a rather deep cavity, which is very analogous to that in *Sphæroma* and many other *Isopoda*. In this cavity are lodged the abdominal false feet and the branchiæ fixed to their posterior surface. There are six pairs of these members, but the most anterior are not distinct, and are united on the median line, so as to constitute a great foliaceous and nearly circular valve, but which is truncated anteriorly, and which entirely covers the succeeding false feet: in each half of this operculum are to be distinguished one or two basilary pieces and two terminal laminæ, which represent the two branches which ordinarily terminate these organs: one of these pieces, situated near the median line, is small, and separated from that of the opposite side by a fissure; the other is very large: finally, on the superior or posterior surface of this first pair of false feet the two orifices of generation are found. The succeeding false feet are equally foliaceous, and united on the median line throughout the whole extent of their basilary piece; but the two branches which terminate each of these organs are free and more developed. The internal branch is composed of two joints, the first of which is quadrilateral and elongated, the second foliaceous and oval. The external branch is represented by a very wide lamina, which is rounded externally, and resembles that of the operculum. The two external thirds of the posterior surface of the basilary portion of these limbs are occupied by a great gill formed of a considerable number of laminæ, or rather of cutaneous folds, disposed transversely, and piled one on the other like the leaves of a book. These leaves adhere to the false feet throughout the length of their base or anterior border, and are free in the rest of their extent. They are triangular, with a curved border, and increase in size from the upper extremity of the branch to its base, so as to give to this last the form of a pyramid, the posterior ridge of which is curved, the two free surfaces convex, and the base rounded. The free edge of each leaf is furnished with a small horny band destined to sustain it, but throughout the rest of their extent these folds are membranous: there are about 150 of them in each of the first pair of gills, and a few less in the succeeding gills; the last has only about 130.

Limulus Moluccanus, reduced one-fourth, and seen from above.

a, position of the two smooth eyes; *b*, *b*, lateral composite eyes; *c*, *c*, respiratory apertures.

The mouth, situated towards the posterior third of the lower surface of the cephalo-thoracic buckler, is surrounded, as has already been noticed, by the feet, the basilary joint or haunch of which is armed with spines or teeth and disposed so as to serve for the work of mastication. This aperture is infundibuliform, and continued with the digestive tube, which is directed at first directly forward, then curves upwards and backwards, and proceeds in a direct line to the extremity of the abdominal buckler, where it presents anew a small curvature in its course to the anus. The first portion of this canal, directed forwards and situated below the intestine, constitutes the œsophagus: it is narrow, rather long, and furnished internally with longitudinal plaits. The stomach is represented by the curved and anterior portion of this same tube; it is small and directed vertically; its walls are very fleshy, and puckered (fronçées) internally; an internal furrow separates it from the œsophagus, and its pyloric extremity advances in form of a cone in the cavity of the intestine, so as to constitute a species of valvule. The third portion of the intestinal tube occupies nearly the whole length of the body, and represents the duodenum, or chylific ventricle: it is cylindrical, straight, and has towards its two extremities some transverse folds of the internal membrane, and more or less projecting papillæ. On each side, a little above the level of the mouth, are two small circular orifices, which belong to the biliary apparatus, and its posterior extremity is suddenly contracted in order to its continuation with the fourth portion of the digestive tube, which may be considered as the intestinum rectum. It is very short, plaited longitudinally in its interior, and curved downwards at its extremity in order to reach the anus, which is situated in front of the insertion of the caudal sword. The liver fills in the cephalo-thorax the space situated between the intestine and the muscles of the feet: it extends also into the abdomen, and is composed of blind and contorted canals, which are continued with the excretory conduits, the four trunks of which open in the anterior part of the duodenum.



1. *Limulus rotundicauda*, seen from below. *a*, frontal portion of the carapace; *b*, anterior feet; *c*, second pair of feet; *d*, sixth pair of feet; *e*, abdomen; *f*, opercular lamina formed by the first pair of false feet, and covering the branchiferous feet; *g*, branchiæ, or gills; *h*, caudal stylet, or xiphoid process. Milne-Edwards.

2. One of the second pair of jaw-feet. Milne-Edwards.

3. One of the second pair of jaw-feet in a male *Limulus Moluccanus*. Milne-Edwards.

4. One of the branchiferous false feet. *a*, branchiæ.

5. Opercular lamina of the abdomen seen on its internal surface, and showing the orifices of the organs of generation. Milne-Edwards.

The heart bears much resemblance to that of the *Squillæ*. [STOMAPODA.] It is a long dorsal vessel with fleshy walls, which present on each side seven transverse apertures furnished with valvules, and which give origin to various arteries.

The nervous system consists in a medullary ring which surrounds the œsophagus, gives origin to the cephalo-thoracic nerves, and is continued backwards with a stout cord, from the posterior part of which the abdominal nerves spring.

The organs of generation open externally by the apertures at the base of the first pair of false feet. In the female these orifices each communicate with an oviduct, which when arrived in the thorax is divided into two branches, the ramifications of which constitute the ovary and embrace the liver. In the male, in place of the vulvæ, there is a small cylindrical penis. ('Histoire Naturelle des Crustacés' 1840.)

Such is the statement given by M. Milne-Edwards of the organisation of this highly interesting form.

Professor Owen, in his 'Hunterian Lectures' (1843), has drawn attention to certain points in the structure of these animals. He states that the *Xiphosura*, typified by the *Limulus*, or Molucca Crab, have the head and thorax more completely blended together than in the true crabs, which they resemble in the general form of the body; but that they are peculiarly distinguished from all other *Crustacea* by having the office of jaws performed by the first joint of the thoracic legs, which surround the mouth. The large cephalo-thoracic segment is, he remarks, protected above and laterally by an expanded crescentic shield obscurely divided by two longitudinal impressions into three lobes, supporting the organs of vision on their highest part. The tergal parts of the segments of the second division of the body are also blended, he observes, into one trilobate clypeiform piece, their original separation being indicated by the branchial fissures, and the number of the segments by that of the lamelliform appendages attached to their inferior surface. The termination of the intestine beneath the last segment of the second division of the body of the *Limulus* proves, in Professor Owen's opinion, that division to answer to the abdomen in the *Malacostraca*; but admitting the sessile eyes to indicate a distinct segment, not more than sixteen segments can, he remarks, be determined by the appendages to enter into the composition of the entire crust of the *Limulus*, including the sword-shaped appendage, which is analogous, in the Professor's view, to the last or post-anal segment of the higher *Crustacea*, and consists of a single modified segment.

Professor Owen then adverts to the small *Entomostraca*, in which the number of the thoracic and abdominal segments generally exceeds that in the *Malacostraca*, and adduces, as an example, the *Branchipus* (*Chirocephalus*) *stagnalis* [BRANCHIOPODA; CHIROCEPHALUS], which has eleven thoracic segments and nine abdominal or caudal rings, besides a distinct head protected by a thoracic shield. In the *Isaura*, in which this shield is developed, as in *Cypris*, *Daphnia*, and other *Entomostraca*, to the extent and in the form of a bivalve shell enveloping the whole body, the number of thoracic and abdominal segments exceeds, he remarks, twenty-four.

These observations relative to the segments of the *Crustacea* are interesting when considered with reference to a race of that class of which no living analogue exists; and he thus points out the value of this part of their conformation as applicable to the subject:—

"The distinction between the *Entomostraca* and the *Malacostraca* in the number of the segments of the body is of the first importance in determining the affinities of the ancient extinct *Crustacea* called *Trilobites*. These remarkable animals were almost the sole representatives of the present class in the periods which intervened between the deposition of the earliest fossiliferous strata to the end of the Coal Formation. They appear to have been without antennæ and feet; the structure of the tergal part only of their body-segments is yet known; but these are grouped together to form a distinct head, thorax, and abdomen or tail. The head is formed by a large semicircular or crescent-shaped shield; the thorax consists of from ten to fifteen segments, and the abdomen or tail includes at least eight segments in this *Calymene* (Prep., No. 208), in which it is bent under the thorax, as in the Crab; the abdomen, post-abdomen, or tail, as the third segment is variously termed, contains fifteen fettered segments in *Asaphus caudatus*: the segments of both thorax and abdomen are very similar to each other, and gradually decrease in size. They are divided by two longitudinal furrows into three lobes. The head supports a pair of large compound eyes situated near the sides, like the large outer pair of eyes in the *Limulus*, which they resemble in form and structure.

"The *Malacostraca* are divided into two groups, according to the attachment of the eyes: those with immoveable sessile eyes form the *Edriophthalma*; those with moveable pedunculated eyes the *Podophthalma*.

"The lower organised or Edriophthalmous forms of Malacostracous *Crustacea* resemble the *Trilobites* in the non-confluence and uniformity of the segments of the thorax and abdomen. Certain genera, as *Serolis* and *Bopyrus*, have the tergal arcs of the segments trilobed; but they exceed not the characteristic number in the *Malacostraca*, and the seven rings of the thorax are clearly indicated in each by the seven pairs of articulated feet which they support, although these are very small in the parasitic *Bopyrus*. In the *Cymothoa* the seven thoracic and seven abdominal segments are more distinctly characterised."

With regard to the nervous system and senses Professor Owen, after alluding to Cuvier's description of that part of the organisation in the Common Crab, Mr. Swan's illustrative dissections and beautiful plates of the same, and the able display of the corresponding structure in the *Maia* by Audouin and Edwards, observes that an analogous concentration of the nervous system, but with interesting modifications, has been described by Professor Van der Hoeven in the *Limulus*, or King-Crab, the most gigantic form of the Entomostracous tribe, and probably the only existing genus from which we may derive an insight into the organisation of the extinct Trilobitic Crustaceans. Professor Owen was therefore induced to put the well-preserved specimens of *Limulus* given to the College of Surgeons in London by Mr. Boot, of Boston, United States, into the hands of Mr. Goadby, the anatomical assistant to the college, whose beautiful dissections and preparations will be found in the museum of the College.

Professor Owen observes, in his Lectures, that the large lateral compound eyes of this crustacean are sessile. The cornea, he proceeds to state, is divided into a considerable number of small circular facets, each of which corresponds to an ocellus; and the optic nerve, after its long course as a simple chord without forming a ganglion, divides near the eye into a pencil of fine filaments, which severally receive the impressions from their respective ocelli, of the aggregate of which the large lateral eye is composed: the two small simple median eyes, which are almost in contact, command the space before the head which is out of the range of the large compound eyes. Each simple eye, he further informs us, receives its distinct nerve from the anterior apex of the corresponding cerebral lobe.

"In the sessile eyes of the *Edriophthalma*, as, for example, in the *Serolis*, the inner layer only of the cornea is divided into hexagonal facets, corresponding with the number of the conical crystalline lenses of the compound eye. But in the *Trilobites* the cornea presents the same subdivided surface as in the *Limulus;* and the position of the two eyes agrees with that of the corresponding compound pair in the large existing Entomostracan. The eyes are more elevated in the *Trilobites*. In the *Asaphus caudatus* the cornea is divided into at least 400 compartments, each supporting a circular prominence; its general form is that of a frustum of a cone incomplete towards the middle line of the head, but commanding so much of the horizon in other directions, that where the distinct vision of one eye ceases that of the other begins. In the Mandibulate Crustaceans, distinguished by having their compound eyes supported on moveable peduncles, the form of the corneal facets varies; they are square in the river Craw-Fish, hexagonal in the Hermit and Common Crabs. There is a conical crystalline lens behind each facet imbedded in a small vitreous humour, upon which the optic filament expands, and each ocellus is lodged in a pigmental cell, which likewise covers the bulb of the optic nerve; the cavity containing the compound eye is closed behind by a membrane continuous with the inner layer of epiderm, and pierced for the passage of the optic nerve. In the Podophthalmous *Crustacea* there is generally a spacious furrow or cavity, in which the eye can be lodged and protected, and it is termed the orbit. In one or two species the eye-stalks project beyond the margins of the carapace." (Owen.)

The same acute observer, speaking of the organs of digestion of these large crustaceans, which form the only genus represented by species which co-existed with *Trilobites*, remarks that the *Limuli* differ from all other living *Crustacea* in their organs of mastication, which are the modified hard joints of the five posterior pairs of legs: the first small pair, serving to bring the food to the mouth, are supported on a rudimental labrum. He refers to the discovery by Mr. Charles Stokes of a distinct subquadrate labrum deeply emarginate anteriorly in *Asaphus platycephalus* [TRILOBITES], and remarks that the nearest approach to this the only known part of the trophi of the *Trilobites* seems to be made by the Entomostracous genus *Apus*, in which however the labrum is truncated. A few of the lowest organised *Crustacea*, as *Caligus*, *Nymphon*, and *Pycnogonon* obtain their aliment, he adds, like the *Epizoa*, by suction.

After referring to the structure of the mouth in the Malacostracous *Crustacea*, and pointing out that the alimentary canal is most simple in the Suctorial Crustaceans, in which it presents no noticeable difference from that in the *Epizoa*, the hepatic appendages however being more localised and better developed, he thus describes this part of the organisation in *Limulus*:—

"In the *Limulus* the mouth is situated nearly in the centre of the inferior surface of the great cephalo-thoracic segment; the œsophagus is continued from it in a very unusual course forwards, and expands into a stomach, which is situated at the anterior part of the head. This organ is abruptly bent upon itself upwards and backwards, and is continued by a gradual diminution of diameter, as appears upon an external view, into the intestine, which passes backwards, with a slight vertical bend, to the base of the penultimate abdominal segment. When we examine the interior of the alimentary tract, the distinction between the stomach and intestine is effected, as Van der Hoeven has shown, by a conical valvular pylorus, which projects into the commencement of the intestine. The stomach is lined by a very dense and corrugated horny membrane. The hepatic mass which, with the generative glands, fills the greater part of the cephalo-thoracic cavity, pours its secretion into the commencement of the intestine by two ducts on each side." (Prep., No. 477, A.)

In the heart of the *Crustacea* we may trace a gradational series of forms, from the elongated median dorsal vessel, to the short, broad, and compact muscular ventricle in the lobster and the crab; and in all the *Crustacea*, as in all the other articulate animals, the heart is situated immediately beneath the skin of the back, above the intestinal tube, and is retained in situ by lateral pyramidal muscles. In the lower, elongated, slender, many-jointed species of the Edriophthalmous *Crustacea* the heart presents its vasiform character: it its broadest and most compact in the crab.

"In this series," says Professor Owen, "we may trace a general correspondence in the progressive development of the vascular as of the nervous system, concomitant with the concentration of the external segments, and the progressive compactness in the form of the entire body. But there is a remarkable exception to this concomitant progress in the *Limulus*, indicative, with the general condition of the instruments of locomotion and respiration, of the essentially inferior grade of organisation of that genus, which, as has already been observed, seems to be the last remnant of the once extensive group of Trilobitic *Crustacea* which swarmed in the seas of the ancient secondary periods of the earth's history.

"We have seen in the compact and broad existing representative of those extinct gigantic Entomostracans, that the nervous system exhibits a concentration of its principal central mass around the mouth, analogous to the condition in the common crab, but with a ganglionic double chord continuing from it. The heart however is far from presenting a corresponding degree of concentration: it remains an elongated fusiform tube, extending parallel with the intestine from the pylorus to the rectum: it is contained in a pericardium with thin membranous walls, formed by the central sinus of the venous system, and it receives the blood from that sinus and from the branchial veins by a series of from seven to ten lateral vertical slits, defended by valves as in the higher *Crustacea*. An aortic trunk proceeds from each extremity of this heart. The anterior aorta is the largest, and immediately divides into three branches. The middle and smallest branch passes forwards to the anterior edge of the cephalic shield, following the curve of its middle line, and supplying the small median ocelli in its course. The two larger lateral branches form arches, which curve down the side of the stomach and the œsophagus, giving branches to both those parts and to the intestine, and becoming intimately united with the neurilemma of the œsophageal nervous collar. They unite at the posterior part of that collar, and form a single vessel, which accompanies the abdominal nervous ganglionic chord to its posterior bifurcation, where the vessel again divides. Throughout all this course the arterial is so closely connected with the nervous system as to be scarcely separable or distinguishable from it. The branches of the arterial and nervous trunks, which accompany each other, may be defined and studied apart.

"The posterior aorta is chiefly destined for the supply of the sword-like tail of the *Limulus:* the first part of its course is wavy, to adapt it to the strong inflections of that appendage. The aërated is mixed with the venous blood in the heart, and is propelled in that mixed condition throughout the body, in the *Limulus* as in the lobster."

With regard to the generative apparatus, Professor Owen observes that most of the small *Entomostraca* carry the impregnated ova in appended ovisacs, like those of the *Lerneæ*. [LERNEADÆ.] These sacs are not developed, he remarks, in the *Limulus*, which also differs from the smaller *Entomostraca*, inasmuch as the ovarian mass interblends its lobes and processes with those of the liver: the oviducts, he adds, form more frequent communications with each other than in the higher *Crustacea*, but ultimately terminate, like the vasa deferentia, by two distinct but continuous orifices on the back part of the first abdominal lamelliform appendage.

The *Limuli* undergo in their youth considerable changes of form. At first there is no sword-like or styliform tail, which in the adult *Limulus* equals, at least, the rest of the body in length; their abdominal buckler is rounded posteriorly, and the last pairs of false feet are not developed. M. Milne-Edwards observed this in the embryos on the point of exclusion from the egg, at which period the abdomen supports only three pairs of appendages.

The species of *Limulus* inhabit the sea, and sometimes come upon the sandy beaches. They are found in the Indian and Japanese seas, and in the Atlantic, on the coast of North America; but they do not appear to have a higher range than 44° N. lat., and seem confined to the northern hemisphere. Their food consists of animal substances; and when stranded, they often bury themselves in the sand as a protection against the heat of the sun, which is soon fatal to them.

M. Milne-Edwards remarks that Leach, it is true, has restricted this generic name of *Limulus* to those species the whole of whose feet are cheliform, and has proposed a new genus, under the designation of *Tachypleus*, for those whose anterior feet are monodactyle; but he observes, it is now well known that this last character is only met with in the male of certain *Limuli*, and does not coincide with other peculiarities of structure of any importance, so that it does not appea a sufficient basis on which to found a generic division. M. Milne-Edwards thus arranges the species known to him, five in number:—

Section I.—Species whose second and third pairs of jaw-feet (two first pairs of Latreille) are monodactyle in the male, and in which the moveable spines of the lateral border of the abdomen are of two sorts, namely, very long and very short.

L. Moluccanus, the Molucca or Common King Crab. The cephalo-thoracic buckler is regularly rounded anteriorly in both sexes, and above showing three rows of small spiniform points, situated one on the median crest, the others on the crests which separate the occipital region from the lateral regions; the posterior and lateral borders finely dentilated. The abdominal buckler smooth above, and terminated by two very short teeth, the internal border of which is very long, and the external border (comprehended between the point and the insertion of the last spine) very short; tooth of the latero-anterior border moderate, and situated towards the middle of that border; moveable spines of the latero-posterior border moderate, and all nearly of the same length in the male; the first three rather long in the female; but the last three extremely short, and much wider than they are long. Caudal stylet triangular, spiny on its upper border, and slightly concave on its inferior surface. Last pair of jaw-feet furnished towards the end with four elongated appendages, which are lamellated, flattened, and sublanceolate. (Milne-Edwards.)

This is the *Cancer Moluccanus* of Clusius; *C. perversus* of Rumphius; *Limulus Polyphemus* of Fabricius; *L. gigas* of Müller; and *L. Moluccanus* of Latreille.

M. Milne-Edwards is of opinion that Leach's *L. Latreilli* probably belongs to this species, as well as *L. tridentatus* of the same author.

L. Moluccanus is apparently the *Cancer* figured by Bontius in the fifth book of his 'Natural and Medical History of the East Indies,' p. 83, in which he notices its sword-like appendage, and states that if any incautious fisherman is wounded by it the pain is like that caused by a scorpion, adding, that its flesh is not so delicate as that of the other Crabs. The chapter is headed by the following verses, which refer to the painful wound inflicted by the tail.

"Quisquis caudati sensisti tela Paguri
Disce meo exemplo morsus vitare dolesos,
Dente leonino quos aula volubilis infert
A tergo, et pejus retinet fors cauda venenum."

L. virescens. M. Milne-Edwards states that this species, the female only of which is known to him, bears a strong resemblance to *L. Moluccanus*, but is distinguished from it by the conformation of the posterior feet, the penultimate joint of which is extremely short, and surrounded at its base with seven spines, which, instead of being flat, very much elongated, and rather wide, are rounded, conic, and very much pointed. The first four pairs of feet were broken in the only individual which M. Milne-Edwards had examined, so that he could not verify the character indicated by M. Latreille, the namer and describer of the species, drawn from the monodactylous conformation of the second pair (the first pair of Latreille). It is also worthy of note, M. Milne-Edwards adds, that the cephalo-thoracic buckler is less convex than in the preceding species.

The same author observes that the *Limulus* preserved in the Paris Museum under the name of *Polyphemus heterodactylus*, Lam., and ticketed by Latreille, seems to him to be the male of the preceding species; but the absence of the posterior feet prohibits positive certainty on this point.

L. longispina. M. Milne-Edwards notices this as a species closely approximating to *L. Moluccanus*, but having the teeth or posterior angles of the abdominal buckler larger and more regularly triangular; the external border of these teeth being nearly as long as the internal border, and their base much less wide than the space left between them and occupied by the caudal stylet. Upper surface of the abdomen covered with small spines; the tooth of its latero-anterior border large, and situated very near that which separates that border from the latero-posterior border; moveable spines of the six pairs in the males and of the first three pairs in the female very long; last three pairs very short, but sharp in the female. Caudal stylet triangular, and spiny on its borders. Frontal border of the male strongly notched and sinuous, so as to appear trilobate.

It is found on the coasts of Japan, and probably of China.

This is the Kabuto-Gani (Helmet-Crab) of the Japanese; Un-Kiie, or Umi-do-Game, of the Chinese.

Section II.—Species in which the third pair of jaw-feet are cheliform in both sexes, and in which the moveable spines of the latero-posterior border of the abdomen diminish gradually in length in both male and female.

a. Second pair of jaw-feet monodactylous in the male. Caudal stylet triangular and spiny on its upper border.

L. Polyphemus. Cephalo-thoracic buckler more convex than in the preceding species, and preserving for a longer period the seven spines situated on its upper surface. Posterior teeth of the abdomen very large, and representing an equilateral triangle, or even being longer than they are wide at their base. The moveable spines of the latero-posterior border are moderate, and similar in both sexes; the three teeth of the median line project more than in the preceding species, and the caudal stylet is less long. (Milne-Edwards.)

It inhabits the Atlantic Ocean and the coasts of North America and the Antilles.

This is the *Araneus marinus* of De Laet; *Cancer Moluccanus* of Wormius; *Monoculus Polyphemus* of Linnæus, but he confounds under this name both the Oriental and American species; *L. Cyclops* of Fabricius; *L. Americanus* of Leach; *Polyphemus occidentalis* of Lamarck; and *L. Polyphemus* of Ranzani.

John De Laet, in his 'Novus Orbis' (1633), gives a very fair figure of this species in the 19th chapter of his second book, and states that the arms of the Indians (Almouchiquosy) of 'Wijngaerden Eylandt,' in 'New France,' are lances, clubs, bows and arrows, which, for want of iron, they sharpen with the crustaceous tail of the monstrous fish Signoc, Siguenoc, or *Araneus marinus*, by which name the *Limulus* there engraven is known to the Indians and Dutch. De Laet gives a good description of it, and says that it loves the shallows, and is mostly taken in æstuaries, of various sizes, not a few having a tail exceeding a palm in length.

M. Milne-Edwards observes that *L. Sowerbii* of Leach is a variety of this species, having the last median tooth of the upper surface of the abdomen more projecting than it is ordinarily to be seen in adults.

a a. All the jaw-feet cheliform in the male, as well as in the female; caudal stylet rounded above.

L. rotundicauda. Cephalo-thoracic buckler wider than in the preceding species, less convex, and deprived of the series of small spines between the great teeth of its upper surface, but with a great number of these spiniform points scattered on the occipital region; terminal teeth of the abdomen short, and having their internal border about twice as long as the external border; the moveable spines nearly as in the preceding. Caudal stylet obscurely triangular, with rounded borders. (Milne-Edwards.)

It is found in the Moluccas.

It is the *Cancer marinus perversus* of Seba.

Fossil Limuli.

The fossil forms of this group, contemporaneous as some of them were with the *Trilobites*, to which they bear so strong a relationship, are among the most interesting. One fossil species, *Limulus trilobitoides*, Buckland, from the ironstone of the coal-formation, Coalbrook Dale, figured on plate 46 of the 'Bridgewater Treatise,' is very trilobitic in appearance, and in the early state of the animal, before the development of the caudal stylet, the resemblance must have been still more striking; nor will it escape the observation of our palæological readers that some of the *Trilobites* are furnished with a long caudal appendage.

Limulus, as Dr. Buckland remarks in the work above noticed, has been found fossil in the coal-formation of Staffordshire and Derbyshire, and in the Jurassic limestone of Aichstadt, near Pappenheim, together with many other marine crustaceans of a higher order.

M. Milne-Edwards notices the numerous species which have been recorded. That figured by Desmarest under the name of *Limulus Walchii* (*Cancer perversus* of Walch and Knorr) is found, he observes, in the lithographic slate of Solenhofen and Pappenheim. In Milne-Edwards's opinion it approaches *Limulus longissimus* more than any other existing species, but appears to have the latero-posterior prolongations of the cephalo-thoracic buckler less developed, and the abdomen wider, with its latero-anterior borders very short; as to the moveable spines, they are, he remarks, six in number, and are all long and slender.

Other fossil *Limuli* have been discovered not only in this formation, but also in the Muschelkalk and the Jurassic limestone, by Count Munster, who has given figures of them in the excellent work of Van der Hoeven on the *Limuli*; but M. Milne-Edwards thinks that these fossils have not been as yet described with sufficient details to enable naturalists to assign specific characters to them; and he confines himself to the observation that *Limulus intermedius*, Munster, found at Solenhofen, and *Limulus brevicauda* (*brevicaudatus?*), Munster, found at Aichstadt, are remarkable for the form of the abdomen, which represents a rhomboid rather than a hexagon, its anterior border being nearly confounded with its latero-anterior borders. *Limulus ornatus* of the same author, in the opinion of M. Milne-Edwards, appears to approach *Limulus Walchii* closely, but presents a much deeper furrow throughout the length of the caudal stylet.

M. Milne-Edwards finally calls attention to *Limulus trilobitoides*, Buckland, above mentioned, remarkable for the spiniform prolongations of the lateral angles of the cephalo-thoracic buckler and many other characters.

LINA'CEÆ, *Flaxworts*, a small natural order of Plants, related to *Cistaceæ*, from which it differs in having an ovary with many cells, containing one or two seeds each, several styles, a definite number of stamens, &c., and to *Geraniaceæ*, from which the separate styles and peculiar fruit of *Linaceæ* abundantly separate that order. The definition of *Linaceæ* may be briefly expressed thus: polypetalous, hypogynous, monadelphous exogens, with a broken-whorled calyx; a many-celled many-styled ovary, containing one or two pendulous ovules in each cell, and a capsule splitting at the point into as many valves as there are cells. The fruit is remarkable for having each of its carpels divided into two cells by a spurious dissepiment originating inside the back, so that in reality each cell is 2-seeded, although from the presence of this spurious partition it seems to be 1-seeded.

But although *Linaceæ* approach the two orders already named in the structure of the organs of fructification, the vegetation is essentially different, the leaves being alternate, free from all trace of a volatile secretion, and destitute of stipules, and the nodes of the stem not being capable of disarticulation. The whole order contains but two genera, *Linum* and *Radiola*: the former comprehends many species, the most important of which is common flax, *Linum usitatissimum*, the woody tissue of whose stems is so valuable for its toughness and fineness, and whose seeds furnish linseed oil. [FLAX, in ARTS AND SC. DIV.; LINUM.]

LINA'RIA (from λίνον, flax, owing to a similarity in the leaves), a genus of Plants belonging to the natural order *Scrophulariaceæ*. It has a 5-parted calyx, a personate spurred corolla, the lower lip 3-fid with a prominent palate closing the mouth. The capsules open by valves or teeth at the top. The species are annual or perennial plants, very rarely small shrubs, and the flowers of a beautiful appearance, racemose or spicately racemose at the tops of the branches.

L. Cymbalaria, Ivy-Leaved Toad-Fax, has roundish heart-shaped leaves, 5-lobed and glabrous; the stem procumbent, slender, and rooting. The flowers are solitary, axillary upon long stalks, and of a pale blue colour. It is a native of Europe, chiefly on old walls. It grows abundantly in Italy and Sicily, and is found in Great Britain. There are several varieties of this species.

L. Elatine, Halbert-Leaved Toad-Flax, has ovate hastate leaves, the lower ones ovate, the peduncles glabrous, stem procumbent, and the spur straight. The flowers are solitary, on long slender stalks, small, and of a yellow colour, with the upper lip purple. It is a native of Europe and Africa, and is found in chalky corn-fields in Great Britain.

L. spuria, Spurious Toad-Flax, has roundish ovate entire leaves, the spur curved upwards, the peduncles hairy, and the stem procumbent. The appearance of this plant is similar to the last, but the flowers are larger, and the whole plant not so slender. It is a native throughout Europe in corn-fields, and is found in Great Britain.

L. minor, Smaller Toad-Flax, is distinguished by its linear-lanceolate leaves, which are obtuse, glandular, pubescent, and mostly attenuate. The flowers are solitary and axillary, the peduncles three times as long as the calyx, and the seeds oblong sulcate. It is found in sandy corn-fields throughout Europe and Great Britain.

L. Pelisseriana, is known by its racemose flowers, which are of a dark purple colour with darker veins. It is native of the south and middle of France and of Great Britain.

L. repens, is distinguished by its lanceolate sepals and angular seeds with transverse elevated lines. The flowers are of a bluish colour, the stem erect, branched, and leafy. The seeds are much smaller than either of the following species. It is found on calcareous soils, particularly near the sea, in Great Britain.

L. Italica has scattered linear-lanceolate leaves, lanceolate oblong sepals, and orbicular scabrous seeds, with a membranous margin. The corollas are of a deep yellow colour. This species is found plentifully in the west of England and near Cork, in Ireland; it is also native of Switzerland, Italy, and Hungary.

L. vulgaris, has ovate-acute glabrous sepals, shorter than the capsules and the spur. The flowers greatly resemble those of *L. Italica*, but are twice the size. In Worcestershire this plant is called 'Butter and Eggs.' Gerard names it Wild-Flax, Toad-Flax, and Flax-Weed. It abounds in an acrid oil which is almost empyreumatic. Taken inwardly, it induces nausea. It has been advised in dropsy, but Haller and others disapprove of it. When united with milk the juice is a poison to flies. The flowers are employed in some places to give a yellow colour.

The whole of the species of *Linaria* have an elegant appearance, and are therefore suited for flower-gardens. They grow well in common garden earth, but prefer a dry sandy soil. The seeds of the annual species require to be sown early in the open border where they are intended to remain.

Linaria has also been adopted as the generic name of some species of birds. [LINOTA.]

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*.)

LINARITE, a Mineral consisting of Cupreous Sulphate of Lead. It occurs crystallised. Its primary form is an oblique rhombic prism. Colour deep azure-blue. Streak pale blue. Fracture uneven. Hardness 2·5 to 3·0. Lustre vitreous or adamantine. Transparent, translucent. Specific gravity 5·3 to 5·4. It is found at Linares in Spain, and at Lead Hills, Scotland. Its analysis by Brooke gives—

Sulphate of Lead	74·4	
Oxide of Copper	18·0	
Water	4·7	
		97·1

LINCOLNITE. [HEULANDITE.]

LINGUELLA. [INFEROBRANCHIATA.]

LI'NGULA, a genus of Brachiopodous *Mollusca*, of which several species have been found fossil. They are found in the Silurian, Old Red Sandstone, and Green Sand rocks. [BRACHIOPODA.]

LI'NKIA. Nardo has proposed this name for a group of *Stelleridia* included in *Asterias* by Lamarck. (Agassiz, on *Echinodermata*, 'Ann. of Nat. Hist.,' vol. i.)

LINNET. [LINOTA.]

LINOSYRIS, a genus of Plants belonging to the natural order *Compositæ*. The heads are not radiant; florets all perfect and tubular; receptacle naked, pitted; the pits with elevated dentate margins in the British species; phyllus imbricated; pappus pilose; fruit compressed, silky, without a beak.

L. vulgaris is an herbaceous Plant, found in middle and southern Europe and in Great Britain. It has linear glabrous leaves, corymbose heads, the involucre lax; the stem from 12 to 18 inches high, simple and leafy; leaves single ribbed, smooth or scabrous, very numerous, more or less dotted: flowers yellow. It grows on limestone cliffs. It is the *Chrysocoma Linosyris* of Smith.

LINOTA, a genus of Birds belonging to the family *Fringillidæ*. The genus is thus defined by Yarrell:—Beak straight, conical, pointed. Nostrils basal, lateral, concealed by short feathers. Wings long, somewhat pointed; the first, second, and third feathers nearly equal in length. Tarsi short; feet with lateral toes of equal length; the hind toe and claw as long as that in the middle; claws slender, acute, and curved. Tail forked.

L. cannabina, the Common Linnet, is a hard-billed singing-bird, which though well known under one or the other of its various appellations to every English bird-catcher, has, in consequence of the changes of its plumage and the names applied to it when it appears under those changes, given rise to much confusion in our systems and catalogues, and considerable error among the learned as well as the unlearned.

Mr. Selby, in his 'British Ornithology,' says of the 'Common or Brown Linnet—*Fringilla cannabina*, Linn.:'—"This bird has been considered by most of our authors as two distinct species, under the titles of the Common or Brown Linnet and the Greater Redpole. This error has evidently arisen from the altered appearance it bears at particular ages, and during the different seasons of the year. These changes in all probability had not been suspected, as they certainly had not been traced by the earlier naturalists; and, on the authority of their reputation, succeeding writers sanctioned such mistakes, without giving themselves the trouble of further investigation, till Montagu, who united practical research with scientific knowledge, professed (in the 'Ornithological Dictionary') his conviction of their forming one species; and my own observation and experiments tend to confirm his opinion." Giving all due praise to Montagu and Mr. Selby for their diligence and acuteness in rectifying an error which seems to have been going on from the time of Willughby to the time of the publication of Bewick's 'Supplement,' we must say a word in favour of one of the fathers of Natural History at the revival of letters. A little investigation would have proved that of Bélon at least it cannot be said that the changes of plumage had not been suspected nor traced by him. That acute observer, in his 'Histoire de la Nature des Oyseaux' (Paris, 1555), says, in his description of La Linote, or Linotte, "Les Linotes ont la poictrine et le dessus de la teste, grande partie de l'année, de couleur entre rouge et orengée: car elles ont lors la couleur si vive qu'elle resemble à du sang; mais cela est seulement sur la fin du printemps;"—having previously described the more sombre state of plumage.

Willughby, whose 'Ornithology' was edited by Ray, and contains many observations by the latter, devotes a chapter (xi.) to the subject 'Of the Linnet.' The first section of the chapter is headed 'Of the Linnet in General,' and is as follows:—"The characteristic notes of this kind are—1, a size of body something less than a chaffinch; 2, a testaceous or earthy colour, mixed of cinereous and dusky or brown; 3, a tail a little forked; 4, a peculiar colour of the outmost feathers of the tail, namely, brown, with white borders or edges; 5, a sweet note. Of Linnets we have observed four sorts in England:—1, the Common; 2, the Greater Red; 3, the Lesser Red; 4, the Mountain Linnet." Here is probably the principal origin of the subsequent confusion. These four Linnets are afterwards described and distinguished at length in the same chapter under the names of 'The Common Linnet, *Linaria vulgaris*.' 'The Greater Red-Headed Linnet, *Linaria rubra major*.' 'The Lesser Red-Headed Linnet, *Linaria rubra minor*.' 'The Mountain Linnet, *Linaria montana*.'

Bechstein, under his description of the Common Linnet (*Fringilla cannabina*, Linn.; La Linotte, Buff.; Der Hänfling, Bechst.), states that, instructed by long experience and the observations of many years, he hopes to show in his description that the Common Linnet (*Fringilla Linota*, Linn.), the Greater Redpole (*Fringilla cannabina*, Linn.), and, according to all appearance, the Mountain Linnet (*Fringilla montana*, Linn.), are one and the same species. With regard to the identity of the two first-named species, ornithologists are now generally agreed: with regard to the last the better opinion is against Bechstein, and in favour of the Mountain Linnet being a distinct species.

M. Temminck, who observes ('Manuel d'Ornithologie') that *Fringilla cannabina* and *Frangilla Montium* have been often confounded, and that he has endeavoured to distinguish them by a small number of characters placed at the head of the short descriptions and of the synonyms, applies the same mode of distinction to *Fringilla linaria* and *P. Montium*, which he remarks have also been confounded. The short character given by him to his Gros-Bec Linotte (*Fringilla cannabina*, Linn.), is, "Bill short, of the width of the front, blackish; throat whitish, marked in the middle by some brown spots;" and he thus describes the various states of plumage, and the synonyms of the bird under each.

Old Male in the Spring.—Feathers of the front, of the breast, and of the lateral parts of the latter, of a crimson-red, terminated by a narrow border of rosy-red; throat and front of the neck whitish, with longitudinal brown markings; top of the head, nape, and sides of the neck of a pure ash; back, scapulars, and wing-coverts, chestnut-brown; flanks reddish-brown; middle of the belly and abdomen white; some of the quills black, bordered externally with white; tail forked, black; the feathers edged externally with white and bordered internally by a large white space; iris brown; bill deep-bluish; feet ruddy-brown, more or less pale. Length 5 inches.

Male after the Autumnal Moult, at the Age of a Full Year.—On the top of the head large black spots; the back reddish, with spots of chestnut-brown, bordered with whitish-brown; breast red-ash brown, or red-brown, with borders of whitish-red; brown spots well marked on the flanks, upper tail-coverts black, bordered internally with white and externally with grayish-red. (On raising the feathers of the front and those of the breast the traces of the red colours which ornament the bird in the spring may be seen.)

In this state M. Temminck considers it to be *Fringilla Linota*, Gmelin; Latham, 'Ind.,' v. 1, p. 457, sp. 81; La Linotte Ordinaire, Buffon, 'Ois.,' v. 4 p. 58, t. 1; Id., 'Pl. Enl.,' 151; f. 1; Gérard, 'Tab. Elém.,' v. 1, p. 188; Common Linnet, Lath., 'Syn.,' v. 3, p. 302.

The female, which does not change colour after arriving at the adult state, is smaller than the male; all the upper parts are of an ashy-yellowish, sprinkled with blackish-brown spots; wing-coverts of a tarnished red-brown; lower parts bright-reddish, but whitish on the middle of the belly, and sprinkled on the flanks with numerous blackish-brown spots.

Young males till the spring have the top of the head and the back reddish-brown, marked with deep-brown lanceolate spots; cheeks and nape ashy; all the lower parts of a slightly reddish-white, marked on the middle of the throat and on the breast with longitudinal spots of a deep brown; large reddish-brown spots on the sides; and large lanceolate blackish spots on the coverts of the tail; feet flesh-colour; base of the bill livid-blue: it is then the bird given by Meyer, 'Vög. Deutschl,' and by Frisch, 'Vög.,' t. 9, f. A and B.

For the old birds, male and female, M. Temminck brings together the following synonyms and references:—*Fringilla cannabina*, Gmel., 'Syst.,' 1, p. 916, sp. 28: Lath., 'Ind.,' v. 1, p. 458, sp. 82; Retz., 'Faun. Suec.,' p. 247, No. 226; La Grande Linotte de Vignes, Buff. 'Ois.,' v. 4, p. 58; Id., 'Pl. Enl.' 485, f. 1 (the male putting on his plumage), and 'Pl. Enl.' 151, f. 2 (the very old male, under the false name of Petite Linotte de Vignes); Id., 'Pl. Enl.' 151, f. 1 (either a female, or perhaps a male in autumn); Gérard, 'Tab. Elém.,' v. 1, p. 190; Greater Red-Headed Linnet or Redpole, Lath., 'Syn.,' v. 3, p. 304; Id., 'Supp.,' p. 176; Bluthänfling, Bechst., 'Naturg. Deut.,' v. 3, p. 141; Id., 'Tasschenb.,' p. 121; Meyer, 'Tasschenb.,' v. 1, p. 163; Id., 'Vög. Deut.,' v. 1, t, f. 1 and 2; Frisch, 'Vög.,' t. 9, f. 1 and 2; Naum., 'Vög.,' t. 5, f. 10 (old male) and f. 11 (female); Vlasvink, 'Sepp. Nederl. Vög.,' v. 2, t. p. 157; Montanello Maggiore, 'Stor. degl. Ucc.,' v. 3, pl. 357, f. 1.

In the third part of his 'Manuel' (1835) M. Temminck adds the following references and synonyms:—'Atlas du Manuel,' pl. lithog. (male); Vieill., 'Faun Franç.,' p. 77, pl. 38, *figs.* 2 and 3; Roux, 'Ornit. Provenç.,' v. i, p. 148, tab. 91 (old male in the spring), and 92 (male in autumn); Fichten und Busch Bluthänfling, Brehm., 'Vög. Deut.,' p. 276; La Petite Linotte de Vignes, Buff., 'Pl. Enl.' 151, *fig.* 2 (male in moult); Naum., 'Neue Ausg.,' tab. 121.

Returning to the two first parts of M. Temminck's 'Manuel,' we find him observing that the varieties of the young described by Meyer under the letter *c* and that under the letter *e* ought to be arranged under *Fringilla Montium*.

M. Temminck remarks that this bird moults but once a year—in the autumn; but nevertheless the spring or nuptial plumage is of a beautiful red tint on the head and breast. He ascribes this to friction and the action of the air, which wear away the sombre and ashy borders of the feathers, and cause the red colour, partially hidden in winter under the ashy edges with which these feathers are terminated, to appear in the spring. He adds that one may conceive that age and the more or less distant time of moulting may vary this plumage greatly.

The reader however should not forget the changes of colour that Yarrell and others have shown to take place in the plumage of birds without change of feather, and where friction could hardly have been the agent.

Mr. Selby, after the remarks already quoted, proceeds thus:—"Mr. Bewick however, in the Supplement to his work on 'British Birds,' still continues to believe in the existence of two distinct species; for so we must understand him (although he has brought the synonyms of the two supposed species together), since in a note following the description and figure of his Greater Redpole, or Brown Linnet, he says that 'it loses the red breast in autumn, and regains it in spring; in this it differs from the Gray Linnet, whose plumage remains the same at all seasons.'" From his description of the Gray Linnet (the usual Northumbrian name of this bird), as given in the first volume of his work, it can be no other than the Common or Brown Linnet of a particular age, although he has attached to it the Linnæan synonyms of the Lesser Redpole. "If," continues Mr. Selby, "Mr. Bewick's observations on the plumage of the Linnet were made upon caged birds, I am not surprised at his assertion of its always retaining the same appearance; for I have repeatedly verified the fact of its never acquiring under confinement those brilliant tints which distinguish it at a particular period of the year when in a state of liberty. I will adduce one instance strikingly to the point in question. For some particular purpose of observation a linnet was shot more than two years ago, towards the close of summer, when the plumage showed its most perfect nuptial tint; and, happening to be only winged, it was put into a cage, where it soon became familiarised to its situation, and still continues. About the usual time, in the autumn of that year, it moulted, and acquired the winter dress of the Common Linnet, which it has retained ever since, without displaying at the accustomed season any of the brilliant red that adorned it in the wild state."

Mr. Selby, who gives in his great work the figures of a male bird in summer plumage, and of the natural size (pl. 55, *fig.* 3), and of a female, natural size (Ibid., *fig.* 4), collects the following synonyms for this species:—

Fringilla cannabina, Linn., 'Syst.' i. p. 322, sp. 28.
Gros-Bec Linotte, Temm., 'Man. d'Ornith.,' v. i. p. 364.
Greater Redpole, or Brown Linnet, Mont., 'Ornith. Dict.'
The Linnet, Low, 'Faun. Orcad.,' p. 63.
Greater Redpole Finch, Shaw, 'Zool.,' 9, p. 516.

Syn. of young male after 1st autumnal moult.	*Fringilla Linota*, Gmel., 'Syst.' i. p. 916; Lath., 'Ind. Ornith.,' 1, p. 457, sp. 81. *Linaria*, Raii 'Syn.,' p. 80, A. 1; Will., p. 190; Id. (Ang.), 258; Briss., 3. p. 131, 29. La Linotte Ordinaire, Buff., 'Ois.,' v. 4, p. 58, t. 1; Id., 'Pl. Enl.' 151, f. 1. Common Linnet, 'Br. Zool.,' No. 130; Lewin 'Br. Birds,' 2, t. 83; Lath., 'Syn.' 3, p. 402, 73; Pult., 'Cat. Dorset.,' p. 12; Walc., 'Syn.,' t. 221. Gray Linnet, Bewick, 'Br. Birds,' 1, p. 171.
Syn. of adult male in summer plumage.	*Fringilla cannabina*, Gmel., 'Syst.,' 1, p. 916, sp. 28; Lath., 'Ind. Ornith.,' v. 1, p. 458, sp. 82. *Linaria rubra major*, Briss., 3, p. 135, 30; Raii 'Syn.,' p. 91, A. 2; Will., p. 191, t. 46. La Grande Linotte de Vignes, Buff., 'Ois.,' 4 p. 58; Id., 'Pl. Enl.,' 485, f. 2, old male under the title of Petite Linotte des Vignes.
Syn. of adult male in summer plumage.	Bluthänfling, Bechst., 'Naturg. Deut.,' 3, p 141; Id., 'Tasschenb. Deut.,' 3, p. 141; Id., 'Tasschenb. Deut.,' p. 121; Meyer, 'Tasschenb. Deut.,' 1, p. 163; Id., 'Vög. Deut.,' 1, f. 1 and 2; Frisch, 'Vög.,' t. 9, f. 1 and 2. Greater Redpole or Red-Headed Linnet, 'Br. Zool.,' 1, No. 131, t. 54; 'Arct. Zool.,' 2, No. 161; Will. (Ang.), 260; Lewin, 'Br. Birds,' 2, t. 84; Lath., 'Syn.' 3, p. 304; Id., 'Sup.,' p. 167; Walc., 'Syn.' 2, t. 222; Pult., 'Cat. Dorset.,' p. 12; Bewick, 'Br. Birds,' 1, t., p. 173; Id., 'Sup.,' p., t. 22.

Mr. Gould, in his beautiful work on the 'Birds of Europe,' figures a male in the spring or nuptial plumage, and a female of the natural size, under the name of *Linaria cannabina* (Le Gros-Bec Linotte, Common or Brown Linnet), and refers to Mr. Selby principally for the account of the changes of plumage. He also notices the confusion which formerly obtained about this species.

M. Temminck states that the bird varies accidentally to pure white; whitish, with the wings and tail as they are ordinarily; the colours feebly traced on the plumage; a part of the body white, or variegated with white feathers. All the plumage blackish, or more sombre than ordinary; the feet often red. He says that it is then *Fringilla argentoratensis*, Gmel., 'Syst.,' 1, p. 918, sp. 69; Lath, 'Ind.,' 1, p. 460, sp. 87; Le Gentyl de Strasbourg, Buff., 'Ois.,' 4, p. 73; Gérard, 'Tab. Elém.,' 1, p. 194.

This bird is very abundant in Holland. (Temm.) Very common throughout Britain, extending as far as to the Orkneys, where it is abundant. (Selby.) Indigenous to the British Islands, over the whole of which, and Europe generally, is is plentifully dispersed. (Gould.) Erzeroum in Turkish Armenia.

In Britain it resorts to waste lands and commons in the upper parts of the country, where it breeds. It assembles in winter in very large flocks, and descends to the sea-coasts, where it remains till pairing-time stimulates it to seek the uplands. The food of the Linnet consists of small seeds generally; those of the cruciform plants are favourites. The nest is built in a low bush, most frequently in furze, of moss and stalks of grass interwoven with wool and lined with hair and feathers; eggs four or five, bluish-white dotted with purplish-red. (Selby principally.)

The bird is provincially termed Greater Redpole, Rose Linnet, Gray Linnet, Lintwhite and Lintie. Bélon is of opinion that this species is the bird named *Salus* by the Latins, and Αἰγίθως by Aristotle, in the 15th chapter of his 19th book ('Hist. Anim.'). The French and German names have been given above. It is the Fanello of the Italians, and Llinos and Llinos Bengoch of the Welsh.

The Common Linnet is prized for its sweet song, and has been taught to imitate the human voice. The Hon. Daines Barrington mentions the celebrated talking linnet at Kensington. He heard it repeat the words 'pretty boy.'

L. canescens, the Mealy Redpole, is the *L. canescens* of Gould and Eyton, *L. borealis* of Macgillivray, *Fringilla borealis* of Temminck. This bird is not so common as the last; it has however a wide geographical range. It is found as far north as Greenland, and is very general in the northern regions of Europe, Asia, and America. The beak is larger than the Common Redpole, but it is not so large a bird as the Linnet. It measures about 5¼ inches. From the carpel joint to the end of the wing 2⅞ inches. The first, second, and third quill-feathers nearly equal in length, but the first and second rather longer than the third; the fourth feather two-twelfths of an inch shorter than the third. The irides are dusky brown; in winter the feathers of the forehead dark red; back of the head, neck, upper part of the back, and the smaller wing-coverts, a mixture of dark and light brown, the middle of each feather being the darkest part; the smaller wing-coverts tipped with dull white, forming a short bar; the greater wing-coverts uniform dark brown, with broader ends of dull white; lower part of the back, the rump, and upper tail-coverts mealy or grayish-white, with a few dark-brown streaks; tail-feathers grayish-brown, with light-brown edges, the two in the middle short; the form of the tail deeply forked; the chin almost black; the cheek, ear-coverts, neck, breast, belly, and under tail-coverts pale brownish white, streaked with darker brown, except on the middle of the breast and belly, which are plain; the dark streaks are largest on the flanks; the legs, toes, and claws dark brown.

L. linaria, the Lesser Redpole, or Common Redpole, is the smallest of the British Linnets, and is even a trifle smaller than our diminutive Siskin. This is more especially a winter visitor to the southern counties of England, appearing in small flocks from Michaelmas till April; but it is not often seen in the south of England in summer. It is at once distinguished from the Mealy Redpole, last described, by its smaller size; and though not attractive from its notes, which are little more than a lively twitter, its sprightly habits and engaging confidence render it a general favourite, since it is of all the small birds one of those that are most easily tamed. In some of the northern counties of England, and in Scotland particularly, this little bird is resident all the year; during the summer it retires to the underwood that covers the bases of our mountains and hills, and that often fringes the banks of our precipitous streams, in which sequestered situation it breeds. The eggs are four or five in number; their colour pale bluish-green, spotted with orange-brown principally towards the larger end. The young are produced late in the season, and are seldom able to fly before the end of June or the beginning of July. This little bird is common in Ireland and Scotland. It inhabits Denmark and Scandinavia generally; and so hardy is it, that it is a permanent resident in the Fur Countries of North America, where it may be seen on the banks of lakes and rivers in the coldest weather. The beak is brown, the upper mandible pale-brown; the irides dusky-brown; forehead deep red; the head, neck, back, wing-coverts, rump, and upper tail-coverts, a mixture of dark and light brown, the centre of each feather being darkest; the outer feather only of the small wing-coverts tipped with wood-brown; all the feathers of the greater coverts tipped with pale-brown, forming one conspicuous bar. Quill-feathers brownish-black, the primaries with a very narrow edge and the laterals with broader edges of pale wood-brown; tail-feathers not so deeply forked or near so long as those of the Mealy Redpole, but similar in colour. Chin with a patch of black; cheeks, sides of the neck, sides of the breast and flanks, with dark-brown streaks on pale-brown; the breast strongly marked with vermilion-red; belly and under tail-coverts dull brownish-white; legs, toes, and claws, brown. The whole length of the bird is 4½ inches. From the carpal joint to the end of the wing, 2⅜ inches. The first three quill-feathers nearly equal in length, but the second is the longest; the fourth one-twelfth shorter than the third. The females are without the red on the breast, and the dark-coloured parts about the head are rather brown than black.

L. Montium, the Mountain Linnet, or Twite. It is distinguished from the Common Linnet, and from both the Redpole Linnets, by the greater length of its tail, which gives this bird a more elongated and slender appearance; and it is further distinguished by having a reddish tawny throat, but does not exhibit any red colour either on the head or breast at any season of the year. There is however a tinge of red on the rump of the male in summer, and in the general character of the plumage of both sexes there is considerable similarity to that of the other species of the genus. The Mountain Linnet, as its name would imply, prefers high hills and mountains, or at least an interchange of moor and fell. It is not uncommon in certain localities in Ireland. It is plentiful in the Hebrides; and the Rev. Mr. Low states that it remains in the Orkneys all the year. The eggs are bluish-white, marked towards the larger end with light brown and purplish-red, sometimes with a few blackish spots. The Mountain Linnet inhabits Denmark, Norway, and Sweden, but is said to be rare in Russia, particularly in the eastern portions. It is observed periodically on its passage in Germany and France, and some are said to remain and breed in the mountains of Switzerland. It is found in Provence, at Genoa, and even as far south as Rome in winter; but retires to the northern mountains to breed in summer. The beak is yellow, and hence the term 'flavirostris' has by some authors been attached to this species; the irides hazel; the forehead, crown of the head, ear-coverts, neck behind, back, and wings, are of two shades of brown, the darker colour pervading the middle of the feather, the lighter wood-brown colour on the edges; the greater wing-coverts only tipped with pale wood-brown, forming one bar across the wing. Quill-feathers brownish-black, the primaries with narrow edges, the tertials with broader margins of pale brown. The rump red; upper tail-coverts like the back in colour; tail-feathers brownish-black with narrow white external edges, and broader light-brown inner margins; tail deeply forked; chin and throat uniform reddish yellow-brown, without streaks, but streaked on the sides of the lower part of the breast and flanks with dark-brown; lower part of the breast, belly, and under tail-coverts dull brownish-white; legs, toes, and claws very dark brown. The red colour on the rump is a sexual as well as a seasonal assumption, peculiar to the male only in summer. The whole length of the bird is 5¼ inches; but the body being slender, and the tail-feathers lengthy, this bird has a more elongated appearance than the Common Linnet, or the Mealy Redpole. The female is without colour on the rump, and is also lighter in colour on the back; her beak, less decidedly yellow at the base, is dusky-brown at the tip. Young birds like the females are lighter in colour generally, and are thus distinguished from old males.

(Yarrell, *British Birds.*)

LINSENERZ, a Mineral consisting of Arsenate of Copper. Its primary form is a right rhombic prism. It occurs in octohedral crystals. Cleavage parallel to the primary planes. Colour light-blue and occasionally dull-green. Streak pale-blue or green. Hardness 2·0 to 2·5. Lustre vitreous. Transparent, translucent. Specific gravity 2·926. It is found near Redruth, Cornwall, and in Hungary. Its analysis by Dr. Thomson gives—

Arsenic Acid	43·39
Oxide of Copper	30·10
Water	26·69
	100·18

LINU'CHIA. Eschscholtz gave this generic name to certain forms of the Linnæan genus *Medusa*. ('Actinologie,' p. 289.)

LINUM, a genus of Plants which gives its name to the small family of *Linaceæ*, and is characterised by having 5 distinct sepals, 5 petals, 5 stamens, and from 3 to 5 styles, which are either distinct from the base, or united as far as the middle, or even the apex. Capsule globular, divided into 10 cells, each containing a single seed. Herbs or small shrubs; leaves entire, without stipules; flowers having the petals falling off shortly after flowering. The species are chiefly found in Europe and the north of Africa, but a few likewise in other parts of the world.

Few of the species of *Linum* are of any importance, except that which has been an object of culture from the earliest times of which we have any record, that is *L. usitatissimum*, the Flax Plant, which is valuable as well for its seed, as for the ligneous fibre of its cortical layer, which forms the tow spun into yarn and woven into linen cloth. It is distinguished by its glabrous capsules within the sepals; ovate pointed ciliated lanceolate leaves, and solitary stem. The flower is blue; stem from one to one and a half feet high; sepals 3-nerved. It is a native of Great Britain.

It has been sometimes said that cotton is the substance from which cloth was made in Egypt in ancient times. Cotton was no doubt known to the Hindoos at very early periods, and may have formed an article of commerce to Egypt from India, but that it was not much used is proved by none of the mummy cloth, which has been examined by the best microscopes, being found to be composed of cotton. The seed is valuable for the condensed mucilage contained in its seed-coats, while the almond contains a fixed oil, valuable for burning, and in the arts as a drying oil; the oil-cake is used for fattening cattle. Linseed is extensively imported from Russia, Italy, and Egypt, for crushing, but of late years it has been imported in large quantities from India for the same purpose; this is found to yield a larger proportion of oil than Russian linseed, and the commerce will no doubt continue to increase. Seed is also imported from Holland, America, and other places for the purpose of sowing, as it is found to yield a finer and more abundant crop than the British seed. It is curious that the Hindoos make no use of the ligneous fibre; but the plants, though they there produce fine seed rich in oil, are very dwarfish, and may not therefore be found profitable culture for a people who have cotton in such abundance, and who wove it into cloth in ages when even linen was unknown in Europe.

L. angustifolium is found in sandy and chalky places. It has downy capsules within the sepals, elliptical, pointed, ciliated; leaves linear-lanceolate; stems numerous. Flowers of a pale blue; stem one or two feet high.

L. perenne has obovate-obtuse sepals obscurely 4-nerved, glabrous,

Flax-Plant (*Linum usitatissimum*).

1, the monadelphous stamens, highly magnified; 2, the ripe capsule, split at its end into valves.

leaves linear-lanceolate; stems numerous; fruit-stalks erect. Flowers blue; stem one to two feet long, erect, or decumbent. It is found in chalky places in Great Britain.

(Babington, *Manual of British Botany.*)

LION. [FELIDÆ.]

LIPARIS. [DISCOBOLI.]

LIPYLE. [ADIPOSE TISSUE.]

LIQUIDAMBAR, a genus of Plants belonging to the natural order *Balsamifluæ* of Blume, which has been altered to *Balsamaceæ* by Dr. Lindley. The name is derived from 'liquidum,' fluid, and 'ambar,' the Arabic name of amber. The genus is closely allied to the Willow and Plane tribes, but distinguished from both by its 2-lobed 2-celled many-seeded capsules, and their albuminous embryo. The species are only three in number, all forming fine trees, and occurring in Java, the Levant, and North America.

L. styraciflua is the species found in Mexico and the United States, in the latter of which it is called Sweet Gum, and forms a large and fine tree, bearing some resemblance to the lesser maple (*Acer campestre*): the wood is of a hard texture and fine grain, and makes handsome furniture, but the tree is more noted for the fragrant liquid resin which exudes from incisions in the stem, though not very copiously. This is called Liquidambar, Oil of Liquidambar, and Copalm Balsam, which has a pleasant balsamic odour, and an aromatic bitter taste. This becoming dry and opaque, forms what is called Soft or White Liquidambar, which resembles very thick turpentine, has a feebler odour than the liquid balsam, and contains less volatile oil, but more benzoic acid.

L. orientalis is a small tree, a native of Cyprus and other parts of the East Indies; was introduced into the Jardin des Plantes, Paris, from Smyrna, and is said to occur along the Red Sea. Dr. Pococke, as quoted by Dr. Lindley, states that it is called Xylon Effendi (the Wood of our Lord). In Cyprus, where it produces an excellent white turpentine, especially by incisions made in the bark. It is this substance perhaps which is alluded to in many works by the name Rosa malla or mallos, described as a balsamic fluid produced upon the island of Cabross, at the upper end of the Red Sea near Cadess, which is three days' journey from Suez. But there are no recent accounts of this substance, which is thought by some authors to be procured from the following species.

L. altingia of Blume is a native of the forests of Java, at elevations of 2000 to 3000 feet above the level of the sea. It forms a gigantic tree, with bark having a hot and bitterish taste, yielding a fragrant balsam, or liquid storax, the Rasamola of the Malayan Archipelago, though there is no proof that the liquid storax known in Europe is obtained from it, and it does not grow near the localities whence liquid storax has so long been obtained. It is therefore probable that some portion is obtained by boiling the branches of *Styrax officinale*, or acting upon them with oil, spirit, or naphtha. [STYRAX, in ARTS AND SC. DIV.]

The subject is interesting as connected with ancient commerce, inasmuch as old writers mention a liquid with the solid storax. By the Arabs the former is described under the name Mia-Saileh, liquid storax; and the latter, Mia-Yabseh, solid storax. Both are described by Serapion under the head Miha; by Avicenna under the several heads of Lubnee, Astaruk, and Miha. The name Mia-Saileh, with the affix 'rus' (juice), would appear to be the origin of the Malayan Rasamola, and thus one which has been variously corrupted.

LIQUORICE. [GLYCYRRHIZA.]

LIRIOCONITE. [COPPER.]

LIRIODENDRON (from λείριον and δένδρον), a genus of Plants belonging to the natural order *Magnoliaceæ*. The characters of the genus are as follows:—Carpels 1-2-seeded, disposed in spikes, indehiscent, deciduous, drawn out into a wing at the apex; calyx of three deciduous sepals; corolla of 6 petals forming a bell-shaped flower.

L. tulipifera, the Tulip-Tree, White-Wood, Canoe-Wood, Tulip-Bearing Lily-Tree, Virginian Poplar, and Poplar, is the only species of the genus. It is a handsome tree, with large 4-lobed truncate leaves resembling a saddle in shape, and large elegant flowers coloured with green, yellow, and orange. There are three varieties of this tree described: the *L. t. obtusiloba*, which has its leaves with blunter lobes than the original species, and on account of the yellowness of the wood is called Yellow-Wood, or Yellow-Poplar. The *L. t. acutifolia* has the leaves smaller and more acutely cut than the other varieties. The *L. t. flava* is known by its flowers being entirely yellow.

This tree is one of the most magnificent inhabitants of the forests of the temperate parts of North America. According to Michaux, the northern limit of this tree is the southern extremity of Lake Champlain, in 45° N. lat.; and its eastern limit is the Connecticut River, in 72° W. long. It abounds in the middle states of the North American union, in the upper parts of the Carolinas and of Georgia, and is still more abundant in the western country, particularly Kentucky. These trees sometimes attain a height of 120 feet or more, and their trunks measure 20 feet in circumference. The most common dimensions however are from 70 to 100 feet in height, and from 18 inches to 3 feet the diameter of the trunk.

It is uncertain at what period the Tulip-Tree was introduced into Europe. In England it was cultivated by Compton at Fulham in 1688. Evelyn, in his 'Sylva,' referring to it, says:—"They have a poplar in Virginia with a very peculiar-shaped leaf, which grows well with the curious among us to a considerable stature. I conceive it was first brought over by John Tradescant, under the name of the Tulip-Tree, from the likeness of its flower; but it is not, that I find, taken much notice of in any of our herbals. I wish we had more of them, but they are difficult to elevate at first." They are now planted very generally in Europe, having a geographical range from Berlin and Warsaw on the north to the shores of the Mediterranean and Naples on the south, Ireland on the west, and the Crimea on the east. In this country many of the trees have attained a height of 70 or 80 feet, and a circumference of the trunk of 6 or 7 feet. The trees blossom in Great Britain, but do not ripen their seeds, although they do in many parts of the continent.

The timber of the Tulip-Tree is seldom used in Europe, as the tree is too much valued as an ornament; but in America, where it is so abundant, it is found to yield a light compact fine-grained wood, which is useful for many purposes. It is easily wrought, and receives a good polish. It is used by cabinet- and coach-makers for making furniture and the panels of carriages. The Indians of the west country prefer this tree for the construction of their canoes. In America the bark of this tree has a reputation as being a substitute for the cinchona bark; and in 1792 Dr. Young of Philadelphia published a paper on its remedial agency in the 'American Museum.' The bark has a bitter and an aromatic taste, properties which probably depend, as in other barks, on the possession of an alkaloid and an essential oil; but it does not yet appear to have been chemically examined.

The best mode of propagating the Tulip-Tree is by seeds, which should be obtained from the native country of the tree. These should be sown in heath soil, very fine mould, or sandy loam, and kept moist in a shady situation. When the seeds are sown in autumn, they mostly come up the following spring; but if they are not sown till the spring, they remain a year in the ground. The varieties of this plant may be propagated by budding, grafting, or inarching. This tree does not bear transplanting well, nor the use of the pruning-knife.

(London, *Arboretum et Fruticetum Britannicum*, vol. i.; Don, *Dichlamydeous Plants.*)

LISSA. [MAIIDÆ.]

LISSOMUS. [ELATERIDÆ.]

LISSOTRITON. [AMPHIBIA.]

LISSURA. [HYRAX.]

LISTERA, a genus of Plants belonging to the natural order *Orchidaceæ*. It has a ringent perianth; a deflexed 2-lobed lip; the stigma transverse; rostellum elongated, entire, acute, with a minute globose appendage at its somewhat reflexed apex; column very short.

L. ovata, Tway-Blade, is found in woods and pastures in Great Britain. It has 2 opposite ovate leaves, the lip bifid, the column with a crest which includes the anther; the stem a foot high; spike elongated, very lax; flowers small, and greenish; leaves large.

L. cordata has 2 opposite cordate leaves, 4-lobed lip, column without a crest. Height 3 to 5 inches. The stem is slender. Flowers very small, in a lax spike, and of a greenish colour; the lip with 2 basal and 2 terminal linear lobes. It is found on turfy mountainous moors in Great Britain.

(Babington, *Manual of British Botany.*)

LI-TCHI, or LEECHEE, a fruit commonly sold in the markets of China, and occasionally brought to England It is the produce of the *Euphoria* (*Nephelium*) *Litchi* of botanists, a tree belonging to the natural order *Sapindaceæ.* The eatable part is a pulpy flesh, which covers a stone inclosed in a hard dry tesselated prickly pericarp. The Rambutan and another fruit, called the Long-yen, or Longan, are yielded by species of the same genus. The Chinese cultivate many varieties of each.

LITHOCARPUS, a genus of Plants belonging to the natural order *Corylaceæ.* Blume tells us that his *L. Javensis* is called Papau Batu, or Stone-Bark, because of its hardness. [CORYLACEÆ.] (Lindley, *Vegetable Kingdom.*)

LITHODENDRON, a generic name of some *Zoophyta*, proposed by Goldfuss to include *Caryophyllia* and *Oculina* of Lamarck, and adopted by many geological writers in a rather vague sense. De Blainville rejects the term. ('Actinologie,' p. 347.) The species ranked by Dr. Goldfuss in the group of *Lithodendra* offer many diversities of structure, and lie in strata of various antiquity ('Petrefacta Europæ'), especially in the Transition and Carboniferous Limestones.

LITHODES. [HOMOLIDÆ.]

LITHODOMUS. [MYTILIDÆ.]

LITHOMARGE, a Mineral which occurs massive. It is spheroidal. Colour white, gray, red, yellow, blue. Streak shining. Structure compact. Soft. Dull. Opaque. Unctuous to the touch. Adheres to the tongue. Specific gravity 2·2 to 2·5. It is found in Cornwall near Redruth, in Saxony, and some other places in Europe. Friable Lithomarge occurs in scaly glimmering particles, which aro phosphorescent in the dark. It is found at Ehrenfriedeusdorf in Saxony. The analysis by Klaproth gives—

Silica	32·0
Alumina	26·5
Oxide of Iron	21·0
Chloride of Sodium	1·5
Water	17·0
	——98

LITHOPHA'GIDÆ, a name applicable to all Marine *Conchifera, Mollusca, Radiata,* &c., that penetrate stones, masses of madrepore, and other hard corals, forming therein a nidus for themselves; but more particularly applied to the *Conchifera.* [CLAVAGELLA; GASTROCHÆNA.] This boring however is not confined to the *Conchifera;* for *Petricola* has the power of perforating certain rocks to a limited extent: nor to the *Mollusca* generally; for some of the *Echinidæ* (*Radiata,* for instance), are known to make shallow basin-like lodgements in the rocks whereon they dwell. The means by which these animals bore has been the subject of anxious discussion and observation for many years. It has been attributed to various causes. These may be divided into chemical and mechanical. The chemical causes ascribed are two, first, a secretion of a chemical or acid substance, by which the rock bored is supposed to be dissolved, and second the influence of carbonic acid in tho liquid forming the respiratory currents. The first set of chemical re-agents have not been found to exist, and the last will not account for boring in wood, clay, and sandstone.

The mechanical causes described are also several. The moving round of the shell is one; the use of the tongue, which contains siliceous particles, is another; whilst a third theory ascribes the boring to the action of particles of sand between the shell and the rock. It is not impossible that all these causes may be in operation in different animals, but at present no one is regarded as the universal agent.

In the 'History of British Mollusca,' Messrs. Forbes and Hanley have given a full account of the various theories advanced, and from this work we borrow the materials of the following sketch:—

"All the species of *Pholas* are endowed with the remarkable power of perforating various substances of considerable hardness, such as stone, shale, or wood; some indifferently, some selecting one or other for their habitations. They are never naturally found free. This habit of boring is common to the whole tribe of which *Pholas* is the type, and is presented also by certain members of other tribes. The majority of Lamellibranchiate *Mollusca* may bo said to be borers, so far as the power of burying themselves in sand, clay, mud, or gravel can give them a claim to such appellation, but the boring of the *Pholas, Teredo, Xylophaga, Pholadedea,* of the *Gastrochæna* and its allies, and of certain species of *Mytilidæ,* appears to be effected by very different means. The question how the boring *Mollusca* excavate their dwelling-places has long been discussed, and is still at issue amoug naturalists, and the name *Pholas* (from φυλεω to bore) [?] was applied by the ancients to certain shell-fish whose power of perforating the solid rock attracted their notice. A shell-fish is mentioned by Athenæus under the name of *Pholas,* probably not one of the members of the genus now so called, but the *Lithodomus lithophagus,* or Date-Shell, which is very abundant in the seas of Greece, and used by the people for food, whilst the true *Pholades* are very scarce in the Ægean, and not likely to have attracted popular attention. The earliest observations made upon the boring of *Pholas* were those by the celebrated Réaumur, one of the most excellent of practical naturalists. They are published in the 'Memoirs of the French Academy' for 1812. He figures the *Pholas candidus* in its cavity, and attempts to account for its presence there. He remarks that it is always fouud in cavities either of soft stone or clay, that these are made by the efforts of the animal itself and by means of its foot, for when it was placed by him upon soft clay, it buried itself in that substance by the action of its foot. He argues that they bore only in soft clay, and that their presence in stone (soft stone, which he terms 'La Banche,') is owing to the former being petrified around the *Pholades.* He shows that the dimensions of the cavity in which the full-grown *Pholas* is fouud, are, as compared with shell and aperture, such that the former must have remained in it since it first perforated, and could not havo changed its habitation. He states that the young are always found in clay and the old in stone, and concludes that the stone is only clay petrified by means of a viscous matter derived from sea-water. It need not be said now that Réaumur's observations and conclusions were fallacious, but as a first step in the inquiry they had great merit.

"Mr. John Edward Gray, in an iuteresting paper on the habits of *Mollusca* published by him in the 'Philosophical Transactions' for 1833, gives his opiniou on this question. He holds that *Pholades, Petricola, Venerupis,* and *Lithodomus* bore into shells and calcareous rocks by dissolving them. His reasons for holding this opinion are several:—1st, Because the animals of most of them are furnished with a large foot more or less expanded at the end; 2nd, because the holes fit the shell in *Petricola* and *Gastrochæna,* so as to prevent rotation and the use of the asperities on its surface; 3rd, because all borers are coverd with a periostracum (thin in *Teredo, Pholas,* and *Lasea,* thick in *Lithodomus*), which would be rubbed off during the operation of boring; 4th, because though some borers have spiny shells others have smooth ones; 5th, because all bore into calcareous substances, wood excepted, and into sandstoue only when it has lain a long time under the sea and become as soft as clay. These objections of Mr. Gray to the mechanical theory are some good, some bad; several not consistent with a correct knowledge of the habits aud structure of the genera he quotes. The same naturalist, in a paper on the structure of the *Pholades* in the first volume of the 'Zoological Journal' for 1825, held an opposite view to that quoted above; for he here maintains that the *Pholades* bore by means of rasping. Dr. Fleming's most recently expressed opinion on this subject is in favour of rasping and rotatory motion.

"Among the best memoirs on the subject of the boriug molluscs is that hy Mr. Osler, published in the 'Philosophical Transactions' for 1826. It is entitled 'On Burrowing and Boring Marine Animals,' and contains the fruit of much careful and original observatiou. According to this gentleman, the instinct to bore is exhibited at a very early stage of the animal's life. He found *Pholades* completely buried wheu so minute as to be almost invisible. He regards the curved processes or apophyses within the shell of *Pholas* as characteristic of an animal which bores mechanically by employing its shell as a rasp, holding that the shell is the chief instrument hy means of which *Pholas* bores. He remarks, with respect to *Pholas candidus,* a species whose habits he observed with great care, that it is by means of the anterior and lower part of the shell, which is thicker and spiny, the boring is effected. He considers the peculiar arrangement of the muscles, and the suppression of the ligament in this genus, as peculiarities in its organisation connected with its perforating habits. *Teredo,* he holds, bores in like manner with *Pholas,* and by the same means, effecting the stroke during the operation by the contraction of the posterior adductor muscle.

"The boring of *Saxicava* however Mr. Osler maintains to be effected hy very different means, most probably by an acid solvent. Its hole is not round; and if there are siliceous particles in the stone they are left projecting into the cavity. Mr. Osler was unable nevertheless to detect any direct evidence of free acid, either by the test of litmus paper, or by any experiments he could devise. The account given by Mr. Osler of the operations of *Pholas* when boring is so circumstantial that we quote it in his own words:—

"'The *Pholas* has two methods of boring. In the first, it fixes itself by the foot, and raises itself almost perpendicularly, thus pressing the operative part of the shell upon the substance to which it adheres. It now proceeds to execute a successiou of partial rotatory motions, effected by tho alternate contraction of the lateral muscles, employing one valve only, by turning on its side, and immediately regaining the erect position. I have observed that this method is almost exclusively employed by the very young animals; and it certainly is peculiarly adapted for penetrating iu a direction nearly perpendicular, so that they may be completely buried in the shortest possible time. It may be observed that the posterior extremities of the valves are much less produced in the very minute *Pholades* thau they afterwards become; and thus the time required to complete a habitation is still further diminished; but when the *Pholades* have exceeded two or at the most three lines in length, I have never observed them to work in the manner I have described—the altered figure of the shell, and the increased weight of that part of the animal behind the hinge, would prevent it from raisiug itself so perpendicularly as at first, independent of the narrow space it occupies. In the motions required to enlarge its habitation the adductors perform a very essential part. The animal being attached by the foot brings the anterior part of the shell into contact. The lateral muscles now contract, and raising the posterior adductor bring the dorsal margins of the valves into contact, so that the strong rasp-like portions are suddenly separated, and scrape rapidly and forcibly over the substance on which they press. As soon as this is effected the posterior extremity sinks, and the stroke is immediately repeated by the successive contraction of the anterior adductor, the lateral, and the posterior adductor muscles.

"'The particles rubbed off, and which in a short time completely clog the shell, are removed in a very simple manner. When the projected syphon is distended with water, the *Pholas* closes the orifices of the tubes, and retracts them suddenly. The water which they contained is thus ejected forcibly from the opening in the mantle, and the jet is prolonged by the gradual closure of the valves to expel the water contained within the shells. The chamber occupied by the animal is thus completely cleansed; but as many of the particles washed out of it will be deposited before they reach the mouth of the hole, the passage along which the *Pholas* projects its syphon is constantly found to be lined with a soft mud.'

"In a valuable paper 'On the Anatomy of the Lamellibranchiate Mollusca,' published by Mr. Garner, in the 2nd vol. of the 'Zoological Transactions,' that excellent observer has some short remarks on the means by which *Pholas* and other molluscs bore. He mentions that the boring is effected by currents produced by vibratile cilia, aided in some cases by rasping. He remarks that the valves of *Lithodomus* are not adapted for mechanical boring; that the crypts of *Saxicava* are not circular; that the valves of *Teredo* probably do not correspond to the bore; that *Pholas conoides* is often found in hard timber, though its valves are not adapted for any boring or filing. He further observes, 'There is a cartilage between the two small spinous processes of the hinge in the *Pholas candidus*; in other species of *Pholas* which have no rudiment of it, and allied genera which have a particular character of articulation, I consider the motion of the valves as but a secondary cause in the perforation of the substances in which the animals are found.'

"Mr. G. B. Sowerby objected to the notion that the cavities of *Pholas* were produced by rotatory motions of the shell, since they are fitted to the latter, and since some of the shell bones are externally smooth. He also objected to the notion of a solvent. Mr. W. Thompson, in his paper 'On Teredo,' expresses his belief that the smoothly-rounded termination of the cell made by that animal is due to the action of a solvent supplied by the proboscis, which thus acts as a pioneer in mining the passage that is afterwards increased to its final dimensions by the boring action of the primary valves."

Dr. Drummond, in his 'Letters to a Young Naturalist,' suggested the possibility of the animal of the boring molluscs decomposing the sea-salt as its wants may require, and applying the liberated muriatic acid to the solution of the calcareous rocks.

M. Deshayes, in his work 'On the Mollusca of Algeria,' maintains that the *Teredo* bores by means of a solvent. The foot he regards as a special secreting organ. M. F. Cailland holds a similar opinion with respect to the perforating power of animals of the genus *Clavagella*. In the 'Annales des Sciences Naturelles' for 1839, M. L. A. Necker published some very interesting and important observations on the mineralogical nature of the shells of *Mollusca*, in which he points out differences of structure as indicated by polarisation of light. In it he has the following observations on the subject in question:—" It is very remarkable that two genera of perforating shells, the *Pholas* and the *Venerupis*, radiate strongly calcspar. Thus the asperities which roughen their shells may, with the aid of the acids with which they are provided, excavate the calcareous rocks inhabited by them. The notion that their shells are formed of calcspar seems to render impossible the perforation by the shells themselves of calcareous rocks equally hard with the bodies perforating. But now that we know these shells are composed of arragonite, it is plain that they can act mechanically even on the hardest limestones."

Sir Henry de la Beche has given a table of the specific gravity of some shells as observed by himself, in which he states that of *Pholas crispata* to be 2·82, and of a number of other bivalves and univalves to be nearly the same; indicating a constitution which, allowance being made for amount of animal matter, approximates their shells much more nearly to arragonite than to calcspar, the former having a specific gravity of 2·93 and the latter of 2·71.

Mr. Albany Hancock has put forward one of the most definite and important opinions ever expressed on this disputed question. He states that—"the excavating instrument of *Pholas* and *Teredo* is formed of the anterior portion of the animal, in the surface of which are embedded siliceous particles. The particles penetrating the skin give to it much the character of rasping-paper. The whole forms a rubbing surface, which, being applied closely to the bottom of the cavity by the adhesion of the foot, enables the animal to rub down and so penetrate shale, chalk, wood, or even the hardest limestones and marble. *Saxicava rugosa* is also furnished with a rasping surface covered with siliceous particles. This surface however in this species is formed entirely of the anterior portion of the mantle, the margins of which being united are so much thickened, forming a sort of cushion capable of considerable protrusion at the will of the animal. The foot is small, and, passing through a much-constricted orifice, gives origin to a byssus, which anchors the shell close to the base of the excavation, and thus holds the rubbing apparatus in immediate contact with the part to be excavated."

In summing up all these theories, Messrs. Forbes and Hanley give it as their opinion that "the chemical one, so far as a secreted solvent is concerned, bears the least examination in the case of the *Pholadidæ*. The substances perforated are wood, limestones hard and soft, argillaceous shales, clays, sandstone, and, in the case of a *Pholas* in the magnificent collection of Mr. Cuming, wax. The notion of a secreted solvent that would act indifferently on all these substances is, at present at least, purely hypothetical, and since all attempted tests have failed to detect an acid, gratuitously so; for we can hardly suppose that any of those who have taken this view of the cause would maintain that the animals have the power of secreting different acids at will, according to the substance they have to attack. Yet this notion has been most favoured by naturalists who, sceptical as to the perforating power of such fragile instruments as are the shells of many of these creatures, endowed the animals with supernatural chemical qualifications. Even good experimental observers, Mr. Osler for one, whilst they proved that the *Pholas* could bore mechanically by the rotation of its valves, could not free their minds from the prejudice in favour of a solvent. The important statement put forward by Mr. Albany Hancock respecting the instruments by which *Mollusca* bore, and which, so far as *Gasteropoda* are concerned, appear to furnish us with a true explanation, namely, that it was effected by means of siliceous particles variously arranged in certain portions of the animal's body, led us to hope that a better cause than any yet alleged had been discovered. But we cannot bear it out with respect to the *Pholadidæ*. We can find no such particles in the mantle of *Teredo*, nor have any been noticed by Home or Deshayes, or by the most recent observers, Frey and Leuckart, who paid especial attention to the structure of the tissues of this genus. Nor could we, though aided by the anatomical and microscopical skill of Mr. Busk, detect any siliceous particles in either the mantle, foot, or siphon-tube of *Pholas candidus*. If present in any species therefore they are exceptional, so far as the genus *Pholas* and its allies are concerned. The shells of several British species of *Pholas* and that of *Pholadidæ* have been chemically examined by our friend Mr. Trenham Reekes with a negative result as regards the presence of particles of silex in their substance, where, after the statement of Mr. Hancock respecting the structure of the mantle, we thought they might possibly be found. On the other hand, taking into consideration its mineralogical nature as stated by M. Necker, there is no reason for supposing that the shell of the *Pholadidæ* is so weak a perforating instrument as some have fancied. With its peculiar form and the saw-like asperities of its surface, especially of its antial extremity, it is well adapted for an auger when wielded fresh and elastic by its well-muscled inhabitant, whose foot in all the members of this tribe, even in *Teredo*, where it is least developed, seems especially organised to serve as a fulcrum. We have no evidence that they perforate any substances essentially harder than their shells, or so hard. The sandstones in which they occasionally occur are either friable or marly when fresh, though cabinet-specimens seem so solid. The explanation of Necker accounts for their perforations in the hardest limestones. Wood, wax, and other substances in which they occur, offer no difficulty. The statements put forward respecting their boring in lava and granite have long ago been shown to be mistakes. That they exhibit a rotatory motion during the action of boring has been proved by competent observers; and the cavities they excavate, if examined fresh, invariably show transverse groovings, which could have been caused only by such motions. Currents of water set in motion by cilia doubtless aid materially the animal's operations, and possibly may be the means by which the larvæ effect their first lodgment; but considering the arrangements of the parts of the body in the adult animal, it seems to us that Mr. Garner's view of their being the primary cause of the perforation, whilst the rasping of the valves is secondary, should be reversed. Such currents must be most effective in clearing away loosened and loosening particles. If there be any chemical action aiding, it must be due to the carbonic acid set free during the respiratory process. Evidences of a secreted solvent there is none."

We proceed in this article to the examination of some of the excavating Lamellibranchiate Conchifers which are most remarkable for their boring powers.

Venerupis.—This form is placed by Mr. Garner in that section of the *Dimyaria* (with two adductor muscles) which is distinguished by having the branchiæ united medianly; and the characteristic of *Venerupis*, as given by the same author, is to have the tubes large, and the foot short and prominent behind.

The animal is oblong, rather thick, having the borders of the mantle simple, slightly open before for the passage of a compressed and elongated foot; tubes two in number, rather long, united in a considerable portion of their length, and having their orifices radiated; branchiæ little and unequal; labial appendages very small.

Shell solid, striated, or radiated, a little elongated, gaping posteriorly, more or less irregular, equilateral, very inequivalve, the anterior side being always shorter than the posterior side, which is generally truncated as it were, the other being more or less rounded; umbones marked, nearly contiguous; hinge composed of slender, approximated, and nearly parallel teeth, two in the right valve, and three in the left, or three in each; posterior ligament a little elongated, and in great part external; muscular impressions oval, the posterior one the most rounded, both united by a pallial impression deeply excavated posteriorly.

Such is the character given by M. Rang, who apparently restricts the generic name to those species which excavate stones, &c. "The shells," says M. Rang, "which compose this genus are lithophagous, and excavate in stones and madrepores cavities more or less proportioned to their form and to their volume, wherein they lodge themselves, and out of which when adult they cannot go, the aperture of the excavation being too small to admit of their egress. They are without an epidermis, and generally of a dirty white."

M. De Blainville, who knew not the animal when he published his 'Malacologie,' divides the genus into three sections: the first exemplified by *Venerupis Irus;* the second by *V. Rupellaria* (*Rupellaria*, Fl. de Bell.); third, by *V. lamellosa* (*Petricola*, Lam.); and he remarks that if the system of 'engrenage' of the species of excavating *Veneres* be regarded rigorously, we should be compelled to establish as many genera as there are species. He adds that he has chosen *Venerupis* from among the denominations proposed for some of these genera, because it well indicates that the species composing it are *Veneres* of the rock.

Mr. G. B. Sowerby ('Genera,' No. xxviii.) notices the difficulty of ascertaining any distinguishing character between the Lamarckian *Venerupis* and *Venus Pullastra* and *V. decussata*, and others, except in the apparent habits of the animals; a difficulty which had prevented him from endeavouring previously to clear up a point to which his attention had been frequently directed, but which he thinks he has at last overcome. "It is well known," continues Mr. Sowerby, "that *Venus perforans*, Mont., *Venerupis perforans*, Lam., and some of its congeners, live in cavities perforated in chalk and limestone rocks, and that the *Venus Pullastra, V. decussata*, and several other species that resemble them in general form and appearance, are found buried in the sand; an apparently well marked difference therefore exists in the habits of their respective animals. We think however that we have evidence to prove that there exists in reality very little difference, and that the cavities in which Lamarck's *Venerupes* live are rather the natural consequence of the action of the sea-water in conjunction with some of the excretions of the animal upon the chalk or limestone, than of any power of the animals themselves to pierce independently of such action; so that the difference is really only in the nature of the shore on which the very young shells are accidentally deposited, those which are thrown upou a sandy bottom burying themselves in the sand, and such as are deposited upon limestone or chalk producing a cavity in which they live." Mr. Sowerby then proposes to unite together under one appellation Lamarck's *Venerupes*, and the following of his *Veneres*:—*V. Malabarica, V. papilionacea, V. adspersa, V. punctifera, V. turgida, V. litterata, V. sulcaria, V. textile, V. texturata, V. geographica, V. rariflamma, V. decussata, V. Pullastra, V. aurea, V. virginea*, and some others: and for the genus thus constituted he proposes the name of *Pullastra*, rejecting the term *Venerupis*, or *Venerirupis*, because it would convey the false idea that at least the greater number of tho species were inhabitants of rocks. [VENERIDÆ.]

M. De Blainville and M. Rang, as we have above seen, restrict the genus *Venerupis* to the species that excavate rocks.

Lamarck makes his Lithophages consist of the genera *Saxicava, Venerupis*, and *Petricola;* and quotes the opinion of M. Fleuriau de Bellevue that boring shells generally do not pierce stones by the attrition of the shell against the stone, but by means of a softening or dissolving liquor which the animal sheds a little at a time.

Lamarck observes that it is not his intention to assemble under this family of Lithophages all the boring bivalves, or all that pierce stones; for, as he truly says, such an assemblage would be rather extravagaut. He refers to shells equally excavating with his Lithophages, which cannot be separated, some from the *Veneres*, others from the *Modiolæ*, others from the *Lutrariæ*, others again from the *Carditæ*, and remarks that it is not of these that he is then treating. His Lithophages consist of those shells, among the boring or excavating conchifers, that gape more or less anteriorly, and have the posterior side short, rounded, or obtuse, with the ligament of the valves always external, which live habitually in stones, and for the reception of which he then knew no particular family, or any family to which they might conveniently be approximated. He observes that he nevertheless places among them somo species the habits of which were not known to him. To this M. Deshayes adds in the last edition (1835) a note stating that upon the same ground that it would not be rational to establish a genus or family for the *Modiolæ*, or the *Carditæ*, which pierce stones, it would not be right to reject from the family of the Lithophages shells which do not perforate, but wherein we nevertheless find all the essential characters of the species which it contains. For this reason it would be convenient to approximate the *Byssomyæ* and the *Hiatellæ* to the *Saxicavæ*, and to leave in this genus species which do not perforate. M. Deshayes (loc. cit.), who does not appear to have seen the observations of Mr. Garner and Professor Owen abovo alluded to, refers to the discussions relative to the means by which perforation is brought about by certain acephalous molluscs. Somo authors, he remarks, have supposed that the attrition of the valves against the stone sufficed to wear it away by degrees, and that thus the animal formed a lodgement sufficient to contain it. Olivi, he observes, who was of this opinion, grounded it on the fact that he pretends to have observed that perforating molluscs can attack lavas or other rocks which are not calcareous. "Since this assertiou of the Italian author," continues M. Deshayes, "no well made observatiou has occurred to support it, whilst, on the contrary, a great number of proofs have been collected showing that perforating molluscs are never lodged except in calcareous stones. This mode of life renders very probable the opinion of M. Fleuriau de Bellevue, who believed that the animal was provided with an acid secretion, by meaus of which it dissolved, in proportion to its growth, the walls of the cavity which it inhabits. An observation of my owu is that the greatest number of perforating molluscs are contained in close-fitting cavities by no means made to permit of rotatory motion; that they are oval when the shell is of that form; and that we almost always see rising between the umbones of the valves a caleareous crest which forbids any movement of rotation." M. Deshayes then proceeds thus:—"Many zoologists have believed that there was but little necessity for preserving the family of the Lithophages. M. De Férussac places the *Saxicavæ* in the neighbourhood of the *Gastrochœnæ* and the *Solens*, and he places the *Venerupes* near the *Veneres*. M. De Blainville has adopted a nearly similar opinion. We do not admit it any more thau that of M. De Férussac, and we shall preserve the family of the Lithophages as Lamarck established it in this work. We rest our opiniou on the knowledge of many animals belonging to the three genera *Saxicava, Petricola* and *Venerupis;* they are bound by a common relationship (par des rapports communes); thus the mantle, which scarcely opens for the passage of the rudimentary foot in certain *Saxicavæ*, opens a little more in the *Petricolæ*, and more still iu the *Venerupes*. The foot follows a nearly analogous developmeut, always remaining however proportionally smaller than in other molluscs in which this organ is necessary for locomotion."

Lamarck says of the *Venerupes*, or Venuses of the Rock, that they seem in fact to have a hinge analogous to that of the *Veneres*, but that nevertheless a slight difference in the disposition of their cardinal teeth suffices to enable us to recognise the genus. They are, he adds, lithophagous or perforating shells which are very inequilateral, aud which are not distinguished from *Petricola*, except iu having three cardinal teeth at least in one valve.

"The greater part of the *Venerupes*," observes M. Deshayes in his commentary on this genus, "differ scarcely from the *Petricolæ;* they offer most frequently three cardinal teeth in one valve, two and rarely three in the other. When iu some individuals one of these teeth is abortive, which often happens, the same species may be comprised in the two genera at once. The animals of the perforating *Venerupes* are scarcely to be distinguished from those of the *Petricolæ;* only the mantle is a little more slit and the foot a little longer. In the *Veneres* these parts are different; and this proves that it is necessary to keep separated two genera which Cuvier and M. De Blainville have thought it right to unite or approximate. We do not preteud to dispute, nevertheless, the analogy which is evidently exhibited betweeu certain *Venerupes* and the *Veneres*. We think that the *Venerupes* ouly ought to be withdrawn from the genus and placed among the *Veneres*, because the animals are iu fact similar; only some plunge themselves into hardened mud, whilst others live in the sand. And although they may enjoy the faculty of perforating stone, this would not be a sufficient reason to reject them from the *Veneres*, because we have seen that in a great number of genera belonging to very distaut families there exist perforating species; thus we may well conceive that there may be perforating *Veneres*, but that does not hinder us from admitting a genus *Venerupis*, the characters of which appear sufficient to us."

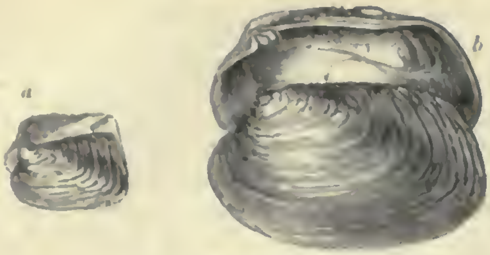
The number of recent species of *Venerupis* is 19, and their range is wide. Species are found on the coasts of England and France, in the Mediterranean, in the South Seas, and in those of India, China, and Australia.

V. perforans is the *Tapes Pullastra* of Wood, the *Venus perforans* of other authors. Shell sub-rhomboidal, concentrically striated, running into strong wrinkles or ridges at the anterior side; sometimes, though very rarely, with very fine longitudinal striæ; colour light-brown; umbo very near to one end, small, and turned a little sideways; the louger side much truncated; hinge with three teeth in each valve, one of which is small, tho others loug, slender, and curving outwards; middle tooth a little bifid. Inside smooth, white, with geuerally some purple at the truncated end; margin plain; valves moderately concave. Length rarely exceeding 3-8ths of an inch, breadth more thau 5-8ths.

Montagu, whose descriptiou this is with very slight alteratiou, says, that with respect to shape it is difficult to fix auy as a permaneut character; it is however, he adds, most frequently sub-rhomboidal; sometimes nearly as long as it is broad, generally straight on the frout margin, but in some instances deeply sinuous or indented.

It is very common ou the coasts of England. Lamarck records a variety smaller and narrower, with sub-striated lamellæ, from the coasts of France, on tho authority of M. Fleuriau de Bellevuo.

V. Irus is a common species ou the British coasts.

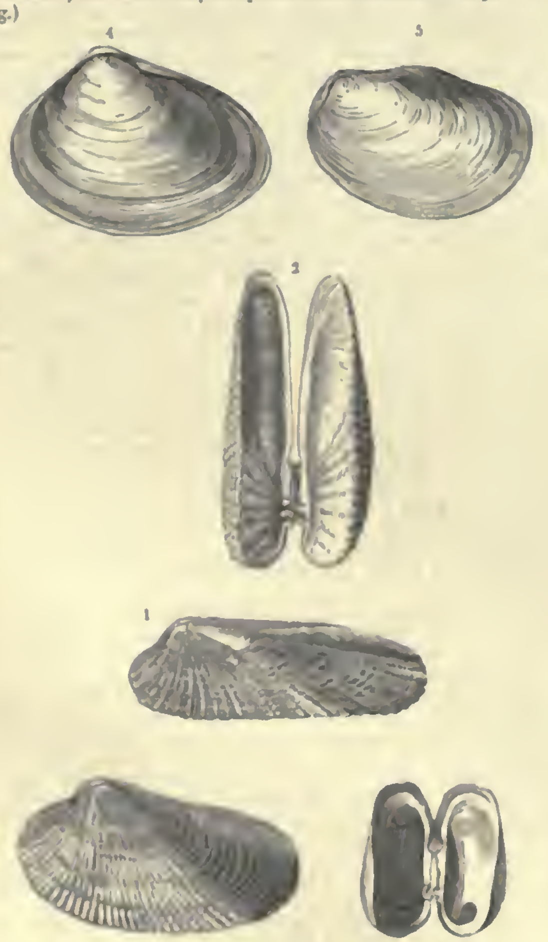


Venerupis perforans.
a, from Montagu's figure; *b*, from the shell.

Fossil Venerupis.—M. Deshayes, in his 'Tables' (Lyell), makes the number of living species eight and of the fossil species (tertiary) six. He also quotes *V. Irus* as being found both living and fossil (tertiary).

Petricola, Lam. (including *Rupelleria*, Fl. de. Bell.).—Animal oval, thick, especially at the upper part; mantle with simple borders, which are a little dilated in front, where they form a rather small opening for the passage of a tongue-shaped and feeble foot; tubes small, in the shape of cones, truncated at their summits, separated for two-thirds of their length, and finely radiated at their orifices; branchiæ small.

Shell rather delicate, without an epidermis, white, radiated, oval, subtrigonal, gaping anteriorly, more or less irregular, equivalve, inequilateral, the anterior side much shorter than the posterior side; umbones not projecting much, and contiguous; hinge composed of small cardinal teeth not diverging much, one of which at least is bifid, to the number of two in one valve, and one in the other, or two in each; ligament external, posterior, short, and convex; muscular impressions oval, united by a pallial impression which is often not very distinct, and has a very deep and rounded excavation posteriorly. (Rang.)



1 and 2, *Petricola Pholadiformis*; 3, *P. Dactylus*; 4, *P. ochroleuca*; 5, *P. rupestris*; 6, *P. subglobosa*. Sowerby.

Mr. G. B. Sowerby observes ('Genera,' No. xv.) that the genus *Petricola*, as it stands at present, is composed of several shells which Lamarck thought sufficiently different to form two genera, his *Petricola* and *Rupellaria*, the first with two cardinal teeth in one valve and one in the other, the second with two teeth in each valve; but Mr. Sowerby entirely agrees with Lamarck in the propriety of uniting them. He is not so well satisfied with the place assigned by Lamarck to this and some other genera which form the hollows in stone wherein they dwell; and he thinks that a great degree of similarity in external figure and appearance, as well as habit, should have brought them nearer to the *Pholadidæ*.

The geographical extension of *Petricola* is nearly coequal with that of *Venerupis*, as far as the localities of that genus are recorded; and rather numerous on the coasts of the warmer parts of America. (Cuming.) Also found on the Galiapagos Islands. (Cuming.) The species are about 30.

Their habits also are much the same with those of *Venerupis*, in the same rock with which, and in its close neighbourhood, *Petricola* is often found. Mr. G. B. Sowerby speaks of the cavities in which they live as being evidently of their own working, though on account of their form they cannot possibly have been produced by a rotatory motion, for they are exactly of the shape of the shell itself, and a very little larger. *Petricola* has been found at depths ranging from the surface or near it to a depth of 11 fathoms.

The foregoing cuts, from Mr. G. B. Sowerby's 'Genera,' represent some of the forms of this genus.

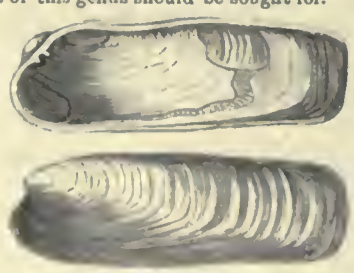
Fossil Petricolæ.—The number of recent species given by M. Deshayes in his 'Tables' (Lyell) is 13, but many more have been described since. The number of fossil (tertiary) he places at 10, and gives the species *P. ochrocleuca*, *P. lamellosa*, and *P. striata* as both living and fossil (tertiary).

Coralliophaga (*Cypricardia*, part, Lam.).—Shell oval, elongated, finely radiated from the summit to the base, cylindrical, equivalve, very inequilateral, the dorsal summits very anterior and but little developed; hinge consisting of two small cardinal teeth, one of which is subbifid, in front of a sort of lamellar tooth, under a rather weak external ligament; two muscular impressions, which are small, rounded, and distant, united by a narrow pallial impression, a good deal excavated posteriorly.

M. De Blainville established this genus for some species of living shells placed by Lamarck among his *Cypricardiæ*, and which appeared to the former to be approximated to the *Veneres*. M. De Blainville states that M. Deshayes had caused him to remark shells of the same species as that cited by M. De Blainville as the type, and which had modified their forms so as to resemble a *Lithodomus* in which they had lived.

M. Rang thinks that this genus is well distinguished from the *Cypricardiæ*, because, in one part the excavation of the muscular impression announces that the animal has tubes, whilst the other shows that it perforates.

C. carditoidea, Blain.; *Cypricardia coralliophaga*, Lam.; *Cardita Dactylus*, Brug.; *Chama coralliophaga*, Gmel. It occurs in the masses of madrepores and other corals at St. Domingo. M. Rang observes that it is in the masses of madrepores so common at the Antilles that the species of this genus should be sought for.



Coralliophaga carditoidea.

The species here figured as recent is also noted by Lamarck as fossil in Italy, under the name of *Cypricardia coralliophaga*.

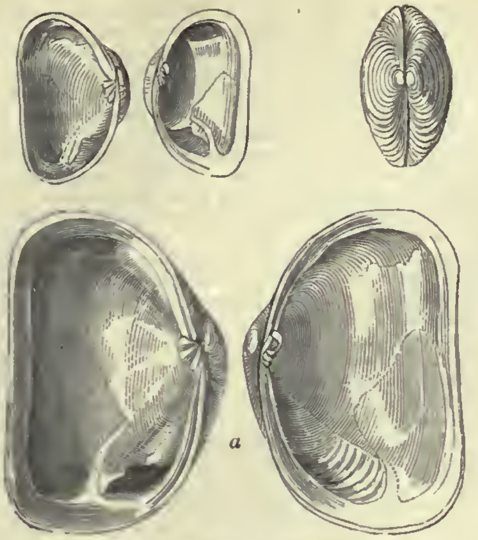
Clotho (fossil only).—Shell oval, subregular, striated longitudinally, equivalve, and subequilateral; hinge formed of a bifid tooth, curved back into a hook, rather longer in one valve than in the other; ligament external.

C. Faujasii. This, the only species that appears to be known, was detected by Faujas in the shells of *Cypricardiæ*, which were still lying in the stone which they had eroded when alive. M. De Blainville and M. Rang both adopt the genus; but the former says that he had not observed it himself.

Ungulina.—Shell longitudinal or transverse, irregular, not gaping, equivalve, subequilateral; umbones sufficiently developed and eroded; hinge formed by a cardinal tooth, which is short and subbifid in each valve, and an oblong marginal furrow or depression, divided into two parts by a contraction; ligament subinternal, and inserting itself in these depressions; muscular impressions elongated; pallial impression not flexuous. (Rang.)

It is said to have been found in the seas of Senegal.

U. transversa may be taken as an example.



Clotho Faujasii. *a*, magnified.

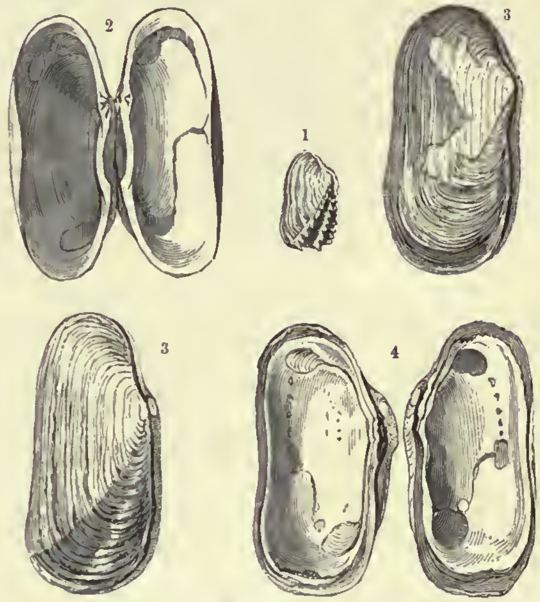
Ungulina transversa.

Saxicava.—Animal elongated, subcylindrical, having the mantle closed on all sides, prolonged backwards by a long tube, double internally, a little divided at its summit, and pierced inferiorly and anteriorly by a rounded orifice for the passage of a small, elongated, delicate, and pointed foot; mouth moderate, labial appendages small; branchial laminæ for the most part free, and very unequal on the same side.

Shell thick, solid, covered with an epidermis, elongated, rounded in front, truncated as it were posteriorly, gaping, irregular, equivalve, very inequilateral, the posterior side being much longer than the anterior; umbones not very distinct; hinge without teeth or with two separated tuberosities more or less developed; ligament external; muscular impressions rounded and a little approximated, united by a small straight pallial impression, very narrow, and occupying the middle of the valve. (Rang.)

M. De Blainville and M. Rang place the genus among the Pylorideans. The former is of opinion that it differs little from *Glycimeris.*

Mr. G. B. Sowerby ('Genera,' No. xxv.) includes in the genus *Saxicava* shells which, he observes, have had, in conformity with the various views of authors, at least six different generic names. He apologises for the conclusion to which he has come in contradiction to so many great authors, but gives the following reasons for his opinion. He premises that it will not be disputed that *Solen minutus* of Chemnitz and Montagu, *Hiatella arctica* of Daudin, *Cardita arctica* of Bruguière, and the *Byssomya* of Cuvier, are one and the same species; and that Leach's *Pholeobius* includes as distinct species of the same genus the *Solen minutus* of Montagu and the *Mytilus rugosus* of Linnæus. "Now the former of these," continues Mr. Sowerby, "is *Hiatella arctica* of Lamarck and Turton, and the latter *Saxicava rugosa* of the same authors: thus all the six genera are reduced to one by Dr. Leach, whose authority is indisputably very great in such matters; we do not however propose to our readers to take it as conclusive, but will state that we possess, as Dr. Leach did, a series of specimens, the young ones of which are more regular in shape and more strongly spinose than the older, and are to all intents and purposes *Hiatella arctica*, or *Solen minutus;* and the older specimens, losing the strongly-marked double rows of spines, though always retaining indications of them, and assuming a much less regular form, become characteristic specimens of *Saxicava rugosa;* the hinge teeth of the younger specimens may be advanced as an argument against the identity of these shells: it is however well known that in many shells, particularly those that are irregular, the teeth become obsolete with age: thus if the hinge teeth, the general form of the shells, or the double row of spines, cannot be depended upon as generic distinctions, the Lamarckian genera *Hiatella* and *Saxicava*, and his *Solen minutus*, merge into one: to show that the shells described as distinct species under either of these generic names are identical is not important to the present work; it is therefore sufficient to observe, that in all irregular shells that are either found attached to or imbedded in rocks, corals, roots of sea-weeds, &c., the general form cannot be taken as a character; and we believe the *Mytilus præcisus* and several of the *Saxicavæ* described by Lamarck and Turton to be merely variations of *S. rugosa*, than which there is perhaps no shell more subject to variety of form." To illustrate this exposition Mr. G. B. Sowerby gives in his 'Genera' the following figures of *Saxicava rugosa* in different stages of its existence.



Saxicava rugosa.

1, the young shell; 2, inside, showing the teeth; 3, a full-grown specimen of the same; 4, the inside, showing the muscular impressions.

The distribution of the species is very extensive. The Northern Ocean, the Britannic seas, the Mediterranean, the South Seas, Australasia, and the warmer coasts of America, are recorded as localities.

Mr. G. B. Sowerby remarks that the *Saxicavæ* are frequently found upon the outside of oysters, protected by their irregularities, and in the clefts of rocks or corals, roots of sea-weeds, and perforating oysters, chalk, limestone, and hardened clay. Those, he adds, which themselves perforate the hollows in which they live are more regular than others.

Mr. Garner states that the crypts of *Saxicava* are not circular: hence M. De Bellevue and Mr. Osler, in this instance, believe them to be formed by the phosphoric acid secreted by the animal, and they suppose this animal to inhabit those rocks only which are composed of carbonate of lime, which last supposition Mr. Garner declares to be not correct from his own knowledge.

Mr. G. B. Sowerby observes that the species of this genus are not numerous, and that they are not easily distinguished from each other, as the reader may imagine from the confusion which has prevailed on this subject. Lamarck recorded five species. Of the first two of these (*S. rugosa* and *S. Gallicana*), one, according to M. Deshayes, must be suppressed, being in reality only a variety of the other. *S. Australis* and *S. veneriformis*, Lamarck's fourth and fifth species, are identical, as we have already seen. To these M. Deshayes adds *S. Guerini*, from the Mediterranean, and *S. rhomboides* (?) as recent species. Mr. G. B. Sowerby ('Zool. Proc.,' 1834) has added three recent species collected and brought home by Mr. Cuming.

Fossil Saxicavæ.—M. Deshayes, in his 'Tables,' gives the number of fossil species as 11, all from the tertiary. He notes two species, *S. minuta* and *S. Pholadis*, as both living and fossil (tertiary).

For the species of *Pholas* and *Lithodomus*, see MYTILIDÆ and PHOLADIDÆ.

LITHOPHYTA. [POLYPIFERA.]

LITHORNIS, a genus of extinct Fossil Birds, described by Professor Owen in the 6th volume of the 'Geological Transactions.' The most conclusive evidence of the existence of birds at the period of the formation of the early English tertiaries is afforded by the remains of this bird. Some of these are now in the Hunterian collection, and consist of a sternum and sacrum, two of the most characteristic parts of the skeleton of a bird. In his 'British and Fossil Mammals and Birds,' Professor Owen says:—

"The Hunterian fossil includes, with the mutilated sternum, the sternal ends of the two coracoid bones, a dorsal vertebra, the lower end of the left femur, and the proximal end of the corresponding tibia, portions of two other long bones, and a few fragments of the slender ribs; all of which are cemented together by the gray indurated clay usually attached to Sheppy fossils. The entire keel and the posterior and right margins of the sternum are broken away; but the obvious remains of the origin of the keel and the length of the sternum forbid a reference of the fossil to the Struthious, or strictly terrestrial order.

"The lateral extent and convexity of the body of the sternum, the pressure and course of the secondary and intermuscular ridges, and the commencement of the keel close to the anterior border of the sternum, remove the fossil from the Brachypterous family of Web-Footed Birds, and lead us to a comparison of the fossil with the corresponding parts of the skeleton in the ordinary birds of flight.

"Sufficient of the sternum remains for the rejection of the *Gallinacea*, and those Grallatorial and Passerine birds which have that bone deeply incised; and the field of comparison is thus restricted to such species as have the sternum either entire or with shallow posterior emarginations. Between the fossil and the corresponding parts of the skeleton of such birds, a close comparison has been instituted in regard to many minor details and modifications; as, for example, the secondary muscular impressions and ridges on the broad outer convex surface of the sternum, its costal margin and anterior angle, the form and extent of the coracoid groove, the conformation of the sternal end of the coracoid bone, together with the form and relative size of the preserved articular extremities of the femur and tibia.

"But, without repeating all the details of these comparisons, it may be sufficient to state, that after pursuing them from the Sea-Gull and other aquatic species, upwards through the Grallatorial and Passerine orders, omitting few of the species and none of the genera of these orders to which belong British birds approaching or resembling the fossil in size, the greatest number of correspondences with the fossil were at length detected in the skeletons of the Accipitrine species. The resemblance was not however sufficiently close to admit of the fossil being referred to any of the existing native genera of Raptorial Birds.

"The breadth of the proximal end of the coracoid removed the fossil from the Owls (*Strigidæ*), and the shaft of the same bone was too slender for the *Falconidæ*; the femur and tibia were likewise relatively weaker than in most of our Hawks or Buzzards. But in the small Turkey-Vulture (*Cathartes Aura*), besides the same general form of the bones, so far as they exist in the fossil, there is the same degree of development, and the same direction of the intermuscular ridge on the under surface of the sternum, which divided the origins of the first and second pectoral muscles. The outer angle of the proximal end of the coracoid is produced in the same degree and form, and a similar intermuscular ridge is present on the anterior and towards the outer part of the coracoid.

"The preserved extremities of the femur and tibia have the same conformation and nearly the same relative size in the fossil as in the existing *Cathartes*. In this genus nevertheless there is a deeper depression on the outer surface of the sternum external to the coracoid groove than in the fossil; but this difference is less marked in some of the large *Vulturidæ*. The vertebra, the shaft of the coracoid, and the preserved portions of the sternal ribs are relatively more slender. The fossil moreover indicates a smaller species of bird than is known amongst the existing *Vulturidæ*.

"The anterior or inner wall of the coracoid groove is broader, the anterior angular process narrower, and the body of the sternum more convex than in the Heron or Bittern; and the proximal end of the coracoid has a different form in the fossil. In the Sea-Gull the keel rises from a more curved surface of the sternum than in the fossil; the inner wall of the coracoid groove is broader; and the outer angle of the sternal end of the coracoid has a different form and position.

"I regret that I have not yet had the opportunity of comparing with this interesting specimen the skeleton of the small European Neophron (*Vultur Percnopterus*), but in the meanwhile I deem it best to retain the sub-generic distinctive appellation originally proposed for the Eocene species of bird represented by the present very remarkable Hunterian fossil."

Professor Owen proposes to call the species *Lithornis vulturinus*, the Vulture-like Lithornis.

LITHOSPERMUM (from λίθος, a stone, and σπέρμα, a seed, in reference to the hard seeds or nuts), a genus of Plants belonging to the natural order *Boraginaceæ*. It has a deeply-cut calyx in five segments, a funnel-shaped corolla, with a naked or minutely 5-scaled throat. The filaments are very short; the stamens included in the tube. The nuts are smooth or tubercular, stony, and attached by their truncate flat base to the bottom of the calyx.

L. officinale (Gromwell), has an erect much-branched stem, lanceolate acute veined leaves, with tubercles and adpressed bristles above, hairy beneath; the throat of the corolla has minute scales within, and is of a pale yellow or greenish colour. The nuts are white, shining, and very hard, two or three ripening in each calyx. They were esteemed in ancient times as an infallible lithonthriptic; their virtues in this respect are however entirely imaginary. This species is a native of Europe, Asia, and North America. It is found in dry and stony places in Great Britain, but sparingly.

L. purpureo-cæruleum has herbaceous stems, the barren ones prostrate and creeping, the others erect. The leaves are lanceolate, acute, and scabrous, of a dark-green, with revolute margins. The flowers are showy and large, at first red, and afterwards of a bright blue. The nuts are white, highly polished, and hispid. This species has no scales in the throat of the corolla, but merely five longitudinal downy folds. It is a native of Middle and South Europe, of the Caucasus in woody mountain places, and of England and Wales in chalky soil.

L. arvense, Bastard Alkanet, or Corn Gromwell, has an erect branched stem, lanceolate leaves, rather acute, hairy, and subciliated; the calyx a little shorter than the corolla; the nuts tubercular, wrinkled, polished, and of a pale-brown. The throat of the corolla is destitute of scales, as in the former species. The flowers are white and small; the root of a bright red, communicating its colour to paper. It is a native of Europe, Asia, Africa, and some parts of North America, and is found plentifully in the corn-fields of Great Britain.

L. tinctorium has herbaceous procumbent stems, lanceolate obtuse leaves, hairy calyxes a little shorter than the tube of the corolla. The upper leaves are half-clasping, the lower ones on petioles. The flowers sessile in simple or conjugate leafy spikes; they are of a fine blue colour with a white throat. It is a native of Spain, South of France, Italy, and Hungary, in sandy sterile places.

L. tenuiflorum has an herbaceous erect branched stem, lanceolate obtuse hairy scabrous leaves, the lower ones opposite; the calyx is shorter than the tube of the corolla, conniving when bearing fruit. It is a native of Egypt and of the island of Cyprus, and has the habit of *L. arvense*, but is much smaller. It is the Λιθόσπερμον of Dioscorides (iii. 148), and the *Lithospermum* of Pliny (xxvii. 74). *L. apulum* is the Σκορπιοειδὲς of Dioscorides (iv. 192).

All the species of *Lithospermum* are noted for the stony hardness of their pericarps, which have the brittleness and lustre of porcelain. This membrane when analysed is found to contain nearly 60 per cent. of earthy matter, which is more than is known in any other organised substance. According to Spenner, *L. officinale* is the only true *Lithospermum*, none of the other species having a crown of scales in the throat of the corolla. The perennial and herbaceous species are plants of very easy culture, requiring hardly any care. They are always propagated by seed, which may be sown in the open ground. The annual species should be treated as greenhouse plants, and the shrubby kinds may be grown on rockwork or on wall-tops, where they will maintain themselves if allowed to scatter their seeds. They do very well in pots among other alpine plants, and cuttings of them may be rooted under a hand-glass. In general they are however short-lived and apt to rot.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Burnett, *Outlines of Botany*.)

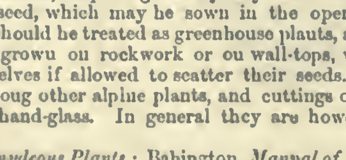
LITHOSTROTION, the name given by Llwyd, and adopted by Fleming, to some fossil 'Madrepores,' as the Lamelliferous Corals are commonly termed, which appear confined to the older strata (especially Mountain Limestone). They are included in *Cyathophyllum* of Goldfuss by Professor Phillips ('Geology of Yorkshire,' vol. ii.), and in *Columnaria* by Blainville ('Actinologie,' p. 350).

LITHOTRYA. [CIRRIPEDIA.]

LITI'OPA, a genus of Pectinibranchiate *Mollusca*, established by M. Rang, with the following characters:—

Animal transparent, spiral, furnished with a rather short and narrow foot, and a head provided with two elongated conical tentacles, with the eyes at their external base.

Shell not thick, horny, with a slight epidermis, slightly transparent; conoid; the whorls of the spire rather rounded, the last whorl larger than all the others put together, the apex pointed and furrowed longitudinally; aperture oval, wider anteriorly than it is posteriorly, borders disunited, the right border or lip uniting itself to the left, without forming a very distinct notch, but only a deep 'contour,' in the place of one; left lip returning inwards (rentrant en dedans) so as to form a projection with the anterior extremity of the columella, which is rounded, arched, and a little truncated anteriorly. No operculum.



Shell of *Litiopa*, magnified.

M. Rang places this form between *Janthina* and *Phasianella*, and observes that the habits of this Pelagic Mollusc are very curious. He states that he had many years ago observed the shell, but time had not permitted him to study the animal. M. Bellanger, captain in the French navy, was the first who recognised it, but that gentleman unfortunately had not studied its external organisation; he observed however the singular fact that this animal, which lives upon floating plants, quits them sometimes, but holds itself fixed by a thread. [LIMNÆADÆ.] M. Rang dissected some specimens preserved in spirit of wine given to him by that officer, and detected some small glairy masses which appeared to M. Rang to be attached to the foot, and which were easily drawn out to considerable length. M. Rang looked in vain for an operculum, the absence of which establishes a great difference between this genus and *Phasianella*, and has described two species, different as regards the shell, but with apparently similar animals.

M. Rang observes that the genus *Litiopa*, like some others, proves that it is not possible to establish divisions founded on the presence or absence of an operculum.

LITTORELLA, a genus of Plants belonging to the natural order *Plantaginaceæ*. It is monœcious; the male flowers stalked; sepals 4; tube of the corolla cylindrical; limb 4-parted; stamens hypogynous; filaments very long. The female flowers sessile; sepals 3; corolla oblong, narrowed at both ends; styles long; capsules 1-seeded.

L. lacustris, has white flowers; the fertile flowers sessile; stalks of the male flower one or two inches long; leaves all radical, linear fleshy, somewhat channeled. It is found on the margin of lakes.

LITTORINA. [LITTORINIDÆ.]

LITTORINIDÆ, a family of Gasteropodous *Mollusca* living in the sea or in brackish water. The animals are bisexual; they have muzzle-shaped heads provided with tentacular and sessile eyes. Their tongues are long, and armed with transverse bands of teeth, each row consisting of a broad and hooked central denticle, flanked on each side by three oblong hooked laterals or uncini. The branchial plume is single; the foot has a distinct linear duplication in front, and a groove along the sole. The form and appendages of the operculigerous lobe afford important generic distinctions. There are no neck-lobes or lateral cirrhi. The mantle exhibits traces of a rudimentary canal, or respiratory fold. Members of this group inhabit all regions of the sea, but by far the greater number live near the shore, and a very considerable portion of them are found between tide-marks.

Littorina.—The species have turbinate shells, solid, sub-conic, or sub-globose, with a short spire; surface smooth or spirally grooved, protected by a more or less developed epidermis; mouth subcircular, peritreme entire, outer lip sharp-edged, columellar lip expanded, imperforate; operculum pyriform, corneous, of few rapidly-increasing whorls; the spiral nucleus laterally placed.

The animal has a muzzle-shaped head, with two tentacula, bearing the eyes on bulgings at or near their external bases; no neck-lobes; operculigerous lobe without filamentary processes; foot rounded at both extremities, grooved below for the two posterior thirds of its length; branchial plume single. They all live strictly between tide-marks, and many of them can exist without inconvenience in localities where the sea only occasionally sprinkles them with its spray.

The *Littorinæ*, or Periwinkles, to call them by their popular name, are distributed through the seas of all climates. Fossil species are enumerated likewise from all formations, even the most ancient, but many are placed in this genus which no doubt belong elsewhere.

L. Neritoides is small, smooth, ovate, conic, usually more or less black; whorls much shelving, flattish, or merely convex; spire short but acute; mouth angularly contracted posteriorly; outer edge of the pillar-lip but little if at all concave; throat very dark. The shell is found on the very edge of tide-marks, and often at considerable distances above it, where only the dash of the spray can moisten it with sea-water. It is common on our rocky shores all round Britain and Ireland, and is distributed all round the coasts of Europe, and extends through the Mediterranean.

L. littorea is solid, not smooth, yet rarely ridged; whorls not rounded, but more or less flattened; base and pillar not so produced, and aperture not so filled up anteriorly, as in *L. rudis;* outer lip joining the body at an acute angle, and more arched below than above; pillar-lip not peculiarly broad, usually white, its inner edge for the most part well arcuated. This is pre-eminently the Periwinkle of our shores, a name said to be a corruption of 'petty-winkle.' In Suffolk they are called 'Pinpatches.' Great quantities are sold in London, and eaten on many parts of our coast, after being boiled, when the animal is extracted by means of a pin: This is a poor man's delicacy, but by no means to be despised. It inhabits the third sub-region of the littoral zone or belt, between tide-marks, that of which *Fucus articulatus* and *F. nodosus* are the characteristic plants, and is found in every district along our shores.

L. rudis is solid, rarely ridged; whorls rounded; spire acute, more or less short; mouth small, more or less rounded, not contracted above, but lessened at the base by the broad confluence of the pillar and outer lip, which latter is rather more arched above than below, and joins the body at nearly right angles; base generally a little produced. This strong shell closely resembles the preceding, but does not attain to its size, and chiefly differs from it in the roundness of its well-defined proportions. The colour ranges from yellowish-white to orange, and is either uniform or banded with about two or three zones of liver-colour or chocolate, of which one at least is broad. The animal differs from that of the preceding species in being of a lighter hue, with the exception of the head, which is more uniformly dusky. It is found almost everywhere on stony and rocky shores, often in considerable numbers, though not strictly gregarious. It inhabits the first and second sub-regions of the littoral zone; those of *Fucus canaliculatus* and *Lichina*, usually below the next species, and always within the reach of the tide. Its continental range is like that of *Littorea.*

L. littoralis is semi-globose, solid, smooth, or at most striolate, the general surface flattish; body bluntly subangulated above, peaked below in the young; spire remarkably depressed, its whorls not rounded; pillar-lip decidedly broad. The animal is usually of a bright-yellow colour; but occasionally, as in a specimen taken in the Isle of Man, is tinged with dusky, and has the tentacula and muzzle nearly jet-black. This species is abundant all round the British and Irish coasts, living on *Fuci* between the tide-mark, but more especially inhabiting the third sub-region of the littoral zone, that of *Fucus serratus*, where it is found in company with *Trochus cinerarius.* It ranges along the shores of the Northern and Celtic provinces on the European side of the Atlantic.

Messrs. Forbes and Hanley admit the following additional species in their 'British Mollusca':—*L. fabalis* and *L. palliata. L. patula*, *L. tenebrosa*, and *L. saxatilis* they are disposed to regard as *L. rudis.*

The other British genera of this family are—*Lacuna*, of which there are the following species:—*L. pallidula, L. puteolus, L. vincta*, and *L. crassior; Assiminea*, including two species, *A. Grayana* and *A. littorea; Rissoa* [RISSOA]; *Jeffreysia* [JEFFREYSIA]; and *Skenea* [SKENEA].

LITUITES, a group of Fossil *Cephalopoda*, confined to the strata of the Silurian and older systems. The shell is partly straight and partly convoluted, nearly as in *Spirula* (Lam.).

LIVER. The liver is the secreting organ or gland by which the bile is formed. Its existence has been traced very low in the scale of animals; and parts supposed to have been an analogous function have been found in insects, but their nature is at present a disputed question. The differences in regard to size, form, and colour, which the liver presents in the higher animals (*Mammalia*, Birds, Reptiles, *Amphibia*, and Fishes), are of no great importance.

In man the liver is a large solid viscus, of a reddish-brown or mottled red and yellow colour, situated immediately beneath the diaphragm, in the right hypochondriac and partly in the epigastric region of the abdomen. [ABDOMEN.] When enlarged, it can be felt by the hand applied below the ribs on the right side. It is flattened in the vertical direction, is thinner at its anterior than at its posterior border, and its outline, when viewed from above, is irregularly ovoid. The upper surface, which is convex, is applied to the diaphragm; the lower, which is irregularly concave, lies above and in contact with the stomach, large intestine, and right kidney, has attached to it the gall-bladder, and presents two deep furrows, which divide it into several compartments, termed by anatomists lobes. Of the furrows, one running from before backwards (the longitudinal fissure) transmitted, during uterine life, the vessel which conveyed the blood from the placenta to the heart of the fœtus; it afterwards contains merely the cord-like remains of that vessel, now impervious in the greater part of its extent. The second furrow, in the under surface of the liver, is called the transverse fissure, since it crosses the former at right angles, lying however chiefly to its right side; it serves to allow the entrance of blood-vessels and nerves to the liver and the exit of the bile-ducts. Like other viscera of the abdomen, the liver receives an investment from the lining membrane of that cavity, the peritoneum, which, being reflected from it at different points, forms broad bands connecting the liver with surrounding parts.

The substance of glands generally is constituted of minute ramified or convoluted canals, closed at their radical extremity, and communicating only with the principal duct, by which the secretion is conveyed away, and of a great number of blood-vessels which surround the above-mentioned canals in their whole extent, and afford the component matters of the secretion; these matters find their way into the interior of the glandular canals, not by distinct openings from the blood-vessels, but by transudation through their walls. In the human subject all other glands than the liver receive one kind of blood only, namely, arterial blood, from which the components of the secretion are derived, and the organ at the same time nourished, and the only veins are those which convey away the same blood after it is rendered venous by the changes it undergoes in the gland. But the liver, like the lungs in man and the kidneys also in some animals, receives two kinds of blood—arterial blood in small quantity, destined principally for the nourishment of the gland, and venous blood in much larger quantity, from which the bile is principally formed. The vessel which brings the arterial blood, the hepatic artery, is small, and comes off the aorta [AORTA], together with the arteries supplying the stomach, spleen, duodenum, and omentum. The venous blood is brought by the portal vein, a large vessel resulting from the union of all the veins returning the blood from the spleen, omentum, pancreas, and gall-bladder, and from the viscera directly engaged in the function of digestion, namely, the stomach and intestines. The hepatic artery and portal vein enter the liver at the transverse fissure or furrow of its inferior surface, where the bile-duct issues, and ramify together with the branches of that duct through the substance of the organ. After the materials for the nutrition of the liver itself, and for the secretion of the bile, have been derived from the blood of the two sets of vessels already mentioned, it is returned to the general circulation by a third set, the hepatic veins, which issue from the liver at its posterior border, and immediately enter the inferior vena cava near the heart.

The ultimate arrangement of these different blood-vessels in the liver is very peculiar: it was first accurately described by Mr. Kiernan. When the substance of the liver is torn, it is seen to be composed of innumerable granules of about the size of a pin's head; each of these contains the elements of a liver. They are connected most intimately with the branches of the hepatic vein, a small twig of which is contained in the interior of each, while on their exterior surface and in their interstices run branches of the portal vein, hepatic artery, and bile-duct. The mass of each granule or lobule is constituted in great part of a close network of capillary blood-vessels, which communicate on the exterior with the small branches of the portal, and on the interior with the twig of the hepatic vein. The blood brought by the portal vein therefore is poured into the capillary network of each granule or lobule of the liver, and, after yielding in it the constituents of the bile, is received into the branches of the hepatic vein, whence it is transmitted to the general vascular system. The branches of the hepatic artery soon become very minute on the exterior of the lobules, and few can be traced into their interior; it is probable that, after having nourished the coats of the vessels and ducts, and other tissues of the liver, the blood of the hepatic artery is poured into the minute network formed by the ultimate division of the portal vein, and contributes with the blood of that vein to yield the constituents of the bile.

The form and disposition in the liver, of the primitive radicles of the secreting canals or bile-ducts, have been the subject of much discussion. Dr. Handfield Jones, in a paper in the 'Philosophical Transactions,' arrives at the following conclusions:—

"The liver in all vertebrate animals may be regarded as consisting of a secretory parenchyma and of excretory ducts. The size of the excretory apparatus bears only a small proportion to that of the secretory.

"These two portions of the liver are not continuous with one another, but are disposed simply in a relation of juxtaposition.

"The action of the liver seems to consist in the transmission of bile as it is formed from cell to cell, till it arrives in the neighbourhood of the excretory duct, by which it is absorbed. This action is probably slow and very liable to be interfered with, contrasting remarkably with that of the kidney, where a particular apparatus is added to insure completeness and rapidity of action. The secretion of the hepatic cells is very liable to be retained within the gland, either in the cells or in a free state. This circumstance, as well as its structural relations, seems to point out the liver as approximating to the class of ductless glands.

"For the same reason it is highly probable that a part of the secretion of the cells is directly absorbed into the blood which traverses the lobules."

From an extensive series of researches in all classes of *Vertebrata*, Dr. H. Jones comes to the conclusion that the excretory system of the liver always terminates in closed tubes. He describes the ducts of the sheep's liver, which in all essential particulars agrees with that of man and the pig, as follows:—

"In the minutest branches (of the biliary ducts), which seem to be approaching their termination, and which can sometimes be examined and isolated in the most satisfactory manner, the epithelial particles are remarkably modified; they can scarcely be said to exist as separate individuals, but rather their nuclei, which are often large and distinct, are set close together in a subgranular or homogeneous basis-substance. In ducts where this condition of epithelium exists there is seldom any distinct trace of basement-membrane, the margin, though sufficiently even, yet exhibiting the bulging outlines of the component nuclei; still less is there any proper fibrous coat, though the ducts may be more or less involved in the filamentary expansions of the capsule of Glisson. Ducts of this character have usually a diameter of about 1-1000th of an inch; they can sometimes be followed for a considerable distance without being seen to give off any branches, or to diminish much in calibre. Their mode of terminating is various: several have been distinctly seen to terminate by rounded and closed extremities, which have nearly the same diameter as the duct itself; others seem to lose their tubular character, their nuclei become less closely set together, and the uniting substance more faintly granular and indefinite; the duct in short gradually ceases, losing all determinate structure. In some of rather minute size, 1-3000th to 1-2000th of an inch in diameter, the exterior form remains distinct, but the canal is almost obliterated by the close approximation of the nuclei of the opposite walls. These structures now described I believe to be truly the terminal branches of the hepatic duct, from which they certainly originate. They seem gradually to lay aside the several component tissues of the large ducts, the fibrous coat blending with the ramifications of Glisson's capsule, the basement-membrane imperceptibly ceasing, and the epithelium becoming resolved at last into its simple fundamental nuclei."

It is important to remark that in a dog Dr. H. Jones found biliary matter in the interlobular fissures. From the fact that in the contents of the hepatic ducts of man and the sheep, extracted by means of a forceps and without injuring the organ, hepatic cells may be detected, Mr. Wharton Jones ('Phil. Trans.,' 1848) draws the conclusion that the hepatic cells are endogenous cells, answering to the epithelium of other glands.

The view taken by Dr. H. Jones that the liver is essentially of the same order as the 'ductless' glands, and should be placed in the same category as the Peyerian follicles, spleen, &c., is probably correct. In fact, startling as this view may at first appear, a very clear transition between the Peyerian follicles, &c., and the liver is afforded by the tonsils, which on the one hand are identical with Peyer's follicles, in so far as they are solid vascular networks whose meshes are filled by a morphologically indifferent tissue; while on the other hand, without differing from the liver in this respect, they resemble it in having these elements arranged around diverticula of the intestinal mucous membrane.

The biliary canals, reduced in number by successive re-union to two tubes, one from the right, the other from the left lobe of the liver, issue at the transverse fissure of its under surface, there soon unite, and form one main trunk, the hepatic duct. After running a short distance, together with the portal vein, hepatic artery, and nerves, in a quantity of dense cellular tissue inclosed within the fold of the peritoneum that connects the liver with the stomach, the lesser omentum [PERITONEUM], the hepatic duct meets and unites with the duct of the gall-bladder, or cystic duct. The tube resulting from the junction of the hepatic with the cystic duct is called the Ductus Communis Choledochus: it is about 3½ inches in length, and terminates by opening, together with the duct of the pancreas, into the portion of the intestine named Duodenum, at the distance of a few inches from the stomach.

The Gall-Bladder is a pyriform membranous sac, lodged in a shallow depression at the inferior surface of the liver, which communicates, as we have stated, with the excretory duct of the liver, by means of a tube called the Cystic Duct. At times, when a supply of bile is not required in the intestinal canal—for instance, during fasting—the bile flowing from the liver is impeded in its progress through the ductus communis choledochus into the intestine, and is consequently obliged to regurgitate through the cystic duct into the gall-bladder, which serves as a temporary reservoir for the secretion, discharging it again when the presence of bile is required in the intestine to aid the digestive process. At the neck of the gall-bladder, close to its termination in the cystic duct, the lining membrane forms a spiral fold, which seems destined to retard the flow of the bile from the reservoir. The gall-bladder is not constantly present; the animals in which it does not exist are for the most part, though not universally, herbivorous, and such in which digestion is constantly going on, and a reservoir for bile consequently not required. But many herbivorous animals have a gall-bladder; and sometimes, where it is absent, the bile-duct presents a considerable dilatation of its cavity near the intestine: such is the case, for example, in the horse and elephant.

The functions of the liver are important. The analysis of the fluid which it secretes shows that it frees the blood from an excess of matters composed of carbon and hydrogen; and by this means, and probably also by effecting some changes in the matters which have been added to the blood during its circulation through the viscera of the abdomen, the liver assists in preparing that fluid for the nutrition of the body. The bile seems also to have a direct influence in the formation of the chyle, the nutritive fluid derived from the food; and some of its ingredients serve as a natural stimulus of the peristaltic action of the intestines. [BILE.]

The liver is developed upon the same plan as the other glands.

According to the latest observations, particularly of Bischoff and Remak, the development of the liver may be thus best understood:—

"The primary rudiment of the liver, which appears at a very early period (about the 55th to the 58th hour in the chick; in Mammals after the Wolffian bodies and the allantois), consists of two masses of cells, an external, proceeding from the fibrous membrane of the intestine, and an internal epithelial, which at first form a simple and afterwards a dichotomously-divided sac. Solid processes, the hepatic cylinders of Remak, are now developed from the epithelial lamina, which, as in the intestine, consists at first of round cells, probably in many layers, by the multiplication of its cells, and extend into the outer lamina, branching out and anastomosing, while at the same time the cells of the outer lamina included in the meshes of this net-work multiply and become successively changed into vessels, nerves, connective tissue, &c. The difficulty is to say how this peculiar reticulated parenchyma of cells and rudimentary vessels becomes ultimately arranged as we know it to be. In the first place, as regards the hepatic-cell net-work, to which by a continual new development of cells fresh processes are added, which unite into new networks, so that the hepatic-cell net-work of the adult liver is the direct progeny of the original reticulation. More detailed information concerning the separate steps of the formation of the hepatic-cell net-work is at present wanting; yet from what is known it would appear to take place in somewhat different modes. Sometimes, in the subsequent stages, free cylindrical processes of the hepatic-cell net-work do not exist to any extent; but it would appear to increase by the continual addition of new meshes at its edges, perhaps also by the constant elongation of the existing columns of hepatic cells and the development of fresh anastomoses between them; this is, if I have observed rightly, the case in man, where even in the seventh week I did not succeed in clearly distinguishing free hepatic columns. At other times free terminations of the hepatic columns are apparently developed for a considerable period, perhaps until the whole organ has nearly arrived at perfection, their formation appearing to precede by some time that of new anastomoses, as is the case in the chick and other birds, and, according to J. Müller, in a few mammals; in the latter of which, according to Müller's figures, the hepatic columns are grouped in lobes. These free superficial hepatic columns may perhaps throw some light upon the meaning of Weber's and Krause's statements respecting the biliary ducts with cœcal ends upon the surface of the liver. With regard to the biliary ducts they are nothing but secondary excavations of a part of the primarily solid hepatic columns and of the larger internal tracts, which border upon the original epithelial diverticulum, and which all consist of many series of cells. The excavation commences in the common biliary duct, proceeds towards its branches, and must be considered to take place exactly as in other glands, namely, either by solution of the inner cells of the rudimentary structures, or by the excretion of a fluid between them, and the consequent production of a cavity. In this mode of regarding the matter, there is only one point for consideration, namely, that according to Remak all the hepatic columns, even the largest, form anastomoses, whilst, as is well known, the biliary ducts ramify without anastomosing. The only solution of this difficulty consists in assuming that the anastomoses of the primary largest hepatic columns do not continue in the course of the further development, but that they are re-absorbed, a process which has its analogue in many phenomena of fœtal growth. In man alone might we find an exception, for it seems that the anastomoses of the right and left hepatic duct, in the fossa hepatis, described by E. H. Weber, are perfectly well explained by Remak's observations, and are simply the embryonic anastomoses of the rudiments of these canals, which have attained to some though no very great development. The mode of origin of the fibrous membranes of the biliary ducts becomes readily comprehensible, if we reflect how the net-works of hepatic columns and the fibrous layers of the liver interdigitate; so that layers of connective tissue, &c., might be readily formed around the hepatic cylinders from those elements of the fibrous layer which are nearest to them. The further development of the vessels, nerves, &c., presents no difficulties, taking place in the same way as in other organs. The gall-bladder in the chick, according to Remak, is a process at first solid, of one hepatic duct, which subsequently becomes hollow and rapidly increases in size. I saw the folds of its mucous membrane as early as in the fifth month in a human fœtus. The investigation of the liver is best undertaken in the pig, in which animal the distinct demarcation of the lobules greatly facilitates the comprehension of the relations of the secreting parenchyma to the vessels and hepatic ducts. The hepatic cells may be isolated with the greatest ease in all animals, either singly in series or in reticulated fragments; but to comprehend rightly their collective arrangement, no better means exist than the making of fine sections in a fresh liver with the double knife, for which sections made off hand with a razor, even in a liver previously hardened in alcohol, pyroligneous acid, chromic acid, &c., are by no means sufficient substitutes. We do not mean to say that the hepatic cell net-work cannot be seen at all in this manner, for it is visible even in opaque sections of liver by reflected light, but merely that no complete view can thus be obtained. The finest hepatic ducts are not readily found, though a careful search in nearly all sections, which include many lobules, will almost certainly detect scattered fragments of them, readily distinguishable by their small polygonal cells, at the edges of the lobules, and long examinations may perhaps eventually discover such a fragment in connection with the hepatic cell net-work, which however I have not yet succeeded in doing. The coarser biliary ducts present no difficulties. Their glands are seen readily, partly with the naked eye, partly by the use of dilute caustic soda. Weber's anastomoses of the two hepatic ducts in the fossa transversa are visible in good injections. The vasa aberrantia in the left triangular ligament and in other localities are readily perceived even without injection on the addition of acetic acid or of caustic soda. The nerves and lymphatics of the liver are, except their finest portions, easily seen in man. The blood-vessels require good injections, for which purpose, in the human subject, I especially recommend children's livers, in which the distribution of the arteria hepatica in the serous coat, on the vessels, &c., is beautifully distinct. The capillary net-work of the lobes may readily be filled with fine injection, and a series of excellent preparations of this kind by various masters of the art are everywhere to be met with."

(Valentin, *Text-Book of Physiology;* Carpenter, *Manual of Human Physiology;* Kolliker, *Manual of Human Histology.*)

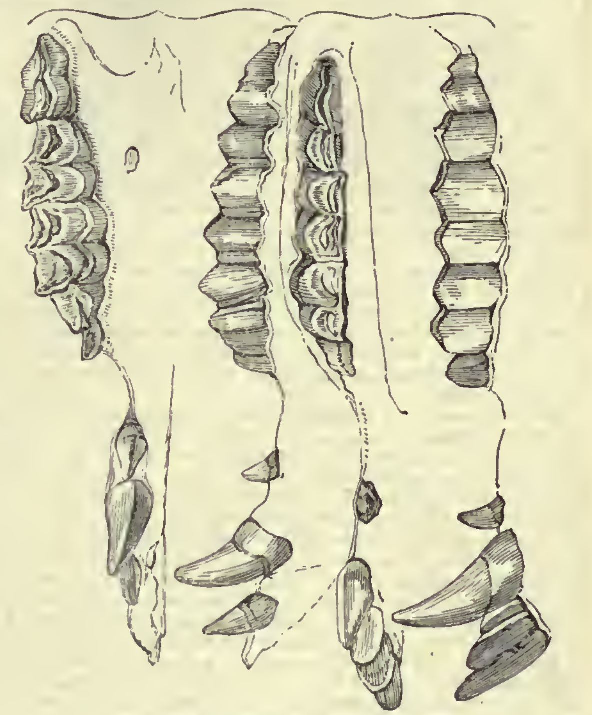
LIZARD. [SAURIA.]

LIZARD-SEEKER, a name given to the species of *Saurothera,* a genus of Birds. [CUCULIDÆ.]

LLAMA (*Auchenia* of Illiger; *Lama* of Cuvier and others), the generic name for that form of the *Camelidæ* which is confined to the New World. Dentition:—

$$\text{Incisors, } \frac{2}{6}; \text{ Canines, } \frac{1-1}{1-1}; \text{ Molars, } \frac{5-5}{4-4} = 30.$$

The difference between the dentition of the two sub-families of *Camelidæ, Camelus* and *Auchenia,* appears to consist mainly in the absence of the two small pointed teeth, which are found in the interval or 'bar' between the canines and the molars in the Camels, from the jaws of the Llamas. Thus the Llamas have four false molars, as they may be termed, less than the Camels. In other respects the dentition of the one is, as nearly as may be, the dentition of the other. The following cut exhibits the dental arrangement of the Dromedary, and will convey a sufficiently accurate idea of the same parts in the Llamas, if the spectator will suppose the absence of the four teeth above mentioned. The difference was considered by F. Cuvier to be of such small importance that he has not considered it necessary to give a figure of the dentition of *Auchenia.*



Teeth of Dromedary. F. Cuvier.

Baron Cuvier observes, that the Camels and Llamas differ in many points from the Horned Ruminants. Considered as a whole, the head of the former presents a narrower and more lengthened muzzle (un museau plus aminci), a cranium larger in proportion, orbits placed more forward, and the edges of those orbits more prominent, in consequence of the temples being more sunk.

In the Llama the bones of the nose are short, and their extremity notched; their base is slightly enlarged; the lacrymal bone is but little advanced upon the cheek, and leaves a wide space between its anterior angle and the upper external angle of the nasal bone. It does not cover the orbitary part of the maxillary bone, but stops above the suborbital internal hole; nothing of the vomer is to be seen above the spheno-palatine hole, and a small portion of the pterygoid internal apophysis scarcely shows itself there. The parietal bones are soon united into a single bone much wider than it is long; the posterior suture of which remains, nevertheless, before the occipital crest. The temporal wing of the posterior sphenoid bone has a descending prominence, and its pterygoid wing terminates in a sharp point, which projects more than that of the pterygoid apophysis. The tympanic bones are compressed, but project very much; the occipital crest is well marked.

The true Camels, according to the same author, have the occipital crest still more marked and the temples still more sunken than they are in the Llamas, and almost as much as they are in the Carnassiers. The occipito-temporal suture is very much in front of this crest. The bones of the nose are of much less width at their bases, and there is a great space between the small membranous portion which exists at their angle and the lachrymal bone, which is extremely small on the cheek; it does not reach in the orbit even to the edge of the suborbital internal hole. There is, as in the Llama, a small membranous space between the lachrymal, frontal, and palatine bones, which advances to that spot by a small tongue-shaped portion. The wing of the vomer shows a small portion above the analogous hole of the spheno-palatine bones. The internal pterygoid apophysis does not exist except towards the point of the wing: it does not rise till it reaches the body of the sphenoid bone, and there is no space between the wing of that bone and the wing of the palatine bone.

In all other respects, as regards the head, the Camels and Llamas offer a singular resemblance. The sockets of the incisors are smaller than in other Ruminants, and the canal analogous to the pterygopalatine terminates in the palate by more numerous holes. The oval hole is smaller. Internally the floor (plancher) of the cerebral cavity is much more united than it is in the Deer and the Sheep; the clinoid posterior apophyses form together only one small plate; and the region where the optic nerves are lodged is nearly on a level with that of the pituitary gland.

The anterior teeth of the Camels exhibit a considerable difference from those of the other Ruminants: they have, in the first place, both above and below, the first molar, or rather false molar, detached from the others, and situated forwards, as we have seen above; and which, from its isolated position and pointed form, puts on the appearance of a canine tooth. They have moreover a true canine tooth implanted at the anterior border of the maxillary bone. This tooth becomes in aged subjects developed like the canine of one of the great Carnassiers. Lastly, they have a true upper incisive tooth implanted in the intermaxillary bone, and this also puts on the form of a canine tooth: thus the Camels seem to have in the upper jaw three canines on each side. In the lower jaw they have only the eight ordinary incisors; but besides that the detached molar performs the office of a canine tooth, the external incisor has a pointed form, and rises to interlock (s'engrener) between the upper canine and incisor: this then again represents a canine tooth, and in the old camel it has the entire appearance of a strong canine of a Carnassier.

"In the Llamas," continues Cuvier, "whilst they have, like the Camels, only five molars in a series, and often even only four below, I do not find the detached anterior molar, or at least I must think that it falls very early; but the upper canine and incisor, and the external incisor below, are disposed as in the Camels, and are only more compressed and trenchant at their edges. In both these subgenera the lower incisors are large, strong, a little unequal, and directed forwards."

The metatarsal and metacarpal bones of the Camels and Llamas are easily recognised, because they are divided higher than in the other Ruminants, and well above the articular pulleys. In the Camels the scaphoid and cuboid bones of the tarsus are not soldered, and always remain distinct. The two edges of the rotatory pulley (poulie rotulienne) of the femur are in the Camel nearly equal, as in the Hog. In the Ruminants generally the ulna is scarcely more than an appendage to the radius, but the distinction generally remains marked throughout the length of the bones, though they become soldered by age, as in the Ox, Deer, Sheep, and Gazelles: in other cases the ulna disappears soon after passing the olecranon, as in the Giraffe, and still more in the Camel. In the Camels and the Llamas the tuberosities of the upper head of the humerus are not elevated as in the other Ruminants. With regard to the pelvis, the Camel has the external angle of the ischium pointed and without truncation, and the spinal angle large and rounded; but this last is as much and more advanced than the other. The posterior front of the pelvis is enlarged, and its posterior border much more like that of the Horse; and so it is in the Llama. ('Ossemens Fossiles.')

Professor Owen has detected an osteological character, not noticed by Cuvier, which peculiarly marks the *Camelidæ*, namely, the absence of the perforations in the transverse processes of the cervical vertebræ for the transmission of the vertebral arteries.

In the structure of the stomach the *Camelidæ* exhibit a marked difference from other Ruminants [CAMELUS], and though doubts have been thrown on the fact, the stomach of the Llama is formed upon the same peculiar principle as that which governs the development of this viscus in the Camel. Sir Everard Home maintains, that though a portion of the stomach of the Llama is, as it were, intended to resemble the reservoirs for water in the Camel, these have no depth, are only superficial cells, and have no muscular apparatus to close their mouths and allow the solid food to pass into the fourth cavity, or truly digesting stomach, without going into these cells. Dr. Knox, on the contrary, has shown that the real differences between the stomachs of the Llamas and Camels are much less than had been imagined. The truth is, that in making observations on parts of this description a great deal depends upon the care taken to keep the body of the subject in a fixed position. Thus we find Mr. Spooner, on the occasion of his reading his notes on the post-mortem examination of a dromedary that died in the Garden of the Zoological Society, observing that though he found nothing to add to the accounts already given by Daubenton and Sir E. Home, the cells of the first cavity in the subject on which he was reading contained food; and he was therefore induced to suggest that doubts might be entertained of the correctness of the generally received opinion, that these sacs are destined to act as reservoirs for fluids.

Upon this, Professor Owen stated that he also had found in the cells of the stomachs of llamas which he had dissected more or less of food; but he suggested the probability that this might have been forced into them by moving the animal about after death, when muscular power being abolished resistance to the admission of food into the cells would have ceased. He added, that in the instance of the camel which was killed some years since at the Royal College of Surgeons (the particulars of the examination of which have been published by Sir E. Home) the cells of the second and first cavities of the stomach were found to be filled with water only: in that case the animal had been kept without drink for three days, was then allowed to drink freely, was killed three hours afterwards, and was opened without being moved from its erect position. Mr. Cox, on the same occasion, suggested that the existence of food in the cells in the instances referred to might perhaps be accounted for by the fact that the animals in question had been kept for many years in this country, where they were at all times provided with water: under these circumstances a receptacle for the preservation of fluid would not be called into use; and the cells having therefore ceased to be applied to that purpose the muscular power of their apertures would have been consequently diminished. Colonel Sykes added that on examining, in India, the stomach of a camel he had found the cells devoid of food. ('Zool. Proc.,' 1832.) Professor Owen informs us that the camel killed at the College of Surgeons had been a long time in England; but the function of the water-cells was not altered, as the experiment clearly proved.

The student, if he be disposed to doubt at all, will have his doubts on this point cleared up by an examination of the parts in the Museum of the Royal College of Surgeons, prepared by Professor Owen; and, as this part of the subject is peculiarly interesting, we proceed to give a description from the pen of that gentleman of the preparations there preserved. No. 566 B (Physiological Series), is the stomach of a fœtal Llama (*Auchenia Glama*, Desmarest). This singular form of ruminating stomach, observes Professor Owen, is peculiar to the Camel tribe; it is in some respects simpler than that of the horned ruminants, and in others more complicated. Like the stomach of the small species of Moschus (No. 554), the psalterium is less distinctly separated from the abomasus, and at this early period of existence it exhibits in the Llama a similar deficiency of the characteristic laminæ. The reticulum however is much more complex, each of the larger alveolæ being developed into many smaller ones, a structure partially indicated in the reticulum of the Goat (No. 564), and more strongly marked in that of the Ox (No. 464 A). There are moreover two groups of cells developed from the rumen, which differ from those of the reticulum in being shallower, and being visible from without, giving a sacculated character to those parts of the paunch. The several compartments of the stomach have been laid open in this preparation to show their communications with each other and the character of their inner surface. The rumen is lined with cuticle, but is wholly destitute of the villi which characterise it in the horned ruminants. It is partially divided into two compartments by a strong fasciculus of muscular fibres, which, commencing on the left side of the cardiac orifice, traverses the paunch longitudinally. On the right side of this ridge about fourteen smaller muscular fasciculi pass off at right angles, and these ridges are connected by still smaller fasciculi, running transversely between them at different distances from each other; the quadrangular spaces which result from the above arrangement of fasciculi are partly closed by a production of the lining membrane, leaving a circular aperture in the centre of each square for the passage of liquids into the cells beneath. The compartment of the paunch to the left of the great longitudinal ridge terminates in two sacculi, at what may be considered the cardiac extremity. The sacculus nearest the œsophagus is simple; the one farthest from it is developed into a series of cells, of a smaller size but of precisely similar construction to those on the opposite side of the paunch—a series of smaller muscular bands passing off at right angles from the larger one, which separates the two sacculi, and these lesser bands being connected by transverse fasciculi, in the intervals of which the cells are developed. The reticulum, or water-bag, is laid open, showing that the cells are situated between a series of parallel muscular fasciculi, as in the rumen; but their further subdivision is carried to a greater extent, and their orifices are not guarded by membranous productions. The external muscular coat of this cavity is so disposed that its exterior is smooth and uniform, and the cells are scarcely visible from without. The œsophagus is laid open, so as to show the muscular ridge which traverses it longitudinally, and winds round the upper part of the reticulum to terminate at the orifice of the psalterium. "It is obvious," continues Professor Owen, "that by the contraction of this fasciculus, all communication between the first two cavities and the œsophagus would be cut off, and the remasticated food would be conducted, as in the horned ruminants, into the third cavity. A slighter degree of contraction would cut off the communication with the rumen, and allow the passage of fluids direct into the reticulum, or water-bag, which probably takes place when the Camel or Llama drinks." A free communication however subsists between the water-bag and paunch. A porcupine's quill is passed through the oblique canal leading to the third cavity; this cavity in the Camel is a small sacculus, distinct from and intervening between the reticulum and psalterium; it is not so distinct in the Llama; but on a close inspection, the inner membrane nearest the orifice above-mentioned may be seen to be produced into ridges, which are arranged in a reticulate or alveolar form; and as a similar structure is more distinctly observable in the Camel, this cavity was considered by Daubenton as the true analogue of the reticulum, and the water-bag as a peculiar super-addition. The remainder of the stomach in the fœtal Llama may be seen to form one elongated continuous cavity, bent upon itself at its lower third without rugæ or laminæ, the latter being afterwards developed at the cardiac half of this cavity. The pylorus is a small transverse aperture protected by a large oval protuberance. The duodenum is considerably dilated at its commencement. No. 566 C exhibits a small portion of the stomach of an adult Llama, showing the canal which passes along the upper part of the reticulum, and conducts the ruminated food from the œsophagus to the third cavity. The muscular fibres of the greater ridge, forming the upper boundary of this canal, are displayed: some of the fibres wind round the aperture of the third cavity, while others return and pass into the lesser ridge. It is these latter fibres, observes Professor Owen, which, by a forcible contraction, draw up the orifice of the third cavity towards the cardia, and close the communication between the œsophagus and water-bag. The commencement of the reticulum, analogous to the third or supernumerary cavity in the Camel, is kept distended by a bristle. No. 566 D is a portion of the greater group of cells from the paunch of an adult Llama. The cuticle which lines these cells is turned down, and the subjacent membrane removed, to show the muscular fibres of the larger fasciculi, and also those of the lesser connecting bands, which are distinctly muscular, and evidently calculated to close the orifices of the cells. Professor Owen further observes that, after death, when these contractile parts have ceased to act, the smaller matters contained in the paunch, such as grains of oats, &c., may pass into these cells; but their contents he always found to be chiefly fluid. No. 566 E is the reticulum, second cavity, or true water-bag of the Llama. This cavity, Professor Owen remarks, is not lined with cuticle, as in the horned ruminants; the other differences are pointed out in the description of the following preparation. The muscular fibres of two of the larger ridges have been dissected; they form by no means such powerful fasciculi as in the corresponding ridges of the paunch-cells. The middle fibres in each ridge become tendinous; but the lateral fibres continue muscular, and pass off to the different connecting ridges, from which they spread over the entire circumference of the cells, and constitute the second or internal muscular tunic of this part of the stomach. On the opposite side of the preparation a portion of the external layer of fibres is exhibited. ('Catalogue,' vol. i.)

We here see that the structure in this very essential part of the organisation is similar in both the forms of the *Camelidæ*, and that the Llamas of the New World, as well as the Camels of the Old World, are provided with the means of preserving fluids in cells appropriated to that office. Such a provision is consistent with the localities and habits of both; for if the parched deserts wherein the lot of the Camel is cast require such a modification of the stomach, the Llama, whose stronghold is the mountain-chain that traverses the southern parts of America, and which is found high up on the Andes, often out of the reach of lakes, requires little less.

Professor Owen, in his interesting paper 'On the Anatomy of the Nubian Giraffe,' states that the action of the abdominal parietes in rumination is much stronger in the Camel than in the Giraffe; and he observes that it is a singular fact, and one which has not hitherto been noticed, that the Cameline Ruminants differ from the true Ruminants in the mode in which the cud is chewed. In the Camels it is ground alternately in opposite directions from side to side: in the Oxen, Sheep, Antelopes, and Deer, the lower jaw is ground against the upper in the same direction, by a rotatory motion. The movements may be successively from right to left, or from left to right, but they are never alternate throughout the masticatory process, as in the Camels: and here again, he remarks, in the rotatory motion of the jaws of the Giraffe, while masticating the cud, we have evidence of its affinity to the Horned Ruminants. ('Zool. Trans.,' vol. ii.)

With regard to external characters, we have, both in the Llamas and the Camels, the long neck and comparatively small head, and the prolonged moveable upper lip, deeply fissured vertically; we miss, in both, the naked muzzle, and find the apertures of the nostrils mere fissures capable of being shut at pleasure. The differences in the dentition have been already noticed; and though we look in vain for the humps of the true Camels on the backs of the Llamas, yet there is, according to Molina, a conformation in the latter resembling that excrescence, and consisting of an excess of nutritious matter, in the shape of a thick coat of fat under the skin, which is absorbed as a compensation for occasional want of food. The most marked difference appears to exist in the structure of the feet; and this difference is, as we shall presently see, demanded by the several localities and habits of the two groups. No structure can be imagined more admirably contrived for the support and passage of an animal over arid sands than the elastic pad which forms the sole of the Camel's foot, and on which the conjoined toes rest.

But the problem to be solved was the adaptation, in an animal of generally similar structure, of a foot to the exigencies of the case. The pad which connects the toes of the Camel beneath would have afforded no very sure footing to an animal destined to climb the precipices of the Andes; and we accordingly find, in the Llama, toes with strong and curved nails, completely separated from each other, and each defended by its own pad or cushion, so as to present the most perfect modification of the parts with a view to firm progression, either in ascent or descent, whilst there is nothing in the structure calculated to impede great rapidity upon comparatively plain ground.

Considerable doubt is still entertained as to the number of species belonging to the genus *Auchenia*, and we shall endeavour to trace some of the accounts given, beginning with some of the earlier

Camel's Foot; skin removed.

Foot of Llama, with the skin on.

historians and zoologists, and continuing the inquiry down to the present time.

The Spaniards, when they conquered South America, found the Llama, which seems to have been the only beast of burden possessed by the natives, to whom it likewise gave food and raiment; for the flesh was eaten by them, and the hair or wool was woven into cloth. We cannot be surprised that so useful an animal should have been called by the conquerors a sheep, especially when we recollect the qualities of its flesh and of its wool; and accordingly we find the Llamas described as sheep by the earlier Spanish writers. Thus, Augustin de Zarate, treasurer-general in Peru in 1544, in his account of the conquest, speaks of the Llama, as it was observed in the mountains of Chili, as a sheep of burden. He says that in situations where there is no snow, the natives, to supply the want of water, fill the skins of sheep with that fluid, and make other living sheep carry the skins; for he remarks that these Peruvian sheep are large enough to serve as beasts of burden. De Zarate evidently had the eye of a zoologist, for he says that these sheep resemble the camel in shape, though they have no hump. He states that they can carry about a hundred pounds or more, that the Spaniards used to ride them, and that their rate of travelling was four or five leagues a day. His description appears to be that of an eye-witness, and bears upon it the impress of truth. When they are tired, says De Zarate, they lie down, and the load must be taken off, for neither beating nor help will make them get up. Their weariness is manifested in a very disagreeable way when a man is on one of them; for our author says that if the beast is pressed on under such circumstances, it turns its head and discharges its saliva, which has a bad odour, into its rider's face. He speaks of them as of great utility and profit to their masters, praises their good and fine wool, particularly that of the species named 'pacas,' which have very long fleeces; and shows that their keep costs little or nothing, either in money or trouble, for they are satisfied with a handful of maize, and are able to go for four or five days without water. He declares that their flesh is as well-flavoured as that of a fat Castilian sheep, and notices the public shambles for the sale of it in all parts of Peru then frequented by these animals. But, he remarks, this was not the case on the first arrival of the Spaniards; for when an Indian killed a sheep at that time, his neighbours came for what they wanted, and then another Indian would kill a sheep in his turn.

The Llama soon found its way to Europe; for we find, in the 'Icones Animalium' (Gesner, &c.), a figure of one with a collar round his neck, led by a man, apparently his keeper. This figure is by no means badly executed, and is given as the *Allocamelus* of Scaliger, who speaks of it as an animal 'in terra Gigantium' (Patagonia probably), with the head, the ears, and the neck of a mule, the body of a camel, and the tail of a horse: "Quamobrem ex Camelo et aliis compositum 'Αλλοκάμηλον appellavimus." The figure, it appears, was taken from a print, with the following account:—"In the year of our Lord 1558, on the 19th day of June, this wonderful animal was brought to Middleburgh (Mittelburgum Selandiæ), having never before been seen by the princes of Germany, nor recorded by Pliny nor other ancient writers. They said it was an Indian Sheep from Piro (perhaps Peru), a region nearly 6000 miles distant from Antwerp." Then follows the description, from which it may be gathered that the animal was either a brown Llama or a pied one. The neck is stated to have been very white, "cygneo colore candidissimum," and the body rufous, "rufum aut puniceum."

John de Laet (fol., Leyden, 1633) appears to have collected most of the Spanish authorities up to his time. He quotes Garcilasso as saying that the domestic animals of the Peruvians are of two kinds, the greater and the less; which the Peruvians, as a common name, call Llama, that is, cattle or sheep (pecudes); thus the shepherds say Llama Miehec. They call the greater cattle (majus pecus) Huanacu-

Llama, on account of its similitude to the wild animal which is named Huanacu, and from which it differs in colour only; for the domestic Llamas (domesticum pecus) are found of various colours, like the horse; but the wild Llama is only of one colour, like chestnut. The greater kind have a great resemblance to a Camel, except that they want the hump, and are not so large. The small kind (minus pecus) they call Paco-Llama, and this is only fed for is flesh and its wool, which is the best and longest, as it is unequal to the carrying of burdens.

De Laet then turns to Acosta. "Peru," says the latter, "has nothing better or more useful than its cattle, which our countrymen call Peruvian sheep, but which the Peruvians, in their tongue, name Llama; for they bring large profit, and are kept for next to nothing (vilissimo alitur). These cattle furnish the natives with wool for their vestments, like our sheep, and are used by them as beasts of burden. There is no necessity for shoeing them, guiding them by a rein, or feeding them with oats; for these animals serve their masters gratuitously, being content with the wild herbs which they meet with everywhere. There are two kinds (species)—one which is woolly and called Paco by the natives, the other covered with a slight fleece (villis levibus) only, and nearly naked, whence it is more fitted for carrying burdens, called Guanaco. They are rather larger than sheep, but less than heifers, with a long neck like camels, lofty legs, and a compact body: the colour is various, for some are white, some black, some brown, and some piebald (versicolores), which they call Moromori. Their flesh is good, although rather gross (spissior), but that of the lambs is much the best and the most delicate; but they are rarely killed, because they are of by far greater use as beasts of burden, and their wool serves for making cloth. This wool the barbarians clean, spin, and weave into garments; but it is of two sorts, one coarser and more common, which they call Havasca, the other finer and more loose (absolutior), which they call Cumbi (according to Garcilasso, Compi): from this last they weave various curtains and hangings (aulea et peristromata) of most elegant workmanship, which last a long time, and in splendour do not yield to silk; nay, what is wonderful for barbarians, they are so neat in their weaving that the elegance is nearly equal throughout, nor is the web or woof ever apparent. The ancient Peruvian monarchs kept up many works for weaving Cumbi, the principal artificers in which lived at Capachica, on the banks of the Lake Titicaca. These wools they dyed with the juice of various herbs, according as the nature of the work required. But most of the Peruvian barbarians are cunning in this weaving, and have in their huts instruments adapted for the art; and from these sheep they draw most of the necessaries of human life. By far the greatest use of these animals however is in carrying burdens; for sometimes 300, sometimes a drove of 1000, carry various articles of merchandise, skins of wine, chocolate (cocam), maize, Chunno, and quicksilver to Potosi and the other mines and towns." Acosta then speaks of their employment in conveying silver from Potosi, &c., and observes that he has often wondered how droves of these animals, sometimes consisting of 1000, sometimes of two only, and not unfrequently laden with 3000 bars or plates (laminæ) of silver, worth 3000 ducats, should make their way, accompanied by a few barbarians only, who direct them, and load and unload their burdens, and hardly attended by one or two Spaniards, passing the night in the open air and without a guard—and that so safely that a bar is scarcely ever missed, such is the security of travelling in Peru. "The burden of each beast," continues Acosta, "amounts to 100 lbs. and sometimes 150 lbs., which they carry three or at the most four leagues a day, according to the length of the journey. But their leaders know their stations, where food and water for their cattle abound; here they pitch their tents, and unload their beasts. When however they have only one day's journey to make, the Llamas are able to bear a load of even 200 lbs., or to move forward as many as eight or ten leagues. These animals rejoice rather in a cool than in a fervid temperature, and therefore they are propagated immensely in the mountains, whilst they fail in the plains, on account of the too great heat. The bald sheep (calvum pecus), or Guanacoes, are of a fawning (vernile) and gentle aspect: often, as they walk along, they stop and regard the passers-by without any expression of fear or pleasure, so attentively with erected neck, that it is difficult to abstain from laughter; sometimes they are so suddenly terrified, that they run off to the mountain precipices with the greatest swiftness, so that it is necessary to shoot them to save their loads. The Pacoes also become so enraged sometimes, or are so wearied with their burdens, that they lie down with their burdens, and cannot be made to rise either by threats or blows; whence a proverb has arisen, and stubborn or obstinate men are said to be Impacatos. For this there is no better remedy than for the conductor to stop and sit down by the animal, until by his blandishments he prevails on the animal to rise spontaneously."

It further appears that the Llamas are subject to scab, called by the barbarians 'carachen,' which is deadly not only to the animal which has taken it, but spreads by contagion among the flock, so that almost the only remedy is immediately to bury the deceased animal. Garcilasso however mentions other remedies: the most powerful is stated to be a very simple one, namely, anointing the affected parts with lard (adipe suilla). The price of a Llama varies in different provinces; but the barbarian who possesses two or three is considered sufficiently rich. Garcilasso adds that the Peruvians, before the arrival of the Spaniards, did not milk their flocks, which give that secretion very sparingly, and only in sufficient quantity for their young; neither did they make cheeses of their milk.

De Laet then proceeds to state, that besides these domestic herds, Peru produces certain wild animals which are not easily to be seen in other parts of the New World, except in the neighbouring country of Chili. Some of these are called Guanaco, or Haunacu, from a similitude to which the domestic kinds obtained the same name. The flesh of these is good, according to Garcilasso, but not so good as that of the domestic Haunacu Llamas. The males keep a look-out on the highest hills whilst the females are feeding in the valleys; and when the former observe the approach of men from afar they neigh almost like a horse to warn the females. If the men come nearer they flee, driving the females before them. The wool of these is short and rough, but it is notwithstanding used by the barbarians for making cloth. These animals are taken in snares and nooses. Others again are called Vicuñas: these are not very unlike goats, except that they have no horns, and are larger, and are of a leonine colour or more ruddy; these live in the highest mountains or groves, and love the colder regions, but especially the solitudes which the Peruvians designate by the common name of Punas; neither are they annoyed by snow or frost, but are rather recreated thereby. They go in flocks, and run most swiftly. Such is their timidity, that at the sight of men or wild beasts they hurry instantly into inaccessible or hidden fastnesses. There were formerly a great number of these animals here, but they are now become much more rare on account of the promiscuous licence in hunting. Their wool is very fine, and like silk, or rather like the wool of the Beaver, and the natives deservedly estimate it highly: for besides other properties, it is also said to resist the heat and impart coolness, whence it is especially used for caps. Next to these come the Tarugas, or Tarucas, which are larger and more swift than the Vicuñas, and of a more burnt colour, with pendulous and light ears: they rarely collect in herds, and generally wander about the precipices singly. Garcilasso says that these are a species of Deer, but less than those of Europe. They were innumerable in the time of the Yncas, so that they entered the very towns; nor was there any deficiency of their fawns and does. Thus far De Laet, who says that all these animals produce bezoar stones, of which those of the Pacoes and Guanacoes are the smallest and lowest in estimation, whilst those from the Vicuñas are rather larger and better, and those of the Tarugas the best of all.

We now turn to Hernandez. We find in the Roman edition (fol. 1651) a figure of the Pelon Ichiatl Oquitli, *Ovis Peruviana*, with a description. Both figure and description leave no doubt that the Brown Llama is the animal represented. There is a very long commentary, well worth the attention of the curious reader. Of this '*Aries* sive *Ovis Peruviana*,' two kinds are mentioned: the first like the animal represented; the other small and stunted (parvæ et pygmææ), with short legs, but strong and able to carry domestic burdens, such as water, corn, &c. Another kind, the Pacoes, are stated not to be so corpulent. In the catalogue of Hernandez the Pelon Ichiatl Oquitli is called Peruichatl.

Marcgrave gives a figure of the long-wooled and larger Llama, under the name of Ovi-Camelus. In some parts it is not bad; in others, the muzzle and fore feet for instance, it is monstrous. He says that the larger kind of Ovi-Camelus is called Paco. His description is worth consulting; and he says, among other statements, that they bore the ears of these 'sheep,' and run ropes through them, by which their masters manage them and lead them where they please. He then gives another figure, much better executed than the other, of a second species, which is nearly naked in regard to fleece, and is only covered by a light and short one (calvum pecus of De Laet?); and says that it partly resembles a camel and partly a deer, so that it might be well called in Greek ἐλαφοκάμηλος.

We gather then from these and other early writers that there were three kinds of these animals—Guanacoes or Huanacoes, Pacoes, and Vicuñas—the term Llama being applicable to each of them, and merely signifying cattle or sheep, but these kinds are by no means clearly defined. "Until the last half century," says Mr. Bennett, "the great majority of naturalists, including Ray, Klein, Brisson, and Linnæus, concurred in reducing them to two species—the Llama, or Guanaco, commonly used as a beast of burden; and the Paco, or Vicugna, cultivated for its flesh and its wool. Of this opinion was Buffon when he wrote the history of the Llama and the Paco; but the observation of living specimens of the Llama and the Vicugna, and the communications of the Abbé Béliardy on the subject, induced him afterwards to admit the latter animal as a third species distinct from the preceding. In this he was followed by Molina, who, in his 'Natural History of Chili,' separated also the Guanaco, and added a fifth species, the Hueque, or Chilian sheep of the older authors. Gmelin, Shaw, and almost every subsequent compiler, have adopted these five species without examination, giving to them such synonyms as they could pick up almost indiscriminately from the writers on the natural history of America, and thus creating a mass of confusion which it would be both vain and useless to attempt to unravel." ('Gardens and Menagerie of the Zoological Society.')

Pennant gives as species the Llama, the Vicuña, the Paco, the

Guanaco, and the Chilihueque, but gives figures of the two first only.

F. Cuvier makes the number of species three—the Llama, the Paco, and the Vicuña; M. Lesson gives the same. Dr. Fischer records the same three and a fourth, *Auchenia Arucana* (Chilihueque), as doubtful. In his 'Addenda et Emendanda' he notices *L. Huanaca* (*Auchenia Huanaca*, Hamilton Smith; *Cervocamelus* of Jonston) with a query if it is not a mere variety of *L. Peruana*. As a synonym to *Lama Paco* he adds *Auchenia Paco* (Hamilton Smith), *Camelus Guanaco* (Traill). To *Lama Vicuña* he adds *Auchenia Vicugna* (Hamilton Smith), less than the former; and to *Lama Arucana, Auchenia Arucana* (Hamilton Smith).

Male Brown Llama. F. Cuvier.

Paco. F. Cuvier.

Mr. Bennett observes that it seems to be the general opinion among the leading writers of the present day that the subdivision of the genus has been carried to too great an extent. He thinks that F. Cuvier is fully justified by the imperfect accounts of Molina in rejecting as species the Guanaco and the Hueque of that writer. Mr. Bennett states that he should have little hesitation in proceeding still further, for he is strongly inclined to agree with Baron Cuvier in regarding the Paco as a mere variety of the Llama with the wool more amply developed; and in considering the Vicuña as the only animal of the group that deserves to be specifically distinguished from the latter. Skeletons of both the Llama and the Vicuña are preserved in the museum of the College of Surgeons, London.

The Cordillera of the Andes, below the line of perpetual snow, is the region inhabited by these creatures. They are found in Peru (but not in Mexico) and Chili principally, though now much reduced in number; in Columbia and Paraguay they are more rare. Most of the navigators to the Straits of Magalhaens and south-western coasts of America mention Guanacoes from early times down to the expeditions under Captain King and Captain Fitzroy inclusive, and the flesh of these animals has afforded a salutary refreshment to the crews.

Vicuña. Buffon.

Brown Llama, exhibited in England.

The habits of the Llamas may be in a great measure gathered from the descriptions of the Spanish writers above given. In a wild state they keep together in herds, sometimes of one or two hundred, feeding on a sort of rushy grass or reed called ycho, which grows on the mountains, and it is said never drinking when they have sufficient green herbage. They resort to a particular spot to drop their dung, which a good deal resembles that of a goat, sheep, or giraffe, a habit which is often fatal to them from betraying their haunts. Modern observers have noticed the careful look-out that they keep, and the rapidity with which they flee, then turn to gaze, and again swiftly gallop off. Molina says that the Guanacoes leave the mountains, where they passed the summer, at the beginning of winter, when they descend to the plains. Here they are hunted down, at least the young and inactive, with dogs by the Chilians. During the chace they are said frequently to turn upon their pursuers, neigh loudly, and then take to their heels again. Another mode of capturing them by the Indians is for many hunters to join and drive them into a narrow pass, across which cords have been drawn about four feet from the ground, with bits of cloth or wool tied to them at small distances, somewhat in the way adopted by gardeners to keep small birds from the seeds. This apparatus with its pendant trumpery frightens the animals, and they get together, when the hunters kill them with stones tied to the end of leathern thongs. If there are any Guanacoes among them they leap the cords, and are followed by the Vicuñas. Those that we have seen in captivity have been tolerably mild and tame, but very capricious, accepting biscuits and such delicacies from visitors, but ejecting a copious shower of saliva in their faces at the least real or fancied affront. This shower, though sufficiently unpleasant, has not, as far as our experience goes, the acrid and blistering properties ascribed to it by some authors.

We need not here repeat those uses to which these animals have been applied by man. Cords and sacks, as well as stuffs for pouchos, &c., are fabricated from the wool, and the establishments for their manufacture in this country employ thousands of artisans. In Mexico the bones are converted into instruments for weaving the wool. Nor is even the dung neglected, for it is used as fuel. These animals seem to have been to the aborigines what the reindeer (with the exception of the milk) is to the Laplander. Surrounded by herds of such animals which required almost no care, and by the spontaneous productions of the soil, the Indian had no incentive to improvement. Humboldt has an eloquent passage on this subject. "When we attentively examine this wild part of America, we seem to be carried back to the first ages when the earth was peopled step by step; we appear to assist at the birth of human societies. In the Old World, we behold the pastoral life prepare a people of huntsmen for the agricultural life. In the New World, we look in vain for these progressive developments of civilisation, these moments of repose, these resting-places in the life of a people. . . . Those species of ruminating animals which constitute the riches of the people of the Old World are wanting in the New. The bison and the musk-ox have not yet been reduced to the domestic state; the enormous multiplication of the Llama and the Guanaco have not produced in the natives the habits of the pastoral life." These multitudes are already lessened, and the form itself will probably ere long be extinct. Civilisation has brought with it the animals of the Old Continent. The horse and the mule have almost entirely superseded the Llamas as beasts of burden, and the sheep and the goat, in a great measure, as contributors to the food and raiment of man.

The White Llama, according to Feuillée, is said to have been the presiding deity of the natives of Callao, before that province was annexed to the empire of the Yncas.

White Llama, exhibited in England.

* The similarity to the Camel appears to have struck every writer who has treated of the Llama.

Linnæus places the genus *Camelus* at the head of his *Pecora*, and makes *Glama* and *Pacos* species of that genus. *Camelus* is followed by *Moschus*.

Pennant also arranges the Llama and Pacos, &c. under his genus *Camel*, which is placed between the Musk and the Hog.

Gmelin retains the Linnæan arrangement, adding three (so called) species to those recorded by Linnæus.

Cuvier places the great genus *Camelus* at the head of the Ruminants, and makes it consist of the Camels properly so called, and the Llamas (*Auchenia*). *Camelus* is followed by *Moschus*.

M. Lesson arranges the Llamas as the third genus of his Camelées, the two first being *Camelus* and *Mericotherium*. This third and last genus is immediately succeeded by the Moschinées.

Dr. Fischer, following Linnæus, places *Camelus* at the head of the *Pecora*; that genus is followed by *Lama*, and *Lama* by *Moschus*.

Mr. Ogilby (1836) gives the *Camelidæ* as the first family of the order *Ruminantia*, with the following characters:—

Feet subbisulcate, callous beneath, toes distinct at the tip from the sole; no spurious hoofs, no horns; incisor teeth, two above, six below. Two genera:—

1. *Camelus*, whose characters are:—Toes conjoined, immoveable; muzzle furnished with a chiloma,* the upper lip (labrum) divided; lachrymal sinuses, none; interdigital pits, none; inguinal follicles, none; teats, four.

2. *Auchenia*.—Toes disjoined, moveable; muzzle furnished with a chiloma, the upper lip divided; lachrymal sinuses, none; interdigital pits, none; inguinal follicles, none; teats, two.

Mr. Ogilby goes on to state that the *Camelidæ* form what Mr. M'Leay would call an aberrant group. "They differ essentially," observes the former, "from other Ruminants in the structure both of the organs of locomotion and of mastication, and their generic distinctions consequently depend upon characters which have no application to the remaining groups of the order." On the other hand, the principles of generic distribution which subsist among the rest of the *Ruminantia* appear, in Mr. Ogilby's opinion, to furnish negative characters only when applied to the *Camelidæ*; but though necessarily expressed negatively, the absence of lachrymal, inguinal, and interdigital sinuses forms, in reality, positive and substantial characters; and as such should be introduced into the definition of these as well as of other genera, in which they unavoidably appear in a negative form. The *Camelidæ*, in Mr. Ogilby's arrangement, are immediately followed by the *Cervidæ*. ('Zool. Proc.,' 1836.)

Dr. Gray makes his sub-family *Camelina*, the third of his family *Bovidæ*, consist of *Camelus* and *Lama*. He recognises four species:—*L. Vicugna*, the Vicugna; *L. Guanacas*, the Guanaco; *L. glauca*, the Llama; *L. Pacos*, the Alpaca.

No fossil species of *Auchenia* has yet been discovered; but Mr. Darwin brought home from South America the remains of a most interesting animal nearly allied to the Llamas, which Professor Owen has characterised under the name of *Macrauchenia*. [MACRAUCHENIA.] The cervical vertebræ in this form present the same character in the absence of the holes for the vertebral arteries in the transverse processes as in the Llamas and Camels. (Owen.)

LOACH. [COBITIS.]

LOADSTONE, a name given to Magnetic Iron-Ore. [IRON; MAGNETISM, in ARTS AND SC. DIV.]

LOASA'CEÆ, *Loasads*, a small natural order of Polypetalous Exogens, consists of herbaceous and frequently annual plants covered over with stiff hairs or stings, which produce considerable pain by the wounds they inflict. They have alternate lobed leaves without stipules; large yellow, red, or white flowers; numerous polyadelphous stamens, within which are stationed singular lobed petaloid appendages, and an inferior ovary with parietal placentæ. The fruit is a dry or fleshy capsule, with the valves sometimes twisted spirally. The order is nearly allied to *Cucurbitaceæ*, *Homaliaceæ*, and *Cactaceæ*; all the known species are American, and the greater part from Chili and Peru. The genera in gardens are *Loasa*, *Mentzelia*, and *Blumenbachia*. It has 15 genera and 70 species.

LOBELIA, a genus of Plants belonging to the natural order *Lobeliaceæ*. The limb of the calyx is 5-parted; the corolla irregular and tubular; the tube slit on the upper side, and ventricose at the base; the limb bilabiate; the filaments are syngenesious; anthers either all bearded or the two lower ones only; the capsule is 2-celled, 2-valved, many-seeded, dehiscing at the apex.

L. inflata, Indian Tobacco, is an annual plant, growing in most districts of North America. In height it is from 6 inches to 2 or 3 feet. The small plants are nearly simple, the large ones much branched; the root fibrous; stem erect in the full-sized plant, much branched, angular, very hairy; the corolla is bluish-purple; the tube prismatic and cleft above; the segments spreading, acute, the two upper ones lanceolate, the three lower ones oval. The seeds are numerous, small, oblong, and brown. The leaves are oval and obtuse, and have an undulated and irregularly-toothed margin, rough surface, and slightly pilose below, possessing a taste which gradually becomes acrid and pungent. The inflated capsules possess the same virtues.

The action on the human system is nearly the same as that of tobacco when chewed, producing a copious flow of saliva, and if swallowed in a considerable dose causing great relaxation of all muscular structures, including the heart and arteries, accompanied with

* Tumid upper lip continuous with the nose or nostril.

Loasa grandiflora.

1, one of the appendages within the stamens; 2, an ovary with all the sepals cut off except one; 3, a transverse section of the ovary, showing the parietal placentation.

debility and cold perspirations, and also paleness of the surface. In large doses it proves decidedly poisonous. It frequently acts as an emetic and expectorant when given in small and regulated doses.

It has been found eminently useful in warding off or cutting short a paroxysm of asthma, either taken internally in substance, or in the form of an ætherial tincture, or inhaled as smoke along with aromatic herbs. It has been found beneficial as an expectorant and relaxant in hooping-cough, but neither in it nor asthma does it prove more than a palliative, or afford more than temporary relief; as such however it is very serviceable in some nervous affections with irregular action of the heart. [LOBELIA, in ARTS AND SC. DIV.]

L. siphilitica, grows in the United States. It is a bright but rather pale-green perennial growing about 2 feet high; the stem is erect, angular, very slightly hairy; leaves ovate-oblong, acute at each end, rather wavy, unequally serrated, slightly hairy; raceme terminal, leafy, cylindrical, dense; peduncles bracteolate, hairy, shorter than the acuminate hairy bracts; calyx leafy, with ovate acuminate hairy segments half as long as the tube of the corolla, and reflexed at the sinus; corolla deep-blue in the tube, paler in the limb, the lower lip of which is convex and white at the base; all the segments ovate and acute; the tube of the stamens deep-blue, elevated through and beyond the dorsal slit of the corolla. The whole plant has a rank smell. Its root is acrid and emetic, and has been used as a remedy for syphilis; it has the reputation of acting as a speedy cure for this disease, but European practice does not confirm its American reputation.

L. Dortmanna has linear entire leaves of two parallel tubes, the stem simple and nearly naked; the root-stock fleshy, with filiform runners; leaves blunt, from 1 to 2 inches long; stem 12 to 18 inches high; the flowers are light blue, distant, in a simple raceme, slightly raised above the water, the rest of the plant submersed. It is found in lakes with a gravelly bottom in Great Britain.

L. urens has a nearly upright stem, the lower leaves obovate or oblong, slightly toothed, upper ones lanceolate serrate, flowers in long terminal racemes; the stem from 12 to 18 inches high, leafy, branched, angular, and roughish; racemes erect, simple, and lax; flowers of a light-blue colour. It is found on heaths near Axminster, Devonshire.

(Babington, *Manual of British Botany;* Lindley, *Flora Medica.*)

LOBELIA'CEÆ, *Lobeliads*, an important natural order of Monopetalous Exogens, differing from *Campanulaceæ* in having irregular flowers and syngenesious stamens, but otherwise resembling them very nearly; of these two characters the last is the most absolute, *Isotoma*, a lobeliaceous genus, being so called because its flowers are regular. The species principally inhabit the warmer parts of the world; in Europe they are rare, in North America much more common, especially in the southern states, and they are abundant in the hotter countries of South America. Many are found at the Cape of Good Hope and in the north of India; their favourite haunts being damp woods or situations freely supplied with moisture. They abound in a milky juice, which in all is acrid, and in some so intensely so as to produce dangerous or even fatal consequences when applied to the surface of the body or taken internally. Among the most virulent is the *Hippobroma longiflorum*, a West Indian species, and the *Lobelia Tupa*, a Chilian plant now common in gardens. Nevertheless certain species have proved in skilful hands valuable curative agents, especially the *Lobelia inflata*, or Indian tobacco. [LOBELIA.] Many of the plants of this order are cultivated in gardens for the sake of their brilliant blue or scarlet flowers: white and yellow are rare in the order. There are 27 genera and 375 species of the order.

LO'BIPES, Cuvier's name for a genus of Wading Birds (family *Longirostres*, Cuvier), the type of which is *Tringa hyperborea*, Linn. The genus is identical with *Phalaropus* of Vieillot.

LOBOITE. [IDOCRASE.]

LOBOPHY'LLIA. A portion of the Animals included in Lamarck's genus *Caryophyllia* is thus named by Blainville. [MADREPHYLLIŒA.]

LOBSTER. [ASTACUS; CRUSTACEA; HOMARUS.]

LOBULA'RIA, a group of recent *Zoophyta*, separated from the Linnæan *Alcyonia*. [ALCYONIDÆ.]

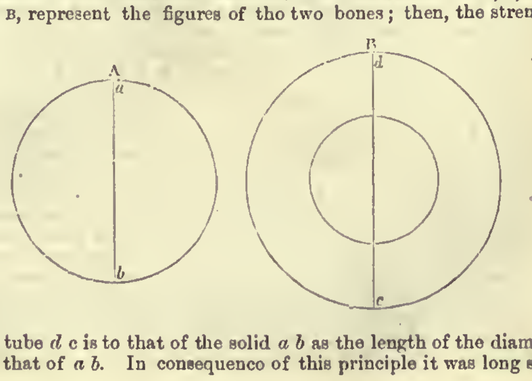
LOCOMOTION IN ANIMALS. The constitution of a vast assemblage of animals requires that they should possess the power of moving from place to place in search of food, and for a multitude of other objects incidental to their sphere of action.

In order to effect this object it is requisite that the framework of animals which are destined to move on the earth should be more dense, and possess greater strength, to enable them to bear the shocks incidental to terrestrial progression, than that of those species which move in air or water. The bony framework of the higher orders of animals, such as man and other *Mammalia*, is composed of a great number of pieces which are hinged together at the joints in such a manner as to allow of more or less mobility, according to the purposes they are intended to fulfil. Thus, the legs and arms are united to the trunk by a ball-and-socket joint, a species of union permitting the greatest possible freedom of motion. The knee, elbow, and ankle, on the contrary, are furnished with the hinge-joint, which admits of motion back and forward in one plane only; but, although the movements of these joints are thus in some measure restricted, greater precision is secured.

The vertebral column, which comprehends the bones of the back, is composed of a long chain of bones, acting as a flexible lever to support the head, neck, and trunk, and forming the connecting link between the several parts of the body. For this purpose the movements of each of the several bones of the back upon each other are restricted; but, in consequence of the great number of joints with which the spinal column in man is furnished, it has a considerable degree of motion. The extremities of those bones which terminate in joints are tipped with a very hard, smooth, pearly-white, opaque substance, termed cartilage, lined with a delicate thin membrane, called the synovial membrane, which secretes an oily fluid into the joints; so that the limbs, in their movements upon each other, are protected from friction throughout the life of the animal.

The elastic cords which bind the bones together at their joints are termed ligaments, and such is their strength that bones are often broken without the connected ligaments being torn or injured.

The long bones which support the trunk of an animal above the surface on which it moves are hollow cylinders, a form which presents a longer surface for the attachment of the muscles by which the limbs are moved, and confers greater strength with less expenditure and weight of material than if they were solid. It is found that the lateral strength of two cylindrical bones of equal weight and length, one of which is solid and the other hollow, are to each other as the diameter of their transverse sections. For instance:—let *a*, *b*, *d*, *c*, *figs.* A, B, represent the figures of the two bones; then, the strength

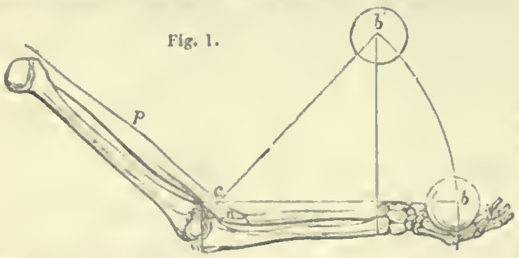


of the tube $d\ c$ is to that of the solid $a\ b$ as the length of the diameter $d\ c$ to that of $a\ b$. In consequence of this principle it was long since observed by Galileo that the strength of bodies is augmented in a thousand ways without increasing their weight; and that if a wheat-straw, which supports the ear which is heavier than the whole stalk, were made of the same quantity of matter, but solid, it would break or bend with far greater ease than is now found to be the case. The feathers of birds present, as well as the bones of animals, similar provision for the combination of strength, lightness, and economy of material. It must however be borne in mind that neither the strength of bodies nor the size of animals can be increased with the same quantity of matter without limit; because when the diameter of the tube exceeds certain dimensions it becomes so thin and fragile as to break without offering any sensible resistance.

The bones, ligaments, and joints of animals are denominated the passive organs, and the muscles the active organs of motion. The bones serve the purpose of levers, which are acted upon after the principle of what is called the first, second, and third orders of lever, so named according to the relative positions of the prop or fulcrum, the power, and the resistance or weight.

The power of the muscles which move the limbs is so great that if the resistance to their action be sufficiently strong, they are often known to break the bones upon which they act. It is in consequence of the great force which the muscles are capable of exerting that they are generally attached to the bones very near the axis of the joint about which the bone moves. The advantage of this disposition is, that a greater power of the muscle is made equivalent to a greater velocity in the movement of the limb. The action of the biceps muscle affords a good example of this principle. In the annexed figure (1) we observe that this muscle p is attached to the bone of the fore arm at a, very near the axis of the elbow-joint f, the effect of which is that in raising the weight in the hand b to b', the muscle moves the point a only to c; but then, as the distance between b and b' is much greater than the distance from a to c, it is manifest that a very small contraction of the muscle is sufficient to produce a very great range in the movement of the extremity of the limb.

Fig. 1.



In this case the muscle is acting under a mechanical disadvantage owing to the obliquity of its direction, and its proximity to the joint: but, as it is endowed with great power, these circumstances do not constitute defects. On the contrary, not only can the limbs be moved upon each other with much more velocity, but the symmetry and beauty of proportion in the human figure are preserved. It is moreover said that a muscle cannot contract upon itself beyond one-fourth of its entire length; so that its work must of necessity be done by acting in some such manner as we find in the case already mentioned.

As the muscles have the power of contracting throughout nearly their whole length, they are capable of drawing the moveable parts attached to them at both their ends; for example, we can, with the same set of muscles, either bend the thigh upon the body, or body upon the thigh. If the muscles had not been endowed with the power to move the limbs under a mechanical disadvantage with the velocity they do, the sledge and the hammer, now so daily in use, would have been instruments of no value to the smith, nor the axe and hammer to the carpenter; and the numberless uses to which rapid motions of the limbs are applied must have been effected by some other means. The figure of the arm affords an illustration of the principles of the third order of lever; that is, the power of the muscle is applied between the weight b and the fulcrum f; and the power of the muscle p is to the weight b, as the length of the line bf to the length of the line fc: from this proportion we can readily find the power of the muscle when the weight is known.

If we select four animals of the same order, having similar figures, whose dimensions of one kind are as 1, 2, 3, 4, the weights of the animals and of all their corresponding parts will be as the cubes of these numbers; that is, as 1, 8, 27, 64; but since it is found that the force of a muscle depends on the number of its fibres, this force must increase in the ratio of its transverse section, that is, as the square of one of the dimensions of the animal, or as 1, 4, 9, 16. The contractile force of the muscles in a healthy man, according to Dr. Young, is equivalent to about 500 lbs. for each square inch of the surface presented by their transverse sections. We may then easily understand from the preceding remarks why it is that the most powerful men have their muscles most developed; and why the largest muscles are placed in those parts of the body where they are subjected to the greatest quantity of work. For example, the force of the muscles that close the lower jaw in man is estimated at 500 lbs.; indeed the force of these muscles is well known to be sufficient to crush the soundest teeth when a hard substance is placed between them. Some individuals are capable of holding between the teeth and of supporting by the lower jaw 240 lbs. and upwards. In many of the lower animals, such as the *Carnivora*, the muscles which close the lower jaw are much stronger and more developed than in man, as is exemplified in the ease with which the lion and tiger lacerate their prey.

It is well known that the quantity of labour which the muscles will endure, and the length of time they will continue to act, increase, within certain limits, in proportion to their daily exercise. If the muscles of the arms or legs, or any others, be called suddenly into action for a longer period than that to which they have been accustomed, they soon communicate to the individual a sense of weariness, and evince a disposition to yield to the action opposed to them, and, unless they are allowed some repose, mischief speedily succeeds. But when their action is very gradually increased day after day, it is observed that the bulk of the muscles, and consequently their power, is augmented. For it has been already stated that the force of muscles is directly proportioned to the square of the surfaces which they present on making transverse sections through them: and if we take the estimate of Dr. Young for the basis of a computation of the additional force they acquire by exercise, we shall find that an increase of a quarter of a square inch in a single muscle is equivalent to a gain in strength of $\frac{500}{4}$, or 125 lbs. Now, as a great number of muscles act at the same time in moving the limbs, it follows that they must all become enlarged, in proportion as they contribute to produce that motion. It is therefore practicable, by gradually increasing the exercise of the different muscles of the body daily, and thereby augmenting their bulk, to attain a vast increase of animal strength; and when we consider that health is the result of such exercise, if it is not carried too far, no stronger argument can be adduced for its adoption. But there is a limit to the amount of exertion which the muscular system will bear: if that limit is passed the muscles lose their vigour, and lassitude and a flaccid state supervene. Experiment teaches us how long the muscles may be continued in action, and the quantity of force which they are capable of expending during that period. We have before stated that the weight of the body is proportional to the cube, and the power of the muscles to the square, of some one of its dimensions: for instance, in two similar-formed men, whose heights are respectively 5 and 6 feet, the muscular power of the former to that of the latter will be as 25 to 36, but their weights will be as 125 to 216, or as 25 to 43 very nearly; the weight therefore increases much more rapidly than the muscular power, and consequently a small man is stronger, in proportion to his size, than a larger one. The same law holds good in all animals of the same kind. In persons predisposed to corpulency, and who neglect to use the proper means of checking it, the quantity of fat continues to increase and the muscles to decrease in volume until they exhibit the deplorable phenomenon of an inability to move even their own weight without pain and difficulty: for it is found on dissection that the quantity of muscular fibre is less, and the fibres themselves more flaccid, in fat persons than in others.

The attitudes and movements of every animal depend on the position of the centre of gravity* and base of support. When a man stands erect a plumb-line passing through his centre of gravity will fall between his feet. It is a subject of mathematical investigation, when the feet are equally advanced and equally inclined (as in *fig.* 2)

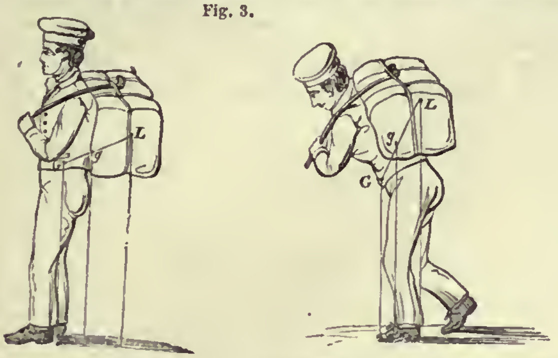
Fig. 2.

to determine the angle $a\,b\,c$, which they must form with the prolongation of the line joining the heels in order to afford the greatest base of support. In general, where the legs are perfectly vertical, it will be found that the line joining the centre of the heels is just equal to the length of the foot, and in this case the required angle will be 60° exactly; as the heels approach each other this angle diminishes, and when they are close together it is rather more than 45°. Opera dancers, besides curving the body, employ their arms to bring the centre of gravity over the base of support, which is often limited to the ball of the great toe of one foot; the weight of the raised leg and foot is also concerned in producing the equilibrium of the body in resting on the other foot. Rope-dancers use a long heavy pole for the same purpose: the pole is grasped by both hands, and carried nearly at right angles to the axis of the rope, as the centre of gravity must be continually brought over the very narrow base which the rope affords, and the rope itself, if slackened, having a motion both lateral and vertical, and being at a considerable height above the ground: the process of rope-dancing requires great muscular activity and precision in the attitudes of the body to secure the performer from falling. The celebrated Madame Saqui, as is well known, lost her life by a fall from a rope. The centre of gravity has always a tendency

* The centre of gravity of any body is that point upon which the body, acted on only by the force of gravity, will balance itself in all positions; consequently, if a line or plane which passes through the centre of gravity be supported, the body will be supported in all positions.

to oscillate on each side of the rope, and the eye of the performer is fixed on one end of it, by which means he is enabled to keep his body steady, and moreover, when his centre of gravity falls on the left side of the rope, a sufficient portion of the pole is shifted to the right side in order to restore the equilibrium. A long rod is then a very good auxiliary for keeping the body steady in positions of difficult equilibrium, such as walking over narrow parapets, or wooden bridges thrown across rivulets without a hand-rail, which may often be met with in country districts. When a porter carries a burden, the

Fig. 3.



attitude of the body must accommodate itself to the position of ths common centre of gravity of himself and his load. Thus, in the above figures it will be observed that when the man stands upright ths centre of gravity of the man G falls within the base of support, and if his load L falls without the base, as does likewise g, the common centre of gravity of the man and load, the consequence would be that he wonld fall backwards; but this is prevented, or which is the same thing, the point g is brought within the base by the man bending his body forward. The reverse happens when the load is carried in front; as, for instance, by the laundress, whose basket is carried in front, as in *fig.* 4. In this case, instead of bending forward,

Fig. 4.

Fig. 5.

as in the former case, the body is thrown back, in order that the centre of gravity common to the woman and the basket may be brought within the base of support. In these and similar casos the person will be prevented from falling when the lins $G\,g$ multiplisd by the weight of the man is equal to the line $g\ L$ multiplied by the weight of the load. When a person stoops to place a load, such as a pail of water, on the ground, the hips are thrown backward so as to bring the point g within the base of support. Just as ths pail reaches the ground the common centre is for a moment however beyond the base, and there is great danger of the body falling forwards, which is sometimes prevented by the person instiuctively clinging to the edge of the pail. Corpulent persons are observed to walk very erect, in order to throw the centre of gravity immediately over the hip-joints, upon which the body rotates, as in *fig.* 5. They are also observed to take very short steps, and walk more slowly than others.

The erect attitude, which contributes, amongst many other things, to distinguish man from the lower animals, is chiefly owing to his organisation, and not the effect of mere mental development. It is found that animals instinctively adopt that position of the body which enables them to bear their own weight with the least expenditure of muscular labour, and that in all other positions the support of the body becomes irksome. Let us now turn our attention to what takes place in the erect posturs in man. The position in which the muscular force is least expended is that in which the bones of the skeleton, and all other parts, are poised upon each other at the joints about which they move: the muscles in this case have merely to perform the office of keeping the superincumbent parts exactly balanced. When a man stands erect, with the eyes directed horizontally forwards, or slightly inclined upwards, the centre of gravity of the head lies vertically over the centre of the joint that connects the head with the neck: also, the weight of the body and head is equally supported on the hip-joints; these again, with the thighs, rest on the centres of the knee-joints, and these on the elastic arches formed by the bones of the foot which ars placed on the ground. Thus, in *fig.* 6 it will be

Fig. 6.

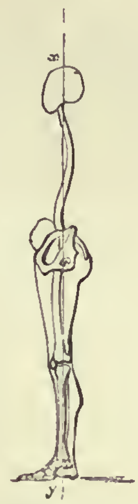


Fig. 7.

seen that the vertical lins x, y, passes through all the points just enumerated; and, whilst the body is erect, there is required only sufficient musculsr power to keep it balanced on the joints, and the joints from bending. Now, to show that the several parts are most easily supported in the erect position, let us see what happens when the body is horizontal. Take the head, for example. The centre of gravity of the head G (*fig.* 7), instead of lying vertically above the joint of the neck g, as when erect, is distant from it by ths length of the line $G\,g$, so that the muscles which keep the head in the horizontal position have to support it with a mechanical disadvantage at the end of a lever $G\,g$; and it will be found that it cannot be sustained in that position, even for a short period, without great fatigue, which is not felt in the erect posture. It will also be observed that the eyes would be directed towards the ground, so that a man could not look horizontally forwards without difficulty, nor vertically upwards at all, both of which actions ars essentially necessary to the pursuits and habits of the human race. In the lower animals the case is quite different; for, if we take the horse as an example, we find that the centre of gravity of the head is brought nearer the joint unitiug the head with the neck in the horizontal than in the erect position. From the position of ths eyes in the head, if the animal were standing erect on its hind legs, it would look directly upwards, and could not direct them to ths ground. These considerations, alone are sufficient to enable us to come to the couclusion that man is not organised to move as a quadruped, nor quadrupeds as man; and moreover, in the posture of the quadruped, the whole sole of the humau foot would not reach the ground, but the toes only; and he would become a digitigrade, instead of being, as he is now, a plantigrade animal. In the position of a quadruped, also, if the hands and arms were employed to contribute to the support of the head and trunk, they would no longer be free to perform all those various offices to which these organs are manifestly adapted.

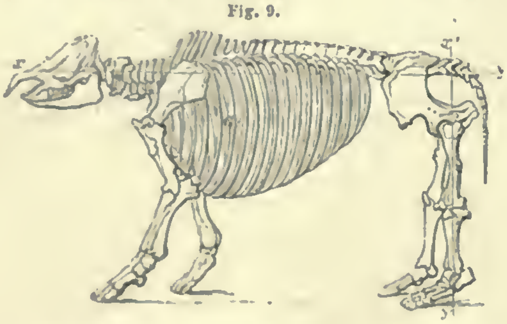
There is a considerable differsnce in the figure of the vertebral column of man and of the lower animals; in ths former it is constructed to bear the greatest weight in the erect, but in the latter in the horizontal position. In man the vertebral column (or, as it is more commonly called, the back-bone) is divided, from the head to the lower part of the loins, into 24 joints. Between each bone of the back there is a very elastic substance interposed, of such a nature as to bear the pressure of the bones without iujury, to enable them to be twisted and bent upon each other without coming in contact, and thus to avoid ths injury that would result from friction. It might be supposed at first sight that a chain of bones, piled upon each other, separated by so many joints, and capable of moving in various directions, would be a weak and impsrfect organ, when considered as a pillar to support the head and body: this, however, is by no means the case; for, independently of its office in upholding the head and trunk, each bone is hollow, so that the vertebral column forms a tube for the passage of the spinal marrow or cord, which it encases, and protects from external violence, in all the varied occupations of life. Destined, then, as the bones of the back are to protect so important an appendage of the brain, and to support the weight of the head and trunk, special care has been taken by the all-wise Creator to construct each bone with sufficient strength for these purposes; we consequently find the bones of the neck, which have the least weight to bear, the smallest, and that they gradually increase in size down the back to the loins, whers they are the largest. Each bone of the back is bound so strongly by ligaments to the one above and below it, and its figure is so constructed to lock into the adjoining bones, that no common force will disunite them: indeed, so firmly are the bones of the back bound and locked together, that a force sufficient to crush the body of the bone will alone separate them. A fracture of this kind is, accordingly, one of the most serious accidents that can befal a man, and, in fact, death most commonly results from it. The vertebral column is not straight, but curved in three places, as shown in *fig.* 8. At *a*, the neck, the spinal column lies in front of the vertical line *x y*; at *b*, the back, part of the column supporting the shoulders lies behind the same line; and at *c*, the loins, the column again lies in front of it. Now, it may be imagined by some persons that this curved condition of the back is a defect and a source of weakness, but it is, on the contrary, a condition of security and strength; for, the jars incidental to walking, leaping, and heavy blows, coming vertically on either extremity, are thus transmitted obliquely through the whole column, so that much of their violence is lost. Moreover, it has been found by Euler that an elastic rod, when slightly curved, will bear upon its end a much greater weight than if straight; and if the number of small curves be three, the weight it will sustain will be the square of three, with one added, or 4 × 4, that is, 16 times greater than if it were straight.

Fig. 8.

Now, if we may consider it admissible to apply this principle to the human vertebral column in bearing a burden on the head in the erect posture, we shall see that, in this posture, a man is capable of carrying, or rather supporting, such a load as would almost break the back in a prone position.

We observe that the bones of the back, or vertebral column, are also curved in the lower animals; but, instead of forming several curves in opposite directions, as in man, it forms one large arc, which is convex upwards, when the spine of the animal is directed horizontally. This form of the bones of the back in quadrupeds is conspicuous in the *Ruminantia* and *Pachydermata*; for instance, in the Rhinoceros, as seen in *fig.* 9, the whole of the column lying between

Fig. 9.



x and *y* forms one large arch with its concavity directed downwards; and, as each bone which enters into the composition of the arch is bound to the adjacent bones by ligament, or fibrous cord of great strength, any force or load laid upon the back of the animal, in its natural prone position, by tending to bring that portion of the spine lying between *x* and *y* into a straight line, tightens these cords; and thus the spine itself is capable of bearing as much, or perhaps more weight than the limbs of the animal could carry in its natural position: but, if the load were laid on the top of the spine, instead of across it, on the supposition that the body of the animal assumed an erect posture, the arch of the back would increase, and the spine would be broken by the same load which it would easily bear when laid across it. Here, then, we have another illustration of a quadruped requiring a prone position derived from the constitution of its vertebral column. Independently of this, if we were to examine the relative positions of the joints, we should find that, when a quadruped is placed in an erect posture, a vertical line passing through the centre of gravity of the head and the axis of the joint which unites it to the trunk, does not, and cannot pass through the centre of gravity of the animal, *G*, and the hip, knee, and ankle joints at the same time, as in man; neither can the horizontal line *x y* be brought to coincide with the vertical line *x' y'*: and, that therefore, the erect position of a quadruped is not that of least expenditure of muscular action, which we maintain is the position natural to every animal in the act of standing.

The human body is supported during progression on one or both legs, and the conditions of its locomotion differ from those of almost all other animals. We may observe that when locomotion takes place, the centre of gravity of the body must be lowered from the position in which it is found when standing perfectly erect: and for this purpose the legs are furnished with three joints, the first of which connects them to the trunk, the second is the hinge-joint of the knee, and the third is the ankle-joint, the structure of which partakes of the hinge-like action of the knee, but has also a small extent of lateral motion. It is owing to the power of flexion and extension of the legs that it is possible to carry the centre of gravity of the body almost in a perfectly horizontal line and with a uniform velocity. The length of the legs in man, if measured from the hip-joint to the ground when standing erect, is found in most persons to be greater than the length of the rest of the body above that point. Of the three joints of the leg, the first, or hip-joint, allows it only to move forwards; the second, or knee-joint, allows it only to move backwards; and the third, or ankle-joint, either backwards or forwards. In *fig.* 10 we

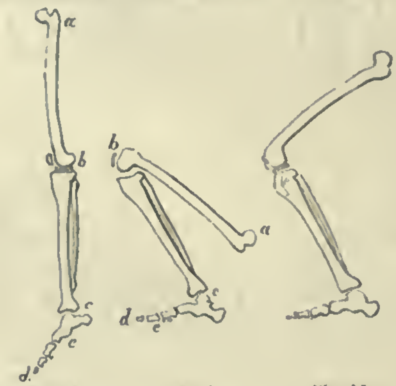


Fig. 10. Fig. 11. Fig. 12.

observe the greatest length the leg can assume by the complete extension of all its joints, this length being the distance between *a*, the head of the thigh-bone, and *c*, the convex surface of the ankle-joint. In *fig.* 11 we have the least length of the leg, produced by the simultaneous flexion of all the joints, but this bending of the leg is evidently much greater than is necessary in the act of quickest walking, during which the bending of the leg is as represented in *fig.* 12; so that the range of motion in the several joints of the legs is greater than is necessary for the common purposes of walking, but is essential to some other attitudes. It will be observed that the length of the thigh-bone is nearly equal to that of the leg from the knee to the ankle, and in consequence of the opposite directions in which the

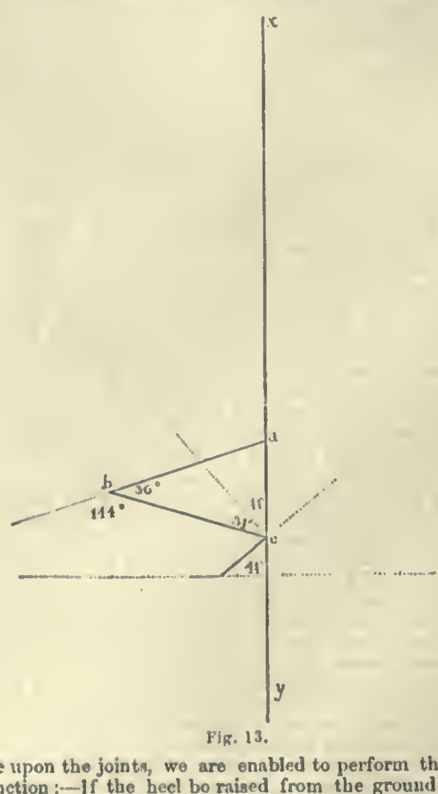


Fig. 13.

limbs move upon the joints, we are enabled to perform the following curious function:—If the heel be raised from the ground about 41°, so that the body rests on the ball of the foot only, the centre of gravity may be made to descend in a vertical line by bending all the joints of the legs simultaneously (*fig.* 13): a reference to the figure will show how this is accomplished. The entire range of the knee-joint being, in round numbers, 144°, the least angle that can be formed between the leg and thigh is 36°; and since the distance from the hip-joint to the knee when bent is equal to the distance from the knee to the ankle, the hip-joint a will always be found in the vertical line $x\ y$, and when the knee-joint is fully bent, that is, when the leg and thigh are inclined at an angle of 36°, each of the angles at the base of the equilateral triangle $a\ b\ c$ will be 72°; now, the utmost forward range of the leg upon the ankle is only 31°, therefore the heel must be raised 41° in order to throw the leg sufficiently forward to make the angle between itself and $x\ y$, the vertical line 72°, by which means the point a will have descended to the lowest possible position in that line. This is a property peculiar to the structure of the human frame. In the act of standing both legs concur to the support of the trunk, and for this purpose alone there is a considerable expenditure of force employed to keep the centre of gravity of the body above the ground; and we all know that in standing for a considerable length of time great weariness is experienced; and although the force exerted in standing is less than in walking and running, it is nevertheless estimated to be equal to the height of the centre of gravity multiplied by the weight of the body.

In walking, as well as in running, we may divide the body into two portions: first, the portion which constitutes the burden to be borne, consisting of the trunk, head, neck, and arms: and, secondly, that which supports the burden, and propels it along, consisting of the legs. In walking, the trunk, with its appendages, is carried forward on the heads of the thigh-bones, like a rod poised lengthwise on the tip of the finger; and we know that if the finger be moved onwards when the rod is poised vertically, it will fall backwards, and that it must be inclined forwards to preserve its position on the finger, indeed its inclination must be very nicely adjusted to prevent it falling as the finger moves forwards, and this inclination must be greater as the movement of the finger is increased; and if the wind moves in an opposite direction, a still greater inclination of the rod becomes necessary; and those who have made the experiment must be aware of the difficulty, unless after much practice, to keep the rod thus balanced from falling. Now, the human body is balanced on each leg alternately, in a manner precisely similar to and subject to the same conditions of equilibrium as the rod; the trunk must therefore be inclined forwards during progression, and its inclination must be greater or less, according to the velocity of the movement and the resistance of the air. It is for this reason that we see persons inclining their bodies very much forward in walking against a strong wind, and almost erect when walking in the same direction as the wind. Bearing, then, these principles in mind, we can easily understand why it is that every movement of the arms, head, neck, and trunk, and every position of the legs, require a simultaneous movement of all the rest of the body to keep the whole poised on the heads of the thigh-bones during walking.

The measures of the inclinations of the trunk due to different velocities have been taken by Messrs. W. and E. Weber. The arms, being attached to the upper part of the trunk, and considerably above the axis of motion, or line through the hip-joints, and being moreover free to move in almost every direction, except in that which would tear them from the body, contribute a great deal towards keeping the trunk in a state of equilibrium on the legs, and thus dispense with that large amount of muscular force which would otherwise be required for that purpose: hence in walking we observe the arms in constant motion, oscillating backwards and forwards at every step, and we find, on more closely inspecting the order in which they move, with respect to the legs, that whilst the right leg swings forwards, the trunk is turned round horizontally on the head of the left thigh-bone; which tends to advance the right shoulder before the left; but this is counteracted by the right arm, which swings backwards, and by the left, which at the same time swings forwards, and the combined effect of these two motions is to neutralise the twisting of the upper part of the trunk on the legs during each step. A corresponding effect takes place when the left leg swings forwards; so that a good walker can move without any sensible twisting of the body, which is however generally apparent in the female sex, arising from the greater distance between the heads of the two thigh-bones in them than in males. The swinging of the arms then is attended with considerable advantage; for not only do they lessen the amount of muscular exertion, but give a greater freedom to the attitudes assumed by the trunk in walking and a more easy style of movement, and a graceful gait results from their well-regulated oscillation. When the arms however are made to describe very large curves externally to the vertical plane in which they swing naturally, a trick which youths are prone to, under the erroneous idea of thereby adding to the manliness of their appearance, the effect is in reality extreme awkwardness, for the shoulders are thrown alternately forwards, and much muscular strength is wasted, as may be verified by any one who tries to walk in this manner for a long time and at a rapid pace.

In walking, the centre of gravity does not move in a perfectly horizontal line, but is raised and depressed during each step. Weber found, by an apparatus designed for that purpose, that in ordinary walking, when the length of the step taken was 2·39 feet, the mean elevation and depression was 1·1 inch, and this quantity of vertical motion was very nearly the same whether the speed was increased or diminished. In walking on the ball of the foot the mean elevation and depression of the trunk did not exceed 0·8 inch.

We have already mentioned what quantity of force is necessary to be expended to support the body in standing; but in walking, each leg has not only to sustain in its turn the whole of the superincumbent parts, with the additional weight of the swinging leg, but to push the body forwards, and for these purposes the force is very considerable. The resistance to the forward movement of the body arises from the friction of the joints, the friction of the sole of the foot upon the ground, and of the air, but the principal resistance is that of the advanced leg when it reaches the ground.

It has been always supposed, until a very recent period, by those whose business it is to study the structure and operation of the several organs of animal bodies, that the swinging of the legs in walking and running depended on the action of the muscles. It has however been discovered by Messrs. W. and E. Weber that the leg swings after it has been raised from the ground by the force of gravity alone, and that it obeys the same laws as the pendulum of a clock. In fact they regard the supporting leg as the substitute for the weight of a clock, and the swinging leg as the substitute for the pendulum, each leg exchanging its office successively. We have here, then, an illustration of the connection between the laws which govern the solar system and those which govern the locomotive actions of the organs of human beings.

Now, as the leg swings according to the laws of the pendulum, and moves forwards without the active interposition of its muscles, we must see how much the economy of the power which is destined to enable us to move upon the earth has been provided for in the formation of the human race; for were the muscles of the legs employed in this movement, their force would soon be exhausted, and we should be able to move over a very limited space in a long time.

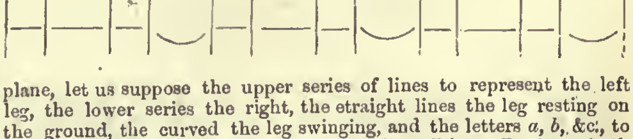
It is well known that a short pendulum will vibrate much quicker than a long one, and that the time of one vibration of the pendulum of all clocks is regulated upon this principle; but to be more precise, the times of the periodic oscillations of any two pendulums are respectively as the square roots of their length. By applying these principles to the swinging leg of a man in walking, we can easily understand why persons with short legs take more rapid steps than persons with long legs, and why males and females rarely step together, unless the former accommodate the length of their step to the time of the latter.

Those who have studied the theory of walking have found it convenient to divide the time of a step into two portions, namely, that in which one leg and that in which both legs rest on the ground; at least this arrangement has been adopted by Borelli, Weber, and Bishop. In walking it is necessary that there should be at least one foot always on the ground, and there is no instant in which the body is not supported either by one or both legs. In running the case is different, as we shall hereafter see.

The period wherein both legs are on the ground is shorter than that in which the trunk is supported by one leg only. During the time the body is supported by one leg the other leg swings from behind forwards; and, being again placed on the ground, the first interval ends, and the other, namely, that in which the body is supported by both legs, begins, and terminates with the raising of the other leg. The time that the body is supported by both legs diminishes continually as the velocity is increased, and when it vanishes altogether, as in quickest walking, we arrive at the common limit of the quickest pace in walking and the slowest in running. Thus the two states in which the body is supported either by one or both legs alternate in such a manner that one begins at the instant the other terminates; and it is found by experiment that only in very slow walking is the time wherein both legs are on the ground equal to half that in which one only supports the body.

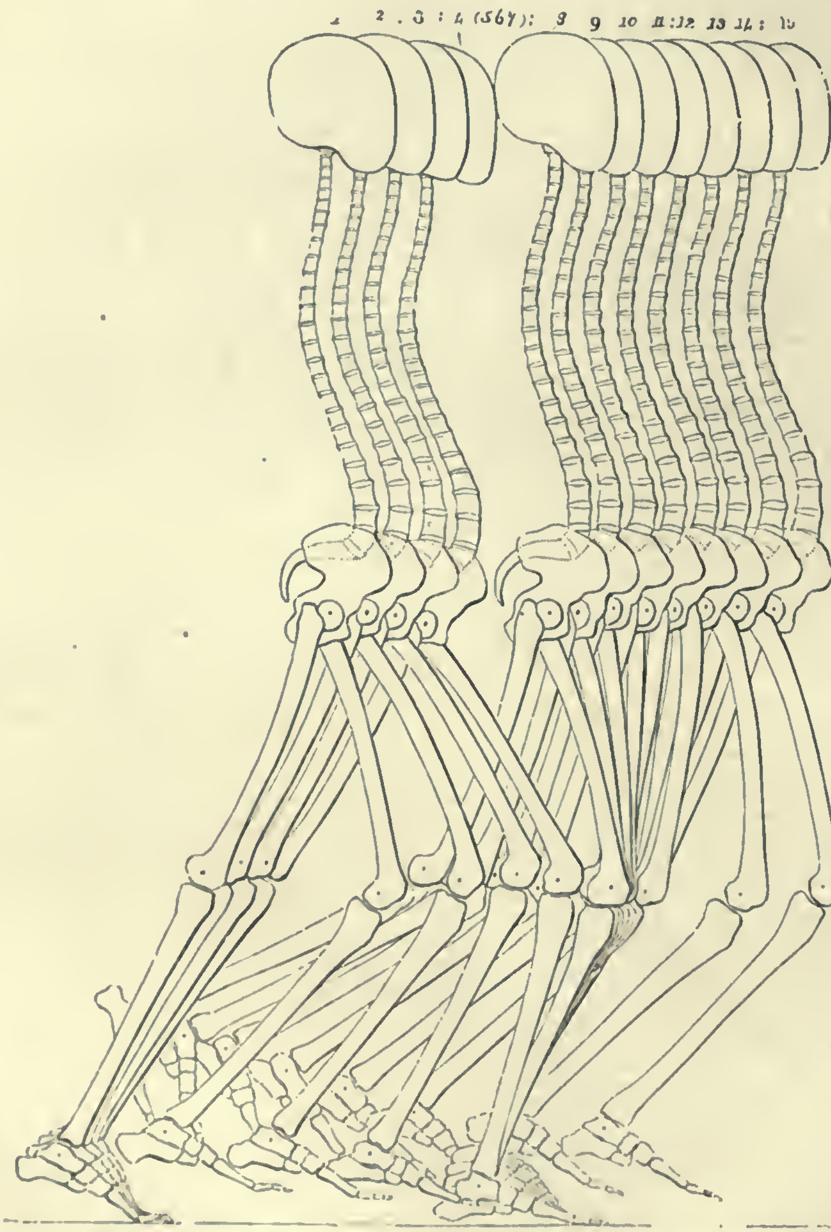
We will now endeavour to illustrate the preceding remarks by means of a diagram. In *fig.* 14, which may be conceived to be a horizontal

Fig. 14.



plane, let us suppose the upper series of lines to represent the left leg, the lower series the right, the straight lines the leg resting on the ground, the curved the leg swinging, and the letters a, b, &c., to denote the different periods of movement in walking. During a both legs are resting on the ground, and at the beginning of b the left leg rises from the ground, and swings forward until c commences, when both legs are again on the ground. During d the right leg in its turn rises and swings from behind forwards, whilst the trunk is supported on the left leg, represented by the upper straight line. At a' both legs are again in contact with the earth; at b' the left leg again rises in its turn, and swings as before; and thus the two legs alternate their offices in succession. We observe that the period a, in which both legs are on the ground, is about half of b, during which the left leg is oscillating, and the figure is consequently an illustration of very slow walking, agreeably to what has been already mentioned. It should also be remarked that b, the period of swinging, is the middle of the space $\frac{a}{2}$, b, $\frac{c}{2}$, which together constitute a single step. In *fig.* 15 an outline of the human skeleton is represented in twelve positions as designed by Professor Weber, on a scale of one-tenth the natural size of man. The simultaneous relative positions of the head, trunk, and legs are preserved at each of these twelve instants, as viewed through a revolving optical instrument like a stroboscope, which has been adapted for this purpose by Stampfer. By means of this instrument the consecutive positions of the trunk and legs may be taken at very minute intervals of time, a subject of great importance to the sculptor

Fig. 15.

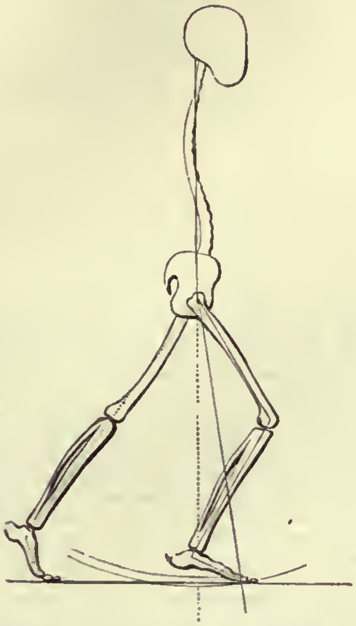


and painter of animals, but which under ordinary circumstances could not be accomplished. In *fig.* 15 the numbers 1, 2, 3 show the right leg on the ground, and the left leg swinging in advance of it, just before it reaches the earth at the end of the step seen at number 4. The numbers 5, 6, and 7, which are omitted to prevent confusion, are the successive positions of the two legs resting on the ground before the next step commences with raising the right leg: during this period the centre of gravity moves forward, and the right leg when raised is as it were left behind, and is found in the position of number 8. Numbers 9, 10, and 11 show the successive positions of the right leg swinging behind the left; and 12, 13, 14 its positions when it overtakes and passes the left leg, until it reaches the last position, number 15, which corresponds with the number 1 of the other leg, as above described. This excellent figure is necessarily complicated owing to the number of positions depicted, but it is easily understood if studied with the attention it deserves.

In very slow walking the centre of gravity is borne along in a more elevated position than in quick walking; indeed, whatever tends to elevate the centre of gravity tends also to decrease the velocity of walking; for the length of the hindmost leg, which is nearly the same in all paces, is equal to the square root of the sum of the squares of the height of the centre of gravity from the ground, and of the length of the step; and consequently, the shorter the step the greater is the height of that centre, and vice versâ. This is observable in corpulent persons, and in porters bearing burdens on the head and shoulders the scientific law being thus confirmed by experience.

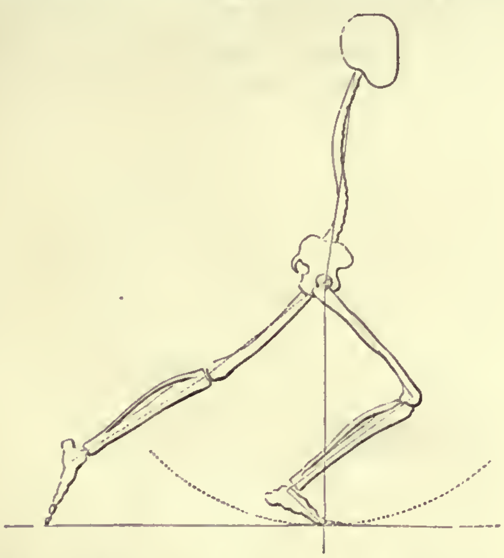
In slowest walking, the swinging leg passes through a less curve than in quick walking. In *fig.* 16 we observe the leg is placed on the ground in advance of the vertical line passing through the head of the thigh-bone; and as a vertical line passing through the centre of gravity falls behind the base of support, the posterior leg cannot be lifted from the ground until the swinging leg has partially swung back again into a vertical position. During this period, both legs being on the ground, the time of the step is a maximum, because the duration of a step consists of the time employed by the swinging leg in describing its curve, and the time wherein both legs are on the ground, both which quantities increase as the velocity diminishes. In this case the straight lines, a, *fig.* 14, have the greatest relative length with respect to the curved lines, b.

Fig. 16.



In quickest walking, the advanced foot reaches the ground in the vertical line which passes through the head of the thigh-bone, as in *fig.* 17. Here the centre of gravity being entirely supported by the forward leg, the hinder leg is in a condition to rise from the ground the instant the other reaches it, and the time wherein both legs are simultaneously on the ground becomes evanescent. If the joints of the legs did not possess, as we have seen, a considerable freedom of motion, we should not be enabled to vary our speed as we now do, because as the length of the step increases the height of the centre of gravity decreases; and to accomplish the latter, the forward leg must be much more bent when it reaches the ground than in slow walking, as seen in *figs.* 16 and 17, the velocity of the man iu *fig.* 16 being ittle more than one-half of that in *fig.* 17. It is also in consequence of

Fig. 17.

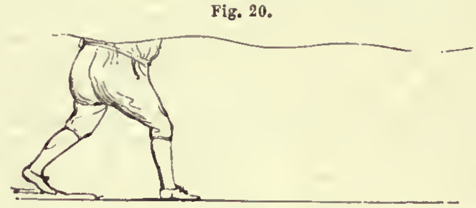


the power we possess of bending the legs that we are enabled to move the centre of gravity nearly horizontally, and thereby to move with a much greater velocity than we could do if our limbs were inflexible; for a man with inflexible wooden legs is restricted from walking beyond a velocity within very small limits, however great may be his muscular power. For example, when a man is walking with wooden legs, as in *fig.* 18, the centre of gravity describes small arcs of a circle, of which each leg is alternately the radius. Now, according to Dr. Young, if the velocity could be sufficiently great to create a centrifugal force exceeding that of gravity, each leg would be raised from the ground immediately after touching it, which would constitute running; for in walking the body is always supported either by one or two legs; and supposing tho inflexible leg to be three feet in length, the centrifugal force would become equal to that of gravity when the velocity in walking became equal to that which a heavy body acquires in falling through half the length of the leg, or one foot and a half, which is very nearly ten feet in a second, or seven miles in an hour. This then is the extreme limit of velocity which a man could reach with wooden legs, or with legs whose joints have been rendered useless by disease; but in reality he cannot move with anythiug like this speed, because he must place his swinging leg on the ground as much before the vertical through his centre of gravity as the other leg is behind it, and therefore his steps must be very short, and taken at a greater mechanical disadvantage than in the slowest walkiug of ordinary persons. In consequence of the flexibility of the legs, the path taken by the centre of gravity undulates without forming any abrupt angles duriug its elevation and depression, as seen in *fig.* 20, where the actual path resulting from the flexibility of the limb is delineated; whilst in *fig.* 19 we see the abrupt manner in which the centre of gravity moves, and the curves begin aud terminate; and we can readily imagine the jars to which the trunk would be subject in locomotion if the legs were destitute of joints at the knee and ankle.

Fig. 18.

Fig. 19.

Fig. 20.

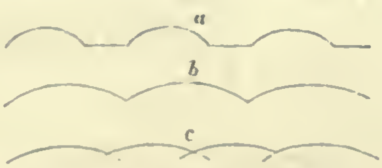


The greatest velocity with which a person can walk (unless by an enormous expenditure of muscular action, which could not be maintained) is when the time of a step is equal to half the duration of the motion of the swinging leg; that is, the time which elapses from the raising of that leg until it is again placed on the ground, having described half its arc of oscillation, the hind leg during the same time pushing the trunk sufficiently forward, so that the centre of gravity may be vertically over the base of support, as in *fig.* 17. Hence, if we suppose the leg capable of describing its arc freely in ·730 of a second, the least time of the step will be ·730 divided by 2, or ·375 of a second. When the swinging leg is first raised from the ground the trunk propels the head of the thigh-bone horizontally forwards, and communicates a retrograde motion to the lower extremity of the leg in the direction of the tangent of the curve in which the leg oscillates This retrograde force tends to retard the movement of the leg forward, and would materially lengthen the time of a step, but the leg being at the same time bent, and consequently shortened, to allow it to swing freely above the ground, its movement is thereby as much accelerated as the retrograde action tends to retard it, and the result is that the leg swings in the same time as if these accelerating and retarding influences did not exist. The velocity in walking theu, in the same person, depends on the time taken in making each step, and on the length of the steps; and both of these are again dependent on the height at which the centre of gravity, or the heads of the thigh-bones, are carried above the ground; for as the height of the latter diminishes the length of the step is increased and the time of the step is decreased, and vice versâ. The velocity of walking in different individuals depends greatly on the relative proportions of their framework, and on the vigour of their muscular system; but it must be borue in mind that it is always the hind leg which has the work to accomplish, and by throwing it into the required position, and regulating its extension, the speed may be adjusted to the figure of the individual. It is indeed owing to the dimensions of the several organs concerned in locomotion, and to the habit of the individual in applying them, that each person has a step peculiar to himself, so that the very sound produced by the contact of the foot with the ground is sufficieut to enable us to recognise the approach of individuals with whom we aro familiar long before we see them. Compared with numerous species of the lower animals, the velocity of man in walking is very inferior. The best constituted persons are incapable of acquiring a speed of little more than five miles in an hour; and even at this rate of motion they are quickly exhausted. Our expcnditure of muscular power for the accomplishment of every step is very great, even when walking on a perfectly horizontal path; but it becomes much greater when ascending inclined surfaces, such as climbing the sides of hills and mountains. Under these circumstances the speed is diminished, and the muscular power is expended in raising the body upwards. During this period the number of respirations, as well as the number of pulsations of the heart in a second, augments, and a feeling of languor and fatigue communicates to the pedestrian the conviction that he has done as much work as his system will sustain without danger of over-fatigue and too great a prostration of strength—a condition from which it often takes a long time to recruit. On the other hand, a due exercise of muscular action in walking is necessary, as we have already seen, to the healthy and vigorous play of the several organs of the human body.

We now come to consider Running. The object of calling into action the locomotive organs as we employ them in running is to acquire a greater velocity than can be attained in walking. On investigation it is found that the same motions of the body recur after each double step as in walking. In running, the time of action is divided into two periods, in one of which the body is supported on one leg, and in the other it is not supported on either, and this constitutes the principal difference between running and walking; for in the latter the body is always supported either by one or both legs.

Let us now consider the motions of the legs in running, as we have before done in walking, and for that purpose let us trace their action from the beginning to the end of a step. When the hinder leg, on which the trunk was supported, having been extended to its greatest length, is raised from the ground and begins to swing forward, we observe that the foremost leg has not yet reached the ground, so that both legs are found swinging at the same time during a portion of the step. When the foremost leg reaches the ground, which it does in a vertical position, the trunk is supported on it, and the hinder leg continues to oscillate forwards, whilst the supporting leg, having turned on the ball of the foot as on a pivot, becomes stretched to its extreme length, and is in its turn raised from the earth before the swinging leg has reached it; and when the latter is placed on the ground and is fully elongated, so as to be on the point of rising again, a double step has been accomplished, the single step evidently ending at the moment when the other leg reached the corresponding position. The effect of both legs swinging simultaneously, though for a very short period, is, that in running the duration of the step is less than the time of the half-oscillation of the leg, whilst in quickest walking it just exactly equals it, and in slow walking it is greater than this semi-oscillation. These effects will perhaps be made more intelligible by the annexed *fig.* 21, where *a* represents slow walking, the straight

Fig. 21.



portions of the line being the times when both legs are on the ground; *b* represents quickest walking, wherein each leg succeeds the other in swinging without interruption; and *c* running, wherein one leg begins to swing before the other has finished swinging. The forces which are employed in running, like those of walking, consist of extension, gravity, and resistance.

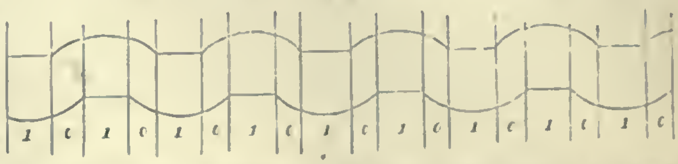
We are not able to propel the centre of gravity horizontally in running, though the undulations are found by observation to be less than in walking; for it is clear, that as soon as both legs are lifted from the ground it must fall during some portion of the time it is unsupported, and so form a series of curves. If the legs were inflexible the centre of gravity would describe a series of curves as in *fig.* 18. The movements of the body in walking and running more nearly resemble each other according as the times wherein both legs are on the ground in the former case, and both legs are in the air in the latter, are diminished; and the limit to which each of these motions continually approaches is, when the body is never without support, but that support is never more than one leg. As the resistance of the air to the motion of the body is greater in running than in walking, the trunk is more inclined in the path of motion, to keep it in a state of equilibrium.

In order to find the amount of the vertical undulations of the body in running, the Messrs. Weber viewed the runner through a telescope adapted for the purpose. They estimated the undulations of the body to be from three-fourths of an inch and a quarter, and the time of a step to be from one-fifth to one-fourth of a second; of this time the body swings freely in the air one-tenth, and falls one-fifteenth of a second. If we calculate the space through which the body falls in the same time by the law of falling bodies, it will be found that the centre of gravity descends about eight-tenths of an inch.

It has been seen in *fig.* 14, that in walking, the period during which the trunk is supported is longer than that in which the leg whilst swinging is supported by the trunk. Now, in running, the reverse takes place, and the time in which the leg is resting on the ground is shorter than that in which it hangs suspended from the trunk.

We will now illustrate these periods by a diagram. In *fig.* 22 let the upper line represent the motion of the left, and the under line that of the right leg, in the act of running, the curved portions being the periods of the leg swinging in the air, and the straight portions

Fig. 22.



the periods of its resting on the ground, which periods are defined by the cross lines. The numbers 1, 0, denote that one or neither of the legs is on the ground. The line between the first spaces 1 and 0, at the left end of the figure, indicates the beginning of a step corresponding with the description already given, that is, the instant when the left leg is raised from the ground, and before the right has reached it.

We observe that the chords of the curved lines, which represent the periods whilst the legs are swinging, are sensibly longer than the straight lines; and if we remember that the resting leg rises from the earth before the other touches it, we at once see that it could not be otherwise; and it also follows, from the same reason, that the straight lines showing the portion of the step when the leg is on the ground must be equidistant from the extremities of the curves respectively opposite to them.

In running, the square of the length of the extended leg is equal to the sum of the squares of the horizontal space described by the centre of gravity during the time the one leg rests on the ground, and of the height of the centre of gravity from the plane of motion at the end of that time.

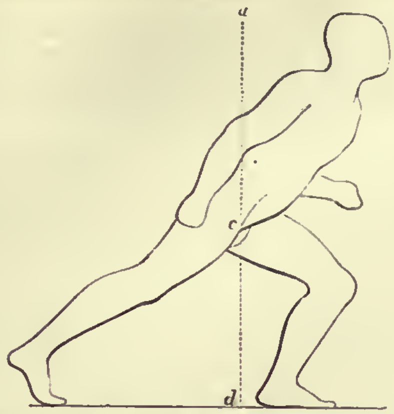
When the forward swinging leg reaches the ground at the end of each step, it must be in a condition to receive the falling trunk, and be prepared to project it from the ground, to swing again in the air; for this purpose the centre of gravity must be in the vertical line passing through the head of the thigh-bone and foot; for if the centre fell behind this line, the runner would fall backwards; and if before it, he would fall forwards. Such being the law which is found to regulate the attitude of the body and leg in running, it is a matter of considerable importance that artists should understand this principle, together with all the other laws by which the locomotion of man and animals is governed. It was in consequence of his being ignorant of, or not attending to, these laws that some of Flaxman's figures were drawn so unlike the reality, which is the more to be regretted because his drawings of the human figure are considered as studies by young artists. We give an illustration of this in *fig.* 23, which represents a

Fig. 23.

man in the act of running, where the line *a c d*, which passes through the centre of gravity, lies far behind the foot (*b*), the base of support, and being therefore unsupported, the man would fall backwards. In fact, no person can be in the position of Flaxman's figure whilst in the act of running without falling to the ground. The same fault is observable in *fig.* 24, another of Flaxman's designs, intended to represent a man just on the point of running: the line through the centre of gravity falls behind the foremost foot, and consequently if the hinder leg be raised, the man must inevitably tumble backwards.

In running, the length of a step increases much more rapidly than the time of it decreases, and hence we chiefly gain by passing over a

Fig. 24.



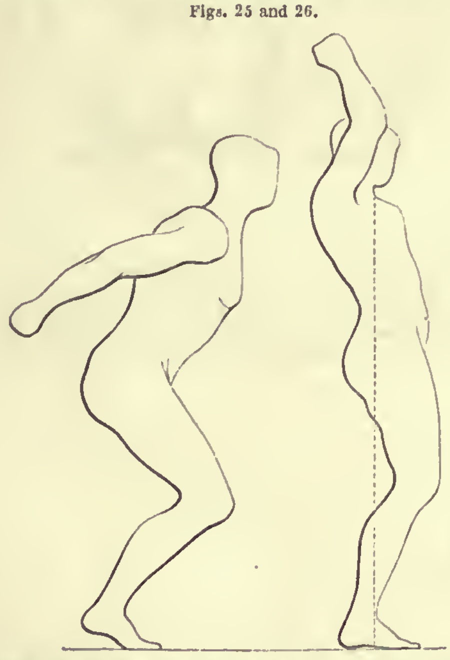
greater space in a given time. Messrs. Weber found that when the time of the step was 0″·301, the length was about 1 foot, and when the time was diminished to 0″·268, the length of step was about 5 feet, so that with a decrease of only thirty-three thousandths of a second the velocity increased by more than a five-fold proportion. In fact the time of a step in running differs scarcely in a perceptible manner from that of quickest walking, it being nearly equal in both cases to the duration of a semi-oscillation of the leg.

Running requires a vastly greater expenditure of muscular force than walking, and cannot be long maintained without completely exhausting the strength.

It appears that a man named Jackson some years ago ran a mile in 4 minutes and 54 seconds, so that he passed over rather more than 18 feet in a second, or at the rate of 12·3 miles in an hour, a velocity very rarely exceeded.

Leaping, Springing, or Jumping.—In leaping, the object to be attained is different from that of running. In the latter we aim at taking the longest step in the least possible time, but in the former we want to take the longest possible steps without regard to their duration, and the longer the step the greater will be the time in taking it. In leaping with both legs at the same time, as in *figs.* 25 and 26, there must

Figs. 25 and 26.



be a pause between each step, and this is not resorted to as a mode of progression, but rather to accomplish a single step of great length; for the expenditure of muscular action is so enormous, that a succession of steps with both legs, alternately resting on the ground and lifted from it together, is rarely had recourse to, except for such purposes as leaping across rivulets or narrow chasms, descending abrupt surfaces, &c.

When the object in view is to maintain a mean uniform progressive motion by leaping, the legs interchange their offices alternately as in running. The step in leaping, like that in running, may be divided into two periods, during the first of which one leg rests on the ground, supports the body, and propels it upwards and forwards; and during the second period, both legs swing in the air simultaneously. The undulations of the centre of gravity are greater in leaping than in walking or running, in consequence of the body being projected higher into the air, whereby the swinging leg is enabled to pass beyond the vertical line through the centre of gravity, and to perform the whole of its arc of oscillation before it is placed on the ground; whereas in running it is arrested at the instant when it arrives at the vertical position; and this constitutes the principal difference between the two motions.

If we begin the step, as in running, at the moment when the hinder leg, being fully stretched, projects the trunk upwards and forwards, and itself quits the ground, we find the other leg still swinging, which it continues to do for a much longer time than in running; after the latter has reached the earth, it rotates round the ball of the foot, and from being in an oblique position in front of the body, it comes into a similar one behind it, the two extreme oblique positions forming equal angles with the vertical. The first-mentioned leg has been all this time swinging, and so continues after the other has left the ground, and at length it comes to the earth obliquely, and rotates into the position with which we commenced our description.

As the swinging leg is suffered to perform an entire oscillation, it follows that the duration of the step is greater in leaping than in running, but in consequence of the greater length of the step, the velocity in the former is not so much less than in the latter as might have been expected. For example, let us suppose the length of the step in running, as is found by experiment, to be 5 feet, and the time of the step to be 0″·268, also the length of the step in leaping to be 6·485 feet, the corresponding time of which is 0″·404, then the velocity in running will be to the velocity of leaping as $\frac{5\cdot}{0\cdot268}$ to $\frac{6\cdot485}{0\cdot484}$, or as 1 to 0·718. Thus we observe the velocity of leaping to be less than that of running, both being estimated at the greatest speed; but then in leaping, the steps, being taken in greater time, do not excite the pulsations of the heart, or increase the number of respiratory movements so much as in running; and persons when fatigued with running find that if they wish to relieve the respiratory and arterial systems without materially slackening their speed, they can accomplish this object by converting the running into a leaping movement, better than by converting the quick into a slow running.

It is found much safer to descend the sides of steep hills with rapidity by means of small leaps than by running, because in the former the foot may be placed on and pressed against the ground in advance of the trunk, and so arrest its motion and prevent the body from falling to the ground, which cannot be done in running.

The movement in leaping, being of all the foregoing motions most under control, is varied by the peculiar manner in which the step is made, and is therefore not so susceptible of accurate demonstration as those of walking and running.

The laws which regulate the locomotion of man admit of mathematical analysis, and those of walking and running are found to be as fixed as those which govern the solar sytsem.

Having given an outline of the mechanism by which the human race perform their movements from place to place by means of their locomotive organs, and having also detailed the leading principles by which these movements are effected, we shall now turn our attention to the means and methods by which the locomotion of animals inferior to man in the scale of organisation is performed. It will be convenient to take in succession the lower animals in classes as grouped by zoologists, and begin with those which are most nearly allied to man. It is true that by this arrangement we shall have to pass from bipeds to quadrupeds, and trace our steps back again to bipeds; but these objections will not embarrass our subject, as would the grouping together of animals of widely different classes whose organs of motion are very dissimilar, although they perform movements which involve some of the laws common to each. In following the plan already indicated, we arrive at a group of animals which excite no common degree of interest in the minds of zoologists, namely, the *Quadrumana.* If we take a glance at the solid bony framework, as represented in *figs.* 27, 28, 29, we shall at once see, without being acquainted with anatomy, that the general outline is nearly the same in all the figures, and that there are many parts in common, or having bones of similar figures, in each of the three skeletons. Upon closer inspection however we shall perceive that some bones are common to the three: some have additional bones, such has an extra pair of ribs; other bones, again, are common between *figs.* 27 and 28, 27 and 29, and 28 and 29. On comparing heads in *figs.* 30, 31, and 32, we observe that the face and jaws are much more extended anteriorly in the chimpanzee (*fig.* 31) than in man (*fig.* 30), and that they are still further prolonged in the orang-outan (*fig.* 32): the proportion in each may be obtained by taking in each case the length of the lines x y. We see also that the forehead is lower and the head flatter in the orang, and still more so in the chimpanzee. The head of each turns by a hinge-joint on a pivot at y; and in the erect position the distance of x y is least in man, greater in the chimpanzee, and greatest in the orang: and, as the force necessary to support the head in standing erect is proportional to the weight of the parts multiplied by their distance from the axis of motion in the direction of these lines, it follows that the power to support the head is least in man, and greatest in the orang-outan. Again, we see that the proportions between the length of the arms and legs are different in each; the arms are longest in proportion to the height in the orang, shorter in the chimpanzee, and shortest in man. The legs are longest in man, less in the orang, and least in the chimpanzee. In the orang we observe that the arms nearly reach the

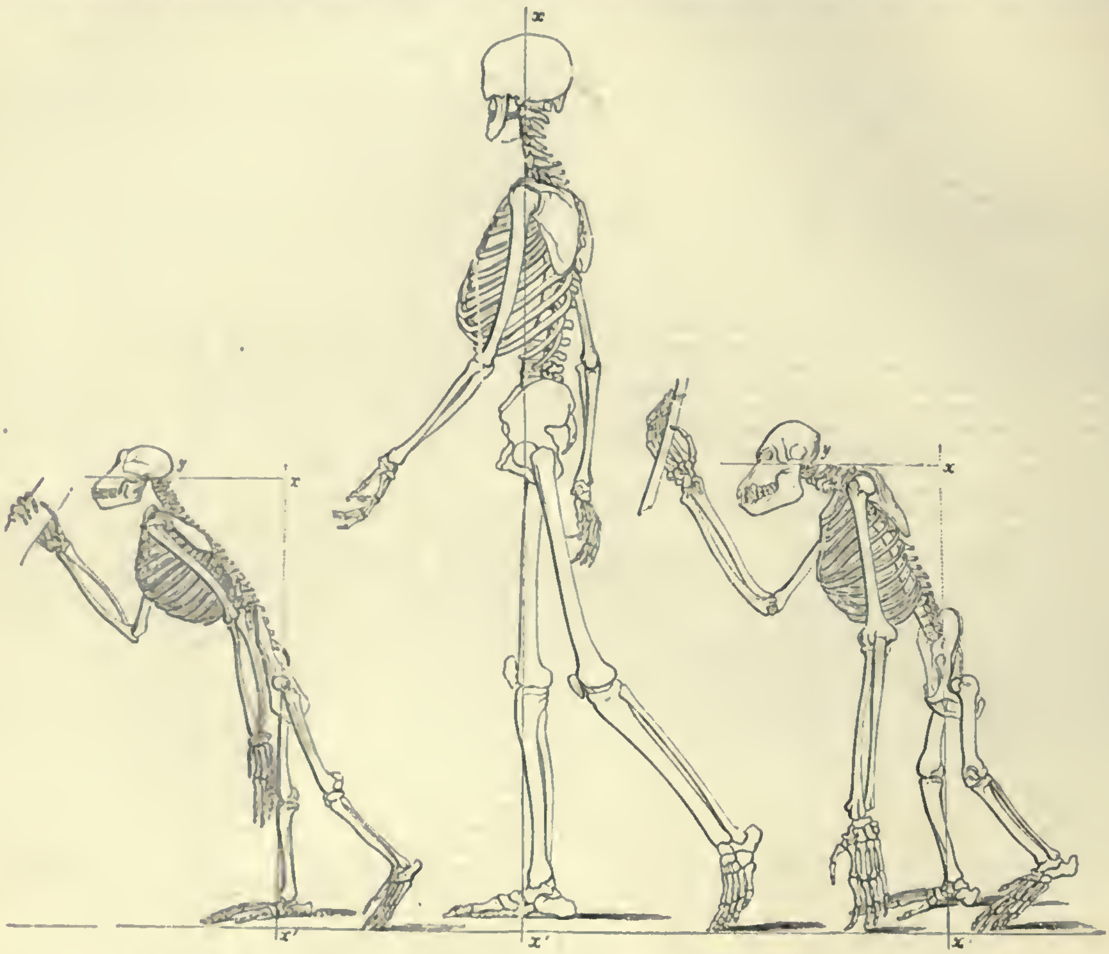


Fig. 28.—Chimpanzee. Fig. 27.—Man. Fig. 29.—Orang-Outan.

[Skeletons of Man and Monkeys.]

ground in standing; also that in man the spine has three natural curves, but in the other two, there is but one, the consequence of which is, that the head is thrown forwards in front of the vertical line $x'x$, and the heads of both orang and chimpanzee are supported in the erect position at a mechanical disadvantage, proportional to the

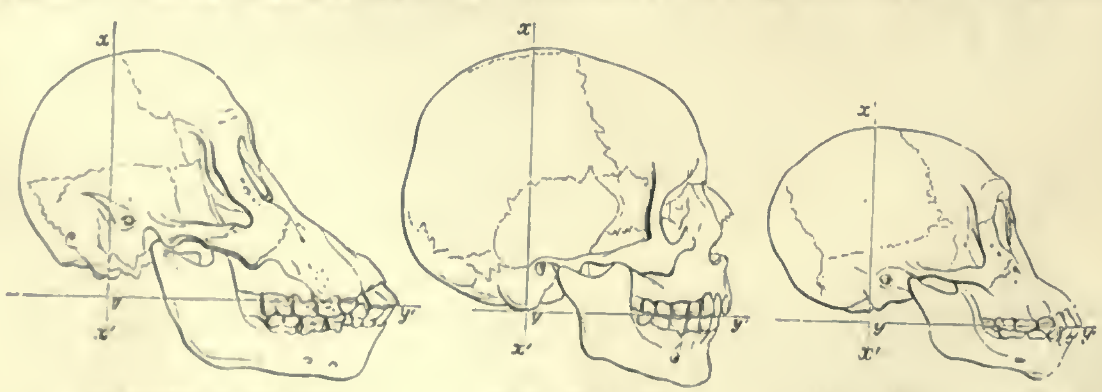


Fig. 32.—Skull of Orang-Outan. Fig. 30.—Skull of Man. Fig. 31.—Skull of Chimpanzee.

[Skulls of Man and Monkeys.]

line x y (*figs.* 28 and 29). But one of the greatest peculiarities existing between man and the other two animals is in the structure of the feet. In man the entire sole of the foot is either in contact with the ground, or, owing to its arched figure, the weight of the whole body is equally distributed over it; but in the chimpanzee and orang the

sole is much narrower and turns inwards, and the outer margin of the foot only presses the ground.

In man the heel projects a considerable distance behind the axis of motion in the ankle-joint, and acts as a powerful lever in raising the weight of the body on the toes, whereas the bone of the heel is shorter in the chimpanzee, and shortest in the orang; also in consequence of the inward direction of the soles of the feet in the latter animal, the muscles act on the heel with less effect than in man; added to which the muscles which raise the body on the foot are much smaller and weaker than in man. But the greatest peculiarity in the hinder extremities of the chimpanzee and orang-outan is, that the inner toe of the foot is attached in an oblique manner, so as to move, like a thumb, in a direction excentric to that of the other toes; whereby the foot in these animals answers the double purpose of a foot and a hand. In the performance of the latter function, the inversion of the sole of the foot, which obstructs plantigrade movement, tends to perfect the organ as an instrument of prehension, and adapts it for climbing trees. Thus we find these animals are endowed with four hands; and hence their generic name of *Quadrumana*. The limbs, being thus organised, may be used either as those of bipeds or of quadrupeds during progression. When the legs only are employed in locomotion on the ground, they obey many of the same laws as those of man, and the reader is referred to the account given of them in the preceding part of this article for the general principles; but the mechanical structure of the chimpanzee and orang-outan renders their gait peculiar, and their power of progression on two legs is inferior to that of man. We observe amongst the higher orders of *Quadrumana* that in walking the long arm of the orang is frequently placed on the grouud to prevent the trunk and head of these animals from falling forwards. This is chiefly owing to the single curve of the spine having its concavity anteriorly, the effect of which is to throw the shoulders and head forwards, so that the weight of these organs falls in front of the vertical line passing through the joints on which the legs move. The muscles of the legs of the *Quadrumana* having far less power than in man, they walk more feebly, and their bent figure gives them the attitude which is assumed during decrepit old age in the human race. If we descend further in the scale of species, we find some of the *Quadrumana*, such as the *Cercopithecus*, furnished with long tails. The tail in this order of monkeys may be considered as a fifth organ of locomotion, and is of essential service in the act of climbing. The strength of the tail in some species is snfficient to enable the animal to suspend its solid weight to the limbs of trees, leaving the hands nearly free to perform many of the offices necessary in procuring food, and often to enact performances accompanied with grimaces, for which many of the monkeys are remarkable. Few of the monkeys below the orang-outan walk on the lower extremities alone, but they move on their four arms precisely like quadrupeds, as the Red Howling Monkey in *fig.* 33. The lemurs, perhaps, never

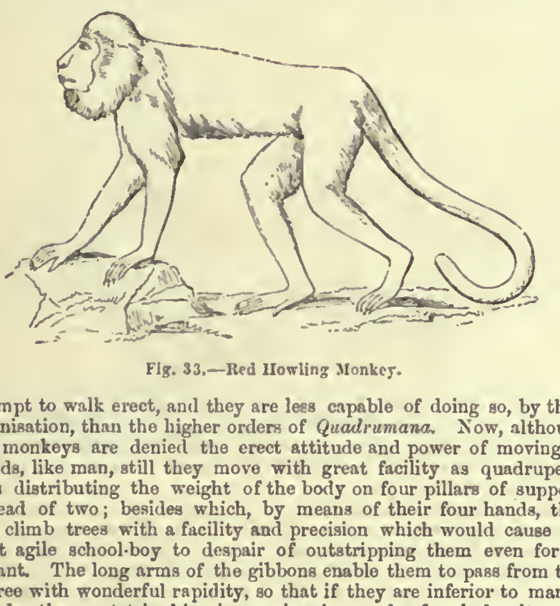


Fig. 33.—Red Howling Monkey.

attempt to walk erect, and they are less capable of doing so, by their organisation, than the higher orders of *Quadrumana*. Now, although the monkeys are denied the erect attitude and power of moving as bipeds, like man, still they move with great facility as quadrupeds; thus distributing the weight of the body on four pillars of support, iustead of two; besides which, by means of their four hands, they can climb trees with a facility and precision which would cause the most agile school-boy to despair of outstripping them even for an instant. The long arms of the gibbons enable them to pass from tree to tree with wonderful rapidity, so that if they are inferior to man as bipeds, they outstrip him in moving in woods of such density that impediments present themselves at almost every step, and of such a nature as tends to obstruct the progress of the pedestrian. Indeed the conversion of the foot into a hand in these animals, instead of being a sign of degradation, has been asserted by some foreign naturalists to be no proof of inferiority in a zoological point of view; and in support of this opinion it is said that in certain districts (as the Landes of Aquitaine) the peasants, who obtain their livelihood by collecting the resin of the *Pinus maritima*, and who are termed 'resiniers,' acquire a power of opposing the great toe to the others like a hinder thumb; but on this subject Professor Owen remarks, that "supposing the extent of the motion of the great toe to be sufficiently increased by constant habits of climbing, or in connection with a congenital defect of the upper extremities, still it does not appear that the os calcis (that is, the bone of the heel), or other bones of the foot, have lost any of the proportions which so unerringly distinguish man from the ape." Indeed, whether we turn our attention to the figure of the head, the length of the arms and legs, the structure and figure of the spine, or more especially to the conformation of the foot or hand in man, compared with those organs in the *Quadrumana*, we see differences which at once (at least in the eye of the zoologist) distinguish man from the highest of the lower animals; and, if these characters are prominent in the framework, still more conspicuous are the mental qualities which elevate and distinguish man far above all other beings inhabiting this earth.

The Bat. [CHEIROPTERA.]—Bats present locomotive organs of a very peculiar construction. Destined like birds to move in the air, their skeleton is adapted iu conformity to that purpose. The bones are light, the body small, the arms and fingers greatly developed, to afford a great number of points for the attachment of the delicate membrane of which the wing is partly composed, as may be observed in the annexed figure (34) of the Short-Eared Bat. The hand of the bat rotates outwards and inwards like the wing of a bird, so that when the wing is folded the little fiuger lies on the smaller bone of the fore arm. The thumb is not included in the membrane of the wing, but projects beyond its margin, where it forms a hook for holding objects. The four succeeding fingers support the membranous wiug, which when expanded presents an exteusive surface for striking the air during flight. The legs are small, twisted, and so weak as to be incapable of supporting the body when ou the ground. The toes, terminating in sharp claws, are well adapted for grasping elevated objects, to which the animal suspends itself in an inverted positiou; by this means it can easily launch itself into the air on the slightest alarm.

Fig. 34.

As the bat is incapable of chasing and capturing its prey on the ground, and its food is chiefly composed of insects taken on the wing, it requires the attainment of a much greater velocity of movement than it would be able to accomplish by meaus of its lower extremities, were they even much stronger than they are. It has, therefore, been furnished with a peculiar apparatus adapted to aerial progression. The principles of its locomotion may be best studied in connection with the locomotion of birds. [FLYING.]

Quadrupeds.—The movements of quadrupeds differ in principle from those of bipeds, and also from those of hexapods (Insects).

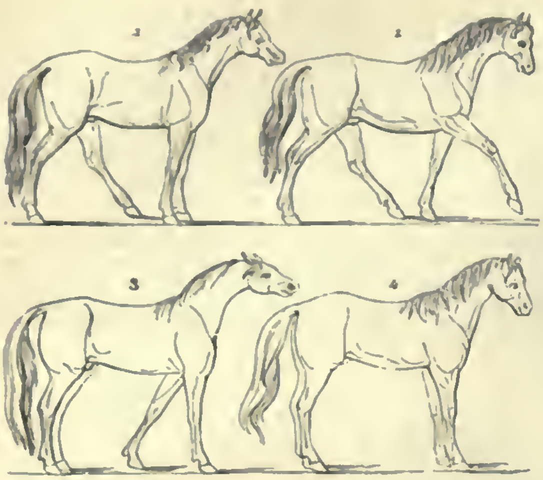
In all quadrupeds the axis of the trunk is directed more or less horizontally, tho angle of inclination depending chiefly ou the difference between the length of the anterior and posterior extremities. In some animals—the giraffe, for instance—the fore legs are the longest, and the axis of the trunk inclines upwards; in others, such as the hare, grayhound, and especially the jerboa and kangaroo, the hinder limbs preponderate in length: the axis consequently (supposing the animal to stand with the four feet on the ground) inclines anteriorly downwards. The difference between the lengths of the anterior and posterior limbs produces a very sensible effect on the movements of such animals.

In quadrupeds the weight of the body is transmitted to the ground by means of their four legs, but we shall find on examination that they do not all bear an equal share of the burden, and that the different species present a diversity of structure which iufluences their movements very perceptibly. In the elephant, for example, the legs are nearly straight, a conformation which enables the animal to support the mass of its body with the greatest mechanical advantage: but, great as it is well knowu to be, the strength of the bones and muscles of its legs is far from being in proportion to the mass of its body when compared with that of many smaller quadrupeds; and we consequently find that the speed of the elephant is not proportional to its bulk.

Quadrupeds move their four legs either singly and successively, or in various orders, which correspond with the different velocities of the auimal. These different kiuds of movemeut of the legs are known under the terms walking, trotting, galloping, and leaping.

As everybody is familiar with the horse, we shall select that animal to illustrate the manner in which the locomotion of quadrupeds iu general is effected. The subject possesses more or less interest to most persons, yet of the millions of people who are in the daily habit of seeing the horse in motion, how very few consider the means by which the movements of that valuable animal are performed. Let us suppose the horse to be standing on its four legs, as in *fig.* 35, number 4, and that it commences the walking step by moving its left hind leg, as in number 1; this having been advanced and placed ou the grouud, the right fore leg is next raised and advanced, as in number 2, and having beeu placed on the ground, the right hind leg performs a similar movement, and the legs of the animal are in the position number 3; lastly, the left fore leg is advanced, and placed in the position of number 4. These four movements complete the step, and duriug the series the centre of gravity of the animal passes over a corresponding space. This is the order in which nearly all quadrupeds move their legs in slow walking; but some authors do uot coincide in this statement, amougst whom is Borelli, who has figured the horse as moving both tho legs on the same side at once in walking, as some horses are taught to do in the amble, and as the giraffe is known to do naturally.

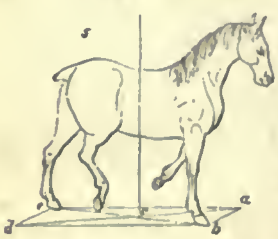
Fig. 35.



A little consideration will clear up the error into which Borelli and others have fallen respecting the horse. It will be observed from the foregoing statement that the left hind leg moves first; the right fore leg second; the right hind leg third; and the left fore leg fourth. Now if we do not analyse this order of motion from its commencement, we may easily be deceived; for in walking by a horse, the two legs appear indeed to move together on the same side, but this arises from the continuity of the series of movements, which we find begins with the left hind leg, and terminates with the left fore leg; the movement of the right fore leg being in like manner followed by that of the right hind leg; which continuity of movement, if not carefully discriminated, gives an impression that the animal moves both legs on the same side simultaneously.

The Trot.—In trotting the horse moves its legs in pairs diagonally: thus, if the legs *a d* (*fig.* 36) be raised and advanced first, the legs *b c* will be raised the instant those designated by *a d* reach the ground. On the other hand, when the legs *b c* are raised before the legs *a d* reach the ground, there is a minute interval during which all the legs are raised above the ground at the same time. In trotting each leg moves rather more frequently in the same period of time than in walking, or nearly as 6 to 5. But the velocity acquired by moving the legs in pairs, instead of consecutively, depends on the circumstance that, in trotting, each leg rests on the ground a short time, and swings during a long one; whilst in walking, each leg swings during a short period, and rests during a comparatively long one. In walking, the trunk oscillates laterally, whereas in trotting it oscillates vertically; but in each of these kinds of movement there appears to be a slight motion of the trunk of the animal both laterally and vertically.

Fig. 36.



It may be observed that the vertical line traversing the base of support passes through the horse in such a manner as to leave by far the greater part of the weight of the body to be supported by the two fore legs.

The Gallop.—In galloping, the horse adopts three different methods of using its organs of locomotion, which are distinguished by the number and the order in which the feet reach the ground.

First order of Motion.—When a horse begins to gallop on the right, the left hind leg reaches the ground first; the right hind leg and left fore leg next follow at the same time, and the right fore leg last. This is called the gallop of three beats.

Second order of Motion.—If the four legs reach the ground in succession, the left hind foot reaches the ground first, the right hind foot second, the left fore foot third, and the right fore foot fourth. This is the gallop of four beats, sometimes denominated the canter. This order of movement is not adapted for great speed, but is an agreeable motion in riding on horseback for ladies, or for gentlemen who ride lazily or badly.

Third order of Motion.—In this kind of action the horse moves the legs in the same order as in trotting; that is, the left hind and right fore feet reach the ground simultaneously, then the right hind and left fore feet. This is the order in which the feet move in racing, and whenever the greatest speed is required. It is called the gallop of two beats.

Leaping.—In leaping, the horse raises the fore legs from the ground, and projects the body upwards and forwards by the hind legs alone. It is well known that they leap rivulets, hedges, and ditches with great ease, even under the burden of heavy riders; but to accomplish this an enormous expenditure of muscular action must be required; since the muscles which produce the effect act at a great mechanical disadvantage.

Horses which are constituted for great speed have the shoulder-joints directed at a considerable angle with the arm. Saintbell has given the relative proportions of the several parts of the skeleton of the celebrated race-horse 'Eclipse,' together with the angles of inclination and range of motion belonging to the joints of the legs. According to his account, that horse, when galloping at liberty, and at its greatest speed, passed over twenty-five feet at each step: these strides were taken two and a half times in a second, being at the rate of about four miles in six minutes and two seconds, or forty miles in an hour and twenty seconds.

Those quadrupeds are best adapted as beasts of burden, or to take long and often repeated journeys, which have the anterior and posterior limbs of nearly equal length, such for instance as the horse, ass, camel, and many other animals, and these have also the power of ascending and descending hills with ease and safety. But such is not the case with those quadrupeds in which the length of the anterior and posterior extremities is remarkably disproportionate. The hare, for example, has the hinder legs much longer than the anterior ones; the consequence of which is that, when pursued, it can often outstrip the grayhound in running up the sides of hills; but in descending it must run in a zigzag direction, or it would tumble over. The rabbit presents the same conformation. In the jerboa and kangaroo the length of the posterior legs predominates exceedingly over that of the anterior, and their mode of progression is effected by a succession of leaps produced by the simultaneous action of their hinder extremities. When pursued the jerboa is said to clear nine feet at each leap, and so rapidly that the Cossacks, though mounted on the fleetest horses, are unable to overtake it. In these leaps the body flies through the air with the legs inclined backwards, as in *fig.* 37, number 7.

Fig. 37.

In the kangaroo the length of the hind legs is nearly double that of the fore legs, which is a disproportion far too great to permit them to move with the same advantage as other quadrupeds. When the kangaroo rests on its four legs the head and trunk incline to the ground, as seen in number 8. They usually sit on the two haunches, using the tail as the third leg of a tripod, as in number 6.

Amongst the *Ruminantia*, the deer and the antelopes are beautifully organised for speed; but as they move on the same principles as the horse, we need not stop to dwell on them.

It may be remarked that those animals which are least furnished with the means of defence, and are least protected, are often endowed with the greatest speed of motion, such as the hare, antelope, deer, &c. On the other hand, the lion, tiger, leopard, and carnivorous quadrupeds which are endowed with great strength, have not the speed of the above-mentioned animals. This shows that, with the same number of locomotive organs, the speed of an animal depends on other conditions besides mere strength. The structure of the several joints; the relative length of the different portions of the limbs; the proportion which the length of the limbs bears to that of the body; the angular disposition of the limbs with respect to each other; the distances at which the muscles act with respect to the axes of the joints; all concur to modify the speed of an animal, independently of its muscular power.

Birds.—As birds are constituted for three kinds of locomotion, that is, in air, in water, and on dry land, it is obvious that they must have organs adapted for these several kinds of progression. Their arms, which form the wings, are not organised to be employed for prehension, as in man, or for moving on them in the manner of quadrupeds. Birds are essentially bipeds when moving on solid surfaces; and as the feet of birds are so constituted that the toes only reach the ground they may be denominated Digitigrade Bipeds.

The head, neck, and body of the bird are poised upon its legs in such a manner that the head may be elevated or depressed without danger of its falling. Those portions of the body situated in front of the legs tend to depress the head towards the ground, and those situated behind the legs tend to raise the head in the opposite direction; the weight of these parts being equal keeps the body balanced on the heads of the thigh-bones, which are not only the points of support of the body, but likewise the axis of motion on which the body turns.

We observe in most birds which move entirely on the land, such as the turkey, pheasant, partridge, and numerous others, that the axis of the body is inclined to the horizon, the head being the most elevated portion of the whole animal. As a line passing through the heads of the thigh-bones is the axis on which the body moves and is supported, the centre of gravity of the body must pass through that axis, or the body of the animal would rotate on it. We know, by daily experience, that the beam of a weighing-machine is made to turn on a pivot; and that if unequal weights be attached at the extremities, as loaded scales, for instance, the arm will be depressed in the direction of the greatest weight, and the arm on the opposite side of the beam will be elevated; but if the weights be equal the beam will remain stationary. Now, the body of the bird is poised similarly to the beam and weights; and it is curious to observe the methods by which the equilibrium of the body on the legs is maintained.

The head of the bird, being placed at the extremity of the neck, which in many species is very long and mobile, acts as a weight placed at the end of a long lever, whose length is the distance of the head from the axis already mentioned, about which the body of the animal turns. Now, as the distance of the head is varied by every change in the direction of the neck, the mechanical effect is the same as the shortening or lengthening of one arm of the beam of a weighing-machine would produce; that is, the force increases in proportion to the increased length, and vice versâ. The vertebræ of birds are firmly joined together, and do not move on each other as they do in man and in quadrupeds, so that the animal cannot twist and turn its body on itself to adjust the trunk on its legs, and it is only at the extremities of the trunk that the parts are moveable. The tail when spread out like a fan furnishes a large surface to strike the air, and in this manner its action is important to some birds when walking, as is very conspicuous in the moorhen and others. The head, neck, and tail then are the parts employed in keeping the trunk of the bird poised on its legs in such a manner that it can stand very steadily, and walk and run without falling; thus we observe that whilst the animal moves the head, neck, and tail are in constant motion. The length of the legs varies considerably in different kinds of birds, and controls the velocity of their movements very sensibly, as does also the mode in which the legs are employed. Cranes and herons whilst walking swing one leg partly round the other, that is, one leg in swinging describes a portion of a circle around the other which is resting on the ground. The *Grallatores* are furnished with long legs, which being destitute of feathers are well calculated for walking in water and for making long strides in search of food. There are many other birds which move one leg at a time, whilst the other supports the body, the two legs interchanging their offices alternately, as in human progression. Thus, when the bird walks slowly the body is supported during a short period by both legs, and during a longer period by one; but if the bird adopts a very rapid pace the body is supported by one leg only at a time, as one leg rises the instant the other reaches the ground; but at no period of walking are both legs raised at the same moment from the ground, as that would constitute running or hopping.

Many birds, such as blackbirds, sparrows, the various kinds of finches, and others, do not move the legs alternately, but simultaneously, performing a succession of small leaps. This mode of progression is common to birds which are furnished with very short legs, a circumstance which would make the step excessively short if performed by moving the legs alternately in the ordinary manner. Even this method however does not enable them to advance with much celerity, and on the least alarm they adopt the more ready and effectual mode of escape by taking wing.

In the parrot, cuckoo, and woodpecker the internal toes and thumb are turned backwards (*fig.* 38), a structure which enables these birds to grasp objects in the manner of a hand. By this means also they have the power of climbing trees with great facility, during which action the tail is frequently employed to aid in keeping the axis of the body in a vertical position as in *fig.* 39.

Fig. 38.—Foot of Woodpecker.

Fig. 39.—Green Woodpecker.

Some birds, such as the ostrich, emu, or cassowary, are not endowed with the power of flight, the weight of the body, compared with the size of the wings, being too great to enable them to sustain themselves in the air; but in walking and running they far surpass all other birds. Their legs are of enormous length, a construction which enables them to take steps of great magnitude with considerable rapidity. The ostrich (*fig.* 40) runs with amazing speed, and can outstrip the fleetest Arabian horse.

Fig. 40.—Hunting the Ostrich.

Next in size and speed to the ostrich are the cassowaries. Of those in Australia the speed exceeds that of the swiftest grayhound, and the length of their legs is very considerable.

In fast walking the hinder leg, having been extended to its greatest length, is raised the instant the head of the thigh-bone in the forward leg comes vertically over the foot, and the position of the two legs at the moment the hind leg is about to be raised is such that they form with the length of the step a right-angled triangle, so that the height of the head of the thigh-bone from the grouud and the length of the extended leg being given the length of the step may be found. In very quick running the forward leg, which supports the body, is much bent, and the centre of gravity of the body brought nearer to the ground. This is necessary in order to accomplish the greatest length of step in the least portion of time; the time of each step is also diminished in running by the hind leg being raised before the forward one reaches the ground, so that the hind leg performs a portion of its arc of oscillation whilst the body moves through the air unsupported by either leg, and the bird is thus alternately supported by one leg during a short period and left altogether unsupported by either leg during a longer period, as in man.

As we find that the ostrich in speed excels the horse, and the cassowary the grayhound, which are reckoned among the swiftest of quadrupeds, we at once perceive that these birds do not require the aid of their wings to raise them in the air in order to escape from their enemies; and if the intelligence of the ostrich were in proportion to its speed the mounted Arab would never be able to overtake it in the chase, but as it directs its flight in a circular instead of a straight course, as in *fig.* 40, its pursuer takes advantage of its ignorance of one of the most simple geometrical facts, namely, that the nearest path between two distant points is a straight line. Hence it appears that though its safety absolutely depends on the knowledge of the course it should take in flight, it has never solved this important problem; and, notwithstanding its greater bulk of brain, it is far inferior in point of sagacity to the dimunitive bee, and many other insects which display considerable skill in the geometrical coustruction of their habitations, and are known (by careful observation) to take the shortest road in their flight from one place to another.

The Lizards and Crocodiles present diversified organs of motion. Amongst the former, tho gecko is supplied with a peculiar pneumatic apparatus in the feet by means of which it has the power of exhausting the air beneath the toes, and is thus enabled to climb vertically the smooth surfaces of walls, and to walk in an inverted position along the ceilings of rooms. This provision is advantageous to the animal when pursuing the insects on which it preys. In many of the lizards, such as the chameleon, tho tail is in like manner used to secure them more steadily on the branches of trees: the hand is furnished with two thumbs opposite to three fingers, and the foot with three thumbs opposed to two fingers. By this arrangement the animal is eudowed with considerable facility in taking hold of tho branches, being thus provided, as it were, with four hands.

The Crocodiles are furnished with four legs, and can walk and run on solids liko mammiferous qnadrupeds. The bones of the ueck and back aro however so locked together that they cannot turn or twist the body sideways except in an exceedingly limited degree. They are consequeutly obliged when moving rapidly to keep in nearly a straight line, and from this cause may be easily avoided by man should he bo pursued by one of theso amphibious monsters.

The Tortoises are slower than the crocodilean reptiles. Like the latter, they cannot twist the body on itself; and tho ponderous caso within which they are inclosed, and which they drag along with the body, resists the freedom of motion of the legs at those points where they pass out of the solid case at *a* and *b* in the following figure (41). This renders their pace exceedingly slow. Their carapace or shield serves however to protect them from injuries arising from the tread of heavy quadrupeds, aud is essentially useful to them duriug their occupatiou of burrowing. They move ou the principles of mammiferous quadrupeds.

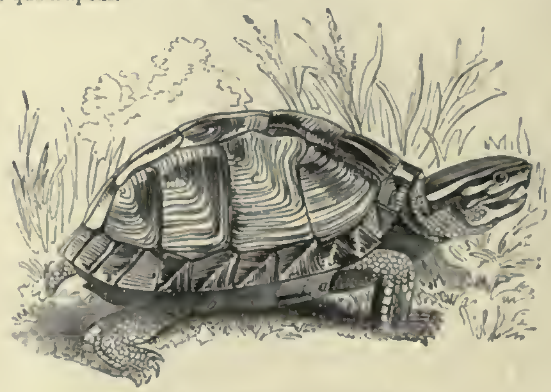


Fig. 41.—Amboyna Box-Tortoise.

Serpents.—Wo have seen that the crocodiles and tortoises possess little or no power to turn their bodies to the right or to the left; and also that it occupies the last-named animals a loug time to change their course from one directiou to another. Serpents, ou the contrary, have a very great range of lateral motion; and indeed, destitute as they are of legs, were the bones of the back as immoveable as those of the tortoiso, they would be deprived of the power of locomotion; but being endowed with very great mobility of the vertebræ, they are euabled, notwithstanding the want of legs, to climb trees, to run with considerable speed on tho ground, and to swim rapidly iu rivers and lakes. The scales, which are seen on the belly of the auimal, enable it to lay hold of fixed objects on the ground, and by the alternate elongation and contraction of the body, it glides aloug with great celerity. There are several ways in which serpents move, but the most common are the vertical and the lateral modes, seen in *figs.* 42 and 43.

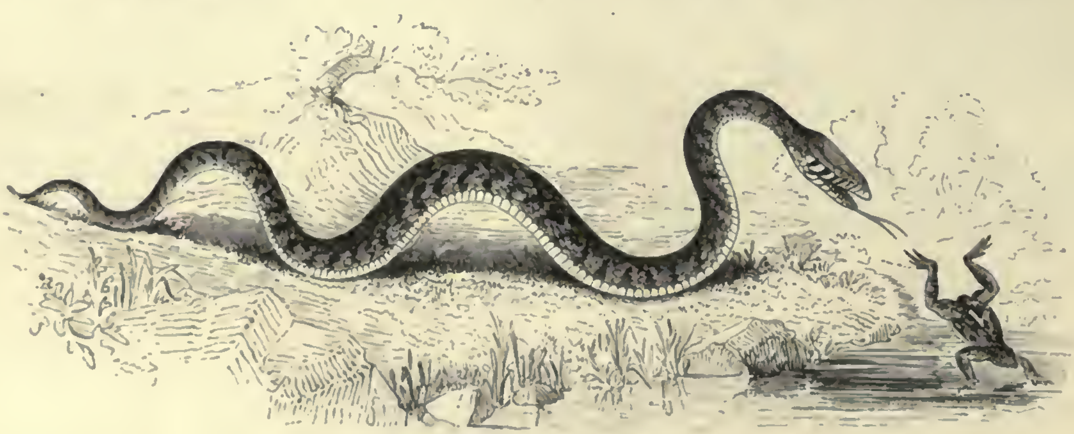


Fig. 42.—Ringed Snake.—Vertical motion.

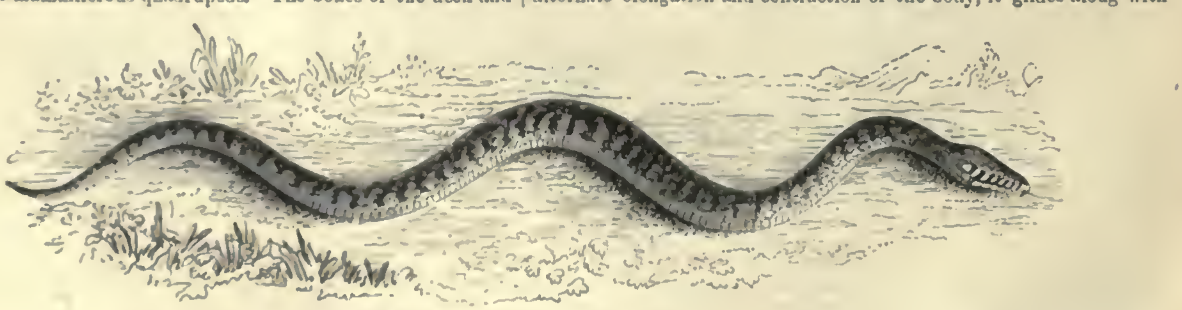
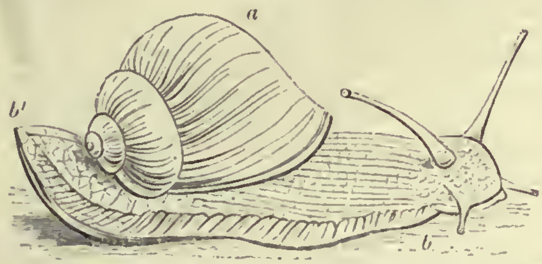


Fig. 43.—Ringed Snake.—Lateral motion.

The Frog, like the crocodile and tortoise, has not the power of twisting its body; it moves by a succession of leaps. It is said that the bull-frogs, which are abundant near the great lakes of North America, can leap 6 feet at a bound, and repeat these leaps so rapidly, that they cannot be captured without great difficulty. They will leap over walls 5 feet in height. The hyla, or tree-frog, has each of its toes furnished with a concave disc, which acts as a sucker; and by this means the animal has the power of laying hold of the branches of trees with considerable force, and can leap from brauch to branch with great agility. It is by means of the hind legs, which are much longer than the anterior, that the body is projected; the movements are performed on the same principle as those of the kangaroo and jerboa.

In descending the scale of organised beings we shall pass from Ophidian reptiles to the Gastropods, such as the *Helices*, or Snails, and the *Limaces*, or Slugs. The movements of these animals are well known to be exceedingly slow. The snail, after creeping from its shell *a*, expands its body in such a manner that the shell lies poised upon its back (as in *fig.* 44).

Fig. 44.



The shell is carried with the auimal in all its perambulations, aud the body is withdrawn into it on the slightest alarm, or when iu a state of repose, leaving the foot *b′*, *b* only, which is in contact with the surface on which it treads, without the shell.

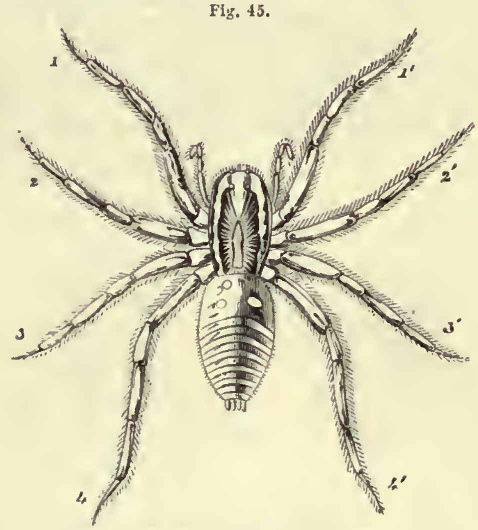
The single foot of the snail is moved by numerous muscular fibres, by means of which it is successively expanded and contracted at various portions of its disc; so that when one portion of it has advanced, and laid hold of an object on the plane of its motion, the next is drawn forward, and so on in succession, until every portion of the foot has advanced; but the length of each step is so small, that the snail takes a long time to walk over a path not more than a foot in length. Tho movements of slugs are performed in a similar manner, and although they have no house to carry on their back, their progression is also very slow. They appear to move with greatest freedom over vegetable substances, but cannot easily traverse fine loose soils; because the segmeuts of the foot cannot find on such moveable surfaces the requisite fulcrum whereby to drag the body along. Gardeners avail themselves of this peculiarity to preservo tender plants from their ravages, by strewing loose ashes, or, what is still better, dry sawdust, over the beds. These Gasteropods secrete a viscid fluid on their track, which enables them to climb the walls of houses in a vertical path. The adhesive fluid, when dry, reflects the light, so as to present a shining silvery appearance, with which most persons (at least those who live in the country) are familiar.

Crabs.—These animals are, it is well known, inclosed in a solid case, or shell. The body is usually either nearly square or a pear-shaped figure, and the tail is not so long and flexible as in the lobsters. They are furnished with five pairs of legs, which are attached to the under side of the trunk, in that portion of it termed the cephalo-thorax. The hinge-like joints of the legs not having their axes of motion perpendicular, but either parallel, or oblique to the mesial axis of the trunk, they are unable to walk directly forwards, but move on solids either in a lateral or in a retrograde direction. Some species, such as the Land-Crab, or *Cancer cursor*, run with considerable rapidity. It is even said that they are capable of running with such speed that a man on horseback has great difficulty in keeping pace with them. According to Labat, "these animals not only live in a kind of orderly society iu their retreats in the mountains, but regularly once a year march down to the sea-side in a body of some millions at a time. The sea is their destination, aud to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course: they neither turn to the right nor to the left. They will attempt to scalo walls to keep the unbroken tenor of their way. They are commonly divided into three battalions, of which the first consists of the boldest and strongest males. Theso are pioneers, who march forward to clear the route, and to face the greatest dangers. The main body is composed of females, which never leave the mountains till the rain has set in for some time; they then descend in columns of 50 paces broad and 3 miles deep. Threo or four days after this, the rear-guard follows, consisting of males and females, neither so robust nor so numerous as the former. The uight is the chief time of proceeding; but if it rains by day, they do not fail to profit by the occasion. When the sun is hot, they make a universal halt, and wait till the cool of the evening. They are sometimes three months in getting to the shore." The order in which the five pairs of legs of the crabs move in walking and runniug does not appear to have been accurately observed.

Spiders.—The *Arachnidæ*, or Spiders, are furnished with four pairs of legs (the female being provided with an additional pair for the purpose of carrying her eggs). The legs of the differeut species of spiders vary considerably with regard to length, but the order iu which they move appears to be the same. The joint which counects the legs to the body is a kind of ball-and-socket joiut, which gives the animal the power of turning the limbs in various directions, but all the other joints of the legs are on the priuciple of the hinge-joiut, thus securing firmness and precisiou in movement. The extremities terminate in either a siugle or double hook for the purpose of prehension.

The apparent complexity of the motions of the limbs of these animals is dissipated by first investigating the order iu which they move the legs on one side, and afterwards that of those on the opposite side. By this means it will be found that the spider advances first the fore leg, theu the fourth, theu the third, and lastly the second leg; that is, in the order 1, 4, 3, 2. (*Fig.* 45). By comparing this order with that of the legs ou the opposite side, when acting simultaneously, it will be found that they begiu by moving the first right leg, then tho fourth left; then follow the first left, and the fourth right; then tho third right, and the second left. The first two sets of legs are thus moved consecutively in the order 1′, 4, 1, 4′, a mode of progression which resembles that of quadrupeds: the remaiuing legs move in pairs simultaneously, namely, 3′, 2, and 3, 2′; aud thus it is found that whilst the legs of one side of the animal are moving consecutively, in the order 1, 2, 3, 4, the legs of the other side are moving in pairs, in the order 4′, 1′, 2′, 3′. Most persons are aware of tho facility with which spiders spin the beautiful but fragile cord, by means of which they safely descend from heights that would be fatal to larger animals unprovided with some means of breaking the shock which would result from a fall from such elevations. In descending their newly-spun thread, they suspend the body to it by one of the hind legs: on returning by the same thread, they make use of three legs, the first two on oue side, and the first or second ou the other. The spider is endowed with the power of running with considerable speed on its web, iu the chace and capture of its insect prey; and is capable of leaping a cousiderable distance, mauy times its owu length. It throws its thread across chasms, and thereby forms for itself a suspension-bridgo in an incredibly shorter period of time than our most celebrated engineers are capable of accomplishing; thus showing that, inferior as the spider is to man iu strength and organisation, it has yet been amply provided by an all-watchful and omnipotent Creator with the meaus of transporting itself from place to place, and of procuring its susteuauce. The same cordage which serves to give it a ready passage across cavities which could not otherwise be traversed without great labour aud expenditure of time, serves also as the best material with which to weave its net for entrapping its prey.

Fig. 45.



Insects.—Many insects are endowed with the triple powers of walking, running, and leaping on solids; of flyiug in the air like birds; and of swimming in water like fishes. For these manifold purposes it is obvious that they must possess a peculiar organisation. To enablo them to move on solids they are furnished with six legs: the first pair is attached to that part of the trunk called the prothorax; the second pair to the mesothorax; and the third pair to the metathorax, which is the last segment of the thorax. In some insects the legs are articulated to the trunk by a ball-and-sockct joint; in others by a hinge-joint: the succeeding portions of the limbs are linked together by hinge-joints. The axes of these joints are turned at right angles to each other, so that they have the power of executing movements in different planes, some in a vertical, and others in a horizontal direction. When the perfect insect walks, it is observed to move three of its legs simultaneously, whilst the other three remain on the ground, supporting the body and urging it forwards. The feet which move simultaneously are the fore and hindermost feet on one side, and the middle foot on the opposite side; consequently the whole of the six feet are moved to accomplish two steps. In the first movement the legs 1, 2′, 3 (*fig.* 46) remain on the ground, whilst those marked 1′, 2, 3′ are raised and advanced, to take a new position on the plane of support: afterwards, whilst the legs 1′, 2, 3′ support the body in a similar manner to those which preceded them in that office, the legs 1, 2′, 3 are raised, and again advanced; and by the alternate action of the six legs in the order just described, the progression of the insect when walking is accomplished. The extraordinary power with which insects are endowed of walking with perfect ease and security up the smooth polished surface of glass, and in an inverted position on the ceilings of rooms, is found to depend on different varieties of structure. The feet of the house-fly are found to be furnished with two membranous suckers, as seen in *fig.* 47; and in the *Bibio febrilis* there are three of these suckers, as shown in *fig.* 48. These suckers are membranous sacs, which are acted on by numerous muscles, so that when the foot is placed on a smooth surface the suckers become enlarged by means of their muscles, and a vacuum is produced. The pressure of the air without becomes by this means sufficient to keep the foot firmly pressed on the surface to which it is applied. We here see the reason why the house-fly chooses the smoothest surfaces of an apartment to walk upon, unless it happens to be moving horizontally; for if the surfaces were rough, the vacuum under the feet would not be perfect, and it would fall. In other instances the hairs are found hooked, whilst some insects secrete a viscid substance, which causes them to adhere to the objects on which they are placed. Many insects, as the fly, are in the larva state destitute of legs, but even these contrive to drag themselves along by the alternate expansion and contraction of their body. We are familiar with an instance of this kind of movement in the maggot commonly found in the hazel-nut. As soon as it is out of the shell it strides along; but, its trunk being cylindrical, it frequently rolls over in its course. Other larvæ, not content with the slow progress made by the method above-mentioned, raise the central portions of the body high above the plane of support, and by means of alternately extending and contracting the body, take steps of considerable length. This kind of movement is shown in *fig.* 49. The trunk is first drawn forward from *a* to *b*, and the head is then extended from *c* to *d*: and thus at each step these larvæ pass over a space equal to *a b* or *c d*. During this process many larvæ, such as the *Geometra*, spin a silken thread, the length of which is consequently the measure of their progress made in walking.

Fig. 46.

Fig. 47.

Fig. 48.

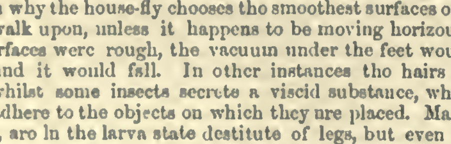


Fig. 49.

Leaping.—Many insects, such as the flea, the grasshopper, and the cricket, are capable of performing extraordinary leaps compared with their bulk. In all the leaping insects the hinder legs greatly exceed the rest in length and strength, and it is in consequence of the length and power of this pair that insects are capable of projecting themselves to the great distances they are known to traverse. The legs are first bent as much as possible, and then suddenly expanded with great force, so as to propel the body through the air. As the grasshopper resides amongst the long grass of meadows, such a mode of progression is requisite to enable it to pass over the rugged surfaces surrounding it on all sides; and we well know with what ease and unerring precision this little creature leaps from point to point.

Worms.—Amongst the *Annelidæ*, or Worms, we find a great diversity of form, and of locomotive organs, suited to the habits and economy of each animal. Some live entirely on land, others reside in water, and are excellent swimmers. The *Lumbrici*, or Earth-Worms, being those with which people generally are most familiar, will be selected to give an idea of their mode of progression. The body of the earthworm is cylindrical, and nearly of equal diameter from head to tail. It is supported by numerous rings encircling the long axis of the trunk throughout, and each ring is furnished with eight conical spines, which are called into action when the animal walks. Between these rings two sets of muscular fibres pass from ring to ring, one set of muscles passing longitudinally, and the other set obliquely. By the aid of these fibres the body of the animal can be either lengthened or contracted, as also twisted in various directions. When touched, the worm immediately assumes the form of the letter S. In walking it expands one portion of the body, and contracts the next successively, so that it requires a series of expansions and contractions throughout its entire length to accomplish a single step. For this reason the progress of the worm is very slow, not being capable of effecting more than about the rate of 30 feet per hour.

For a further account of the special movements of animals see FLYING; SWIMMING.

[In this article we have had the advantage of using the greater portion of an admirable series of articles which appeared in the 'Penny Magazine,' and which were written by Mr. J. Bishop, F.R.S., a gentleman eminent for his physiological attainments, and the author of the profound and original article on 'Motion,' in the 'Cyclopædia of Anatomy and Physiology.']

LOCUST. [LOCUSTA.]

LOCUST-TREE is the *Robinia Pseudacacia* of botanists, a North American forest-tree. [ROBINIA.] The same name has also been given to the *Ceratonia Siliqua*, the Carob- or Algaroba-Tree, which is found in the Levant, and bears large pods filled with nutritious pulp.

LOCUSTA (Geoffroy), a genus of Insects belonging to the order *Orthoptera* and the section *Saltatoria*. The species of this genus have been recently referred by English authors to the genus *Gryllus*. [GRYLLIDÆ.] The terms Locust and Grasshopper are applied to various insects of the order *Orthoptera*, and belong to a section of that order to which Latreille applied the name *Saltatoria*, on account of the power of leaping which they possess. The insects belonging to this section are remarkable for the great size of the thighs of the posterior pair of legs, which are generally very long, and adapted for leaping. The males of some of the species make a shrill sound by the friction of the elytra. The part by which the sound is created is situated on the inner side and near the base of each elytra, is often transparent, and has been compared to a piece of talc. In other species the sound is produced by the friction of the thighs against the elytra.

The section *Saltatoria* contains three families, to which the names *Achetidæ*, *Gryllidæ*, and *Locustidæ* are applied by Dr. Leach. The family *Achetidæ* is thus defined:—Elytra horizontal; wings longitudinally folded, often produced beyond the elytra; tarsi 3-jointed. This family contains the genera *Gryllotalpa* of Ray, Leach, and others, of which the Mole-Cricket (*G. vulgaris*) of this country affords an example, and *Acheta* of Fabricius, which is the *Gryllus* proper of the 'Règne Animal.' The Common Cricket in our houses (*Acheta domestica*) belongs to this genus. The genera *Tridactylus* and *Myrmecophila* are also included in the present family. In the family *Gryllidæ* the wings are disposed in an oblique manner when folded, the tarsi are 4-jointed, the antennæ are long and setaceous, and the oviduct is exserted in the female, of a long and compressed form, and recurved.

The insects of this family form the genus *Locusta* of the 'Règne Animal.' The *Acrida* (*Gryllus*, *Locusta*) *viridissima* is the largest among the British species of the present group. This insect is not uncommon in some parts of England, and is about two inches in length, and of a bright green colour. [GRYLLIDÆ.]

The family *Locustidæ* is distinguished by the following characters:—Wings when folded meeting at an angle; tarsi 3-jointed; antennæ filiform or ensiform; oviduct not exserted. The *Locustidæ* of Dr. Leach are comprised in the genus *Acridium* by Latreille. Unfortunately there is much confusion as regards the names of some of the genera and sub-genera contained in this as well as the other families above noticed. Names originally applied to large groups are restricted to smaller sections, and as entomologists differ in opinion as to which particular division shall retain the original name, the same names are used to designate different groups; hence the references made to Latreille's portion of the 'Règne Animal.'

The principal genera contained in the family *Locustidæ* are the following:—

Locusta (Leach), in which the hinder legs are about equal to the whole body in length, and the antennæ filiform or terminated in a club. Upwards of twenty species of this genus are enumerated by Mr. Stephens in his 'Catalogue of British Insects,' and it is to this group that the *Gryllus migratorius* of Linnæus belongs, a large species which has occasionally been found in Britain, and which in some parts of Europe sometimes multiplies to such a degree as to devastate large districts. Africa at all times appears to have been peculiarly subject to the ravages of these insects. Of their extraordinary devastations in this portion of the globe we have records from the earliest authors, and the works of the most recent travellers confirm them. Mr. Barrow in his 'Travels' states, that "in the southern parts of Africa an area of nearly two thousand square miles might be said literally to be covered with them. When driven into the sea by a north-west wind they formed upon the shore for fifty miles a bank three or four feet high, and when the wind was south-east the stench was so powerful as to be smelt at the distance of 150 miles." In Messrs. Kirby and Spence's 'Introduction to Entomology' numerous accounts of a similar nature will be found. In some parts of Africa they are cooked and eaten by the natives. The natives of Senegal are said to dry them, and, having reduced them to powder, use them as flour.

Gomphocerus (Leach). Hinder legs exceeding the body in length; antennæ capitate, having a spoon-shaped club in both sexes; anterior tibiæ simple. This genus contains numerous species, six or seven of which are found in England. They are usually of small size, and, together with the smaller species of the preceding genus, are commonly called Grasshoppers.

Acrydium (Leach). The species of this genus may be distinguished by the large size of the scutellum, which is produced posteriorly, and covers the wings. They are found on hot sandy banks.

Pneumora (Thunb.) has been established for the reception of certain African *Locustidæ*, which have a membranous pellet between the terminal hooks of the tarsi, the antennæ filiform, the posterior legs shorter than the body, and the abdomen vesicular—at least in one of the sexes.

Proscopia of Klug contains numerous apterous species peculiar to South America, in which the body is long and cylindrical, the head destitute of ocelli and prolonged anteriorly, the antennæ short and filiform, the posterior legs long, and approximated to the intermediate pair, which are remote from the anterior pair.

LODESTONE. [LOADSTONE.]

LOCUSTELLA. [SALICARIA; SYLVIADÆ.]

LOGANIACEÆ, *Loganiads*, a natural order of Exogenous Plants, consisting of shrubs, herbaceous plants, or trees. It is characterised by having opposite entire leaves, usually without stipules, which adhere to the leaf-stalks or are combined in the form of interpetiolary sheaths. The flowers are racemose, corymbose, or solitary; the calyx valvate or imbricated, inferior 4- or 5-parted; corolla regular or irregular, 4-5- or 10-cleft, with valvate or convolute æstivation; stamens arising from the corolla, all placed upon the same line, and not always symmetrical with the divisions of the corolla, pollen with 3 bands; ovary superior, 2-celled; ovules absent or solitary; fruit either capsular, 2-celled, with placentæ finally becoming loose or drupaceous, with 1- or 2-seeded stones, or buried with the seeds immersed in pulp; seeds sometimes winged, usually peltate, albumen fleshy or cartilaginous; embryo small, with the radicle turned towards the hilum or parallel with it. All the species are either tropical or inhabit countries near the tropics, a few in America and Australia forming the only exceptions. It would be difficult to name a more poisonous order than this, of whose qualities the celebrated Nux Vomica may be taken as the representative. Notwithstanding the active qualities of these formidable plants, some are used in medicine with great advantage. Several of the species of *Strychnos* are used in the east as remedies for various diseases, and the seeds of *Ignatia amara*, St. Ignatius' Beans, are employed in India for cholera. *Spigelia* yields also several species which are employed for useful purposes. The order consists of 22 genera and 162 species. It is related to *Apocynaceæ*, *Gentianaceæ*, *Cinchonaceæ*, and *Rhizophoraceæ*. The uses of the species will be found under their respective heads, SPIGELIA; STRYCHNOS, &c. (Lindley, *Vegetable Kingdom*.)

LOGWOOD. [HÆMATOXYLON.]

LOLIGO, a genus of Cephalopodous *Mollusca* belonging to the tribe *Teuthidæ*. It has a firm fleshy cylindrical elongated body, towards its posterior extremity flanked by two triangular fins, which run to the tail. The locomotive apparatus is formed of two oblong margined pits placed at the base of the funnel, and of corresponding linear prominent crests on the inner margin of the sleeve. The eyes are covered by an epidermic expansion pierced with a small opening; no lacrymal sinus. There are ten arms, two of them tentacular, imperfectly webbed. Pen corneous, flexible, lanceolate, as long as the body, terminating in an obtuse point. The Cuttle Fishes of this genus are known popularly by the name of Squids. Their spawn is enveloped in oblong gelatinous tubes, numbers of which are found adhering to a common mass by their lower extremities.

L. vulgaris has fins flanking two-thirds of the body, and forming an oblong rhomb. The body of this handsome animal is cylindrical anteriorly, tapering, and gradually contracted from some distance in front of the middle to the caudal extremity. The angles of the fins are obtuse: these organs extend quite to the tail, and join there. The head is short and broad, not over prominent in the region of the eyes. The eight ordinary arms are stout and rather short, slightly webbed together at their bases; on their inner side they are furnished with two rows of oblique suckers with eccentric openings, of which the horny hoops are armed on their broader side with teeth. The tentacular arms are long, stoutly pedunculated, and furnished at their lanceolate extremity with suckers, large centrally, small towards their tips, and ranked in fours. The general hue of the animal is bluish, with purplish specklings, which are numerous and areolated in the centre of the back, and are close set and dark on the head and hinder portions of the tentacula; beneath it is yellowish-white. The pen is lanceolate; that of the female is said to be broader and more obtuse than the male. The jaws are brown, with white tips. The body grows to a length of nearly a foot and a half; the head and arms add about half a foot to the total length. Dr. Johnston says it makes an excellent bait for cod, but does not occur in sufficient numbers to be used by our fishermen. The ink is jet-black. It appears to be generally distributed around the British Islands, though met with only occasionally.

L. media has an elongated subulate body, produced and acuminated posteriorly; fins narrow and rounded. This cuttle-fish is supposed to be the Lesser Calamary, or Τευθὶς of Aristotle, an opinion opposed by Professor Forbes. It is a much elongated animal, subcylindrical anteriorly, diminishing gradually posteriorly, and much prolonged and pointed at the tail. In specimens preserved in spirits its extremity is singularly sharp and produced; the neck margin of the back is prolonged into a sort of obtuse lobe; the fins are widely apart, above long, somewhat rounded, broad anteriorly, tapering and converging behind, and becoming decurrent on the tail; the head is short, very prominent in the region of the eyes, and is crowned with rather short lanceolate very unequal arms, provided with double rows of suckers; these arms are very much squared at their edges; the tentacular arms are short in proportion to the length of the body; on their lanceolate extremities there are two rows of large suckers, and two rows of smaller ones outside; the mouth is surrounded by an angulated membrane. It is a transparent glassy creature when alive, speckled with dots of red or purple; the pen is lanceolate, narrowing above.

L. Marmoræ has a shorter and stouter body than the last species; tentacular arms longer; tail not much produced; the arms are short and stout, and provided with two regular rows of suckers; the tentacular arms are borne on long peduncles, which can reach to a level with the middle part of the fins; the length of the body and ordinary arms is about four inches. The skin appears to have been strongly dotted with purple or red. Some naturalists affirm that *L. Marmoræ* is only the female of *L. media*.

(Forbes and Hanley, *History of British Mollusca*.)

LOLIGOPSIS. [SEPIADÆ.]

LO'LIUM, a genus of Grasses, containing a few species common in many parts of the northern hemisphere. It is known by the spikelets being many-flowered, distichous, contrary to the rachis, sessile. Flowers not bearded at the base; glumes 2, nearly equal, one of them very often deficient in the lateral spikelets, herbaceous, awnless; paleæ 2, herbaceous; the lower concave and awnless, or awned under the apex; the upper with two keels. Stamens 3; ovary smooth; styles 2, very short; stigmas feathery; hypogynous scales 2, fleshy, entire or 2-lobed; rachis not jointed.

L. perenne, the Common Ray-Grass, or Rye-Grass of the farmer, with lanceolate awnless spikelets which are longer than the glume, a naked stem, and a perennial root. This species is one of the most valuable of our pasture grasses. [RYE-GRASS, in ARTS AND SC. DIV.]

L. temulentum, or Darnel, with elliptical awned spikelets, straight awns longer than the paleæ, glumes the length of the spikelet, and an annual root. Of this species mention is made not only in all parts of Europe, but in Japan, Australia, China, and South America; it is remarkable as being the only well authenticated instance of a plant belonging to the order of Grasses, in which narcotic or even deleterious properties have been found. The grains are said to produce intoxication in man, beasts, and birds, and to bring on fatal convulsions. According to Christison, darnel, when mixed with flour and made into bread, has been known to produce headache, giddiness, somnolency, delirium, convulsions, paralysis, and even death. A few years ago, the same author tells us, almost the whole of the inmates of the Sheffield workhouse were attacked with symptoms supposed to be produced by their oatmeal having been accidentally adulterated with *Lolium*; and a case is on record of a small farmer near Poitiers in France having killed himself by persevering in the use of darnel flour for making bread; his wife and servant, who discontinued to eat it, escaped, but were violently affected with vomiting and purging.

L. Italicum, Italian Rye-Grass, has the spikelets 9-14-flowered; outer palea with a long awn; root with leafy barren shoots; the margins of the young leaves involute. It is cultivated in Britain.

L. linicola has 7-11-flowered spikelets, exceeding the glumes; outer palea longer than its awn or awnless: no barren shoots. The stem is erect. Outer palea cartilaginous below, narrower than the inner, tumid in front. It is found in cultivated fields in Sussex and Yorkshire.

(Babington, *Manual of British Botany*.)

LOMATO'CERAS. M. Bronn has given this name to a generic group embracing certain of the Linnæan *Graptolithi* [GRAPTOLITHUS] instead of *Priodon*, which had been assigned to them by Nilson, but previously employed by Cuvier for a genus of fishes. *Graptolithus scalaris* and *G. sagittarius*, Linn., belong to this group, which as far as yet known is confined to the Transition Strata, in which it occurs in Norway, Bohemia, France, North Germany, Shropshire, &c., generally accompanying trilobites. (Bronn, *Lethæa Geognostica*.)

LOMIS. [HOMOLIDÆ.]

LONCHE'RES, Illiger's name for a genus of *Rodents*, including *Echimys* of Geoffroy, a species of *Hystrix* of Schreber and others, and a species of *Myoxus* of Zimmerman and others. [HYSTRICIDÆ.]

LONCHO'PTERIS, a genus of Fossil Ferns established by M. Adolphe Brongniart. The species belong principally to the Coal Formation, but one, *Lonchopteris Mantelli*, is found in the Wealden deposits and in the Greensand.

The leaves are multipinnatifid, the pinnules adnate to the rachis, marked by a midrib, and equal reticulated nervures, and uniform areolæ. [COAL-PLANTS.]

LONCHU'RA, a genus of *Fringillidæ*, separated from *Fringilla* (Temm.) by Lieut.-Colonel Sykes.

The bill is strong, short, broad; mandibles entire, the upper one extending in an angle on the forehead, and with it forming the arc of a circle. Wings moderate, subacuminate; first quill very short and subspurious; the second, third, and fourth nearly equal and longest. Tail graduated, lanceolate; middle tail-feathers a little exceeding the others in length. Feet moderate, rather slender.

Colonel Sykes observes that the peculiar spear-head form of the tail, and the ridge of the upper mandible and the forehead, forming a segment of the same circle, together with the habits of *Lonchura nisoria*, *L. Cheet*, and *L. leuconota*, afford sufficient characteristics for their separation. Colonel Sykes adds that the Gros-Bec Longicone of the Pl. Col. 96 (*Emberiza quadricolor*, Lath.), belongs to the same group.

The three species are found in the Dukhun (Deccan). The first two are recorded as found only in the Ghauts.

L. Cheet (Sykes) is described as of a pale cinnamon-brown; the body below and the rump white; quills and tail-feathers deep brown. Irides deep red-brown. Female with the colours less intense. Length of the body 3¾ inches; of the tail 2 inches.

Colonel Sykes states that these birds live in small families, and that he frequently found them in possession of the deserted nests of the *Ploceus Philippensis*; their own nest, which he exhibited on a subsequent occasion, is a perfect hollow ball, made of a delicate Agrostis, with a lateral hole for the entrance of the birds. It was found in the fork of a branch of the *Mimosa Arabica*, and contained ten oblong minute white eggs, not much larger than peas, being 15/20ths of an inch long by 8/20ths in diameter. The cry of the bird is 'cheet, cheet, cheet,' uttered simultaneously by flocks in flight. ('Zool. Proc.')

LONDON CLAY. The most considerable of the Tertiary Formations of Great Britain is thus designated, from its development in the valley of the Thames under and around the metropolis. It may be viewed in three parts, occupying the following series:—

Upper part, 'Bagshot Sand,' in which several remarkable fishes have been noticed.

Middle part, 'London Clay,' containing a few bands of sand, nodules of septaria, and multitudes of marine shells.

Lower part, 'Plastic Clays and Sands.'—Various coloured clays and sands, with lignite, and marine, æstuary, and fresh-water shells. [TERTIARY SYSTEM.]

LONDON PRIDE. [SAXIFRAGA.]

LONDON ROCKET. [SISYMBRIUM.]

LONGICORNES, the fourth family of Tetramerous *Coleoptera* in Latreille's arrangement of Insects. It includes a vast number of large and beautiful Beetles, all remarkable for the length of their antennæ, which in many species are several times longer than their bodies. They inhabit woods, where the females deposit their eggs beneath the bark of trees, effecting the operation by means of a long, strong, horny ovipositor with which they are provided. The females are usually larger than the males. The larvæ live beneath the bark of trees or in the wood, in which they bore deeply and do much damage. The greatest assemblage of species and the largest forms are found in South America; but Longicorn Beetles are very generally dispersed. This family is divided into three great groups, of which the genera *Prionus*, *Cerambyx*, and *Leptura* are the respective types.

LONGIPENNES, Cuvier's family name for the long-winged Oceanic Birds (Grands Voiliers), such as the Petrels, Albatrosses, &c. The genera which he includes in this family are *Procellaria*, *Puffinus*, *Halodroma*, *Pachyptila*, and *Diomedea*. [DIOMEDEINÆ; ALBATROSS; LARIDÆ; PUFFINUS.]

LONGIROSTRES, Cuvier's name for a family of Wading Birds (Oiseaux de Rivage), in which he includes the genera *Ibis*, *Numenius*, *Scolopax*, *Rhynchæa*, *Limosa*, *Calidris* and *Tringa*, *Arenaria* (*Calidris*, Vig.), *Pelidna*, *Falcinella* (*Erolia*, Vieill.—*Scolopax pygmæa*, Linn.), *Machetes*, *Hemipalama*, *Eurinorhynchus*, *Phalaropus*, *Strepsilas*, *Totanus*, *Lobipes*, and *Himantopus*—the greater part of which, as he observes, would come under the great Linnean genus *Scolopax*. He remarks that one can hardly place the *Avosets*, *Recurvirostra*, Linn., in any other position than at the end of the *Longirostres*. [SCOLOPACIDÆ.]

LONICE'RA, a genus of Plants named after Adam Lonicer, a German botanist, who was born in 1528 and died in 1586. He practised as a physician at Frankfort-on-the-Main, and wrote a Herbal, which was merely a compilation of what had been done by others. There is also a John Lonicer mentioned who wrote a commentary on Dioscorides.

This genus is the type of the natural order *Caprifoliaceæ*, and has the tube of the calyx 5-toothed, the corolla tubular, campanulate or funnel-shaped, with a 5-cleft usually irregular limb; 5 stamens; a filiform style; a capitate stigma; 3-celled berries, and crustaceous seeds. The species are erect or climbing shrubs, with opposite exstipulate leaves and axillary flowers. There are about 60 species of *Lonicera*, most of which have handsome flowers and emit a delicious perfume.

L. Caprifolium, Goatsleaf, or Pale Perfoliate Honeysuckle, has ringent whorled terminal and sessile flowers; deciduous obtuse leaves, glabrous on both sides, the upper leaves connate perfoliate; the style glabrous. It has a twining stem, with white or purplish flowers and orange-coloured berries. It is a native of the middle and south of Europe, and is found in woods and thickets in many parts of England and the south of Scotland.

L. Periclymenum, the Woodbine, or Honeysuckle, has climbing branches, the leaves all separate, deciduous, sometimes downy, glaucous beneath, ovate, obtuse, attenuated at the base, upper ones the smallest; the heads of flowers all terminal ovate, imbricated; the flowers ringent. The flowers are pale yellow; the berries red, and accompanied with permanent bracts. This plant in early times was supposed to possess powerful medical properties, but it is not now used. It is however extensively cultivated in the gardens and shrubberies of Europe on account of the delicious perfume of its flowers. This plant is the true Woodbine of the poets, and Milton has applied to it the name Twisted Eglantine. This plant has obtained the name of Woodbine, a corruption of wood-bind, from its habit of twisting round the stems of trees.

Thus Shakspeare says—

> "So doth the woodbine, the sweet honeysuckle,
> Gently entwist the maple."

The name Honeysuckle is derived from the habit of children, who draw the corolla out of the calyx and suck the collected honey from its nectary. Several varieties of this plant are recognised by botanists. All these are beautiful climbers and very fragrant; and trained against a wall, twining round a pole, or climbing and rambling amongst bushes, are very ornamental in gardens. It is a native of middle Europe, and very abundant in some parts of Great Britain.

L. Xylosteum, Fly-Honeysuckle, has 2-flowered woolly peduncles as long as the flowers; the calyx-limb deciduous; the berries slightly connected at the base; the leaves oval, downy; the stem erect. The flowers are of a pale yellow, and the berries are scarlet. It is a native of nearly the whole of Europe, in thickets, hedges, and rocky places, and by the side of woods. It is found in the same situations, but is a rare plant, in Great Britain.

L. Tartarica, the Tartarian Honeysuckle, has a glabrous erect stem; cordato-ovate sub-acute leaves; the peduncles shorter than the leaves; the berries distinct when young and nearly globose, but at length connate at the base; flowers rose-coloured, short, somewhat gibbous at the base; the fruit black, with one of the berries usually abortive; the peduncles 2-flowered. It is a native of Tartary, and is one of the most hardy of European shrubs, growing in the open air in the gardens of St. Petersburg and Stockholm. It is very common in British gardens, and is valued much on account of its early leafing and flowering.

L. Iberica, the Georgian Honeysuckle, is an erect plant, with petiolate, cordate, roundish, tomentose, or pubescent leaves; the peduncles 2-flowered, shorter than the leaves, the bracteas oblong, ciliated; the berries globose, blood-coloured, joined together to the middle; the ovarium tomentose. This plant is a native of Georgia, about Teflis, and is a neat little bush with which to form garden-fences.

All the species of *Lonicera* may be cultivated, and are well adapted for gardens, shrubberies, &c. The climbing species may be trained on trellis-work, or in arbours, or against walls. The upright hardy species are best adapted for shrubberies. They will grow in any common garden soil, and may be propagated by cuttings planted in autumn, either in a sheltered situation or under a hand-glass, according as they are more or less tender.

(Don, *Dichlamydeous Plants*; Loudon, *Arboretum et Fruticetum*; Babington, *Manual of British Botany*.)

LOON. [COLYMBIDÆ.]

LOOSESTRIFE. [LYTHRUM; LYSIMACHIA.]

LO'PHIADÆ, a family of Fishes of the order *Acanthopterygii*. The fishes of this family (which forms the Pectorales Pédiculées of Cuvier) are distinguished by the bones of the carpus being elongated, and forming a kind of arm, which supports the pectoral fins. The skeleton is semicartilaginous. The family contains four genera: *Lophius* (Cuv.), *Antennarius* (Commerson), *Malthe* (Cuv.), and *Batrachus* (Bloch., Schn.).

Lophius is thus characterised:—Skin without scales; the ventral fins situated in front of the pectorals: opercule and branchiostegous rays enveloped in the skin; gill-opening situated behind the pectorals; branchiostegous membrane forming a large purse-like cavity in the axilla; two distinct dorsal fins, in front of which are some free rays produced into long slender filaments: head broad and depressed, extremely large in proportion to the body.

L. piscatorius, the Angler, or Fishing Frog, is thus described by Mr. Yarrell:—"The head is wide, depressed; the mouth nearly as wide as the head; lower jaw the longest, bearded or fringed all round the edge; both jaws armed with numerous teeth of different lengths, conical, sharp, and curving inwards; teeth also on the palatine bones and tongue; three elongated unconnected filaments on the upper part of the head, two near the upper lip, one at the nape, all three situated on the middle line; eyes large, irides brown, pupil black; pectoral fins broad and rounded at the edge, wide at the base; branchial pouches in part supported by the six branchiostegous rays. Body narrow compared with the breadth of the head, and tapering gradually to the tail; vent about the middle of the body; the whole fish covered with a loose skin. The number of fin-rays are:—Dorsal, 3 spinous and 12 soft; pectoral, 20; ventral, 5; anal, 8; and caudal, 8. Colour of the upper surface of the body uniform brown; fin membranes darker; under surface of the body, ventral and pectoral fins, white; tail dark-brown, almost black."

The Angler is usually about 3 feet in length, but has been known to measure 5 feet. It lives at the bottom of the water, crouching close to the ground; and by means of its ventral and pectoral fins it stirs up the mud and sand in such a manner as to conceal itself from other fishes. The long filament at the tip of the nose is elevated, and the glittering appendage at its extremity is said to attract the smaller fishes as a bait; and when they are sufficiently near they are seized by this voracious fish.

In the genus *Antennarius* there is the same sort of free rays on the head, the first of which is slender, often terminated by an appendage; the following rays, augmented by a membrane, are sometimes much enlarged, and at others are united to form a fin. The dorsal fin occupies nearly the whole extent of the back; the body is often beset with cutaneous appendages. These fishes, says Cuvier, by filling their enormous stomachs with air, expand themselves like a balloon; their fins enable them to creep on land, where they can live for two or three days, the pectorals, from their position, performing the functions of hind feet. These fishes inhabit the seas of hot climates.

The species of the genus *Malthe* are remarkable for their projecting snout, beneath which the mouth, which is of moderate size and protracted, is situated. The body is studded with bony tubercles, and the dorsal fin is small.

The fourth and last genus of the present family, *Batrachus*, is distinguished by the following characters:—Head horizontally flattened, broader than the body; the mouth deeply cleft; operculum and suboperculum spinous; the ventral fins narrow, inserted under the throat, and containing but three rays, the first of which is broad and elongated. The anterior dorsal fin is short, and supported by three spinous rays; the posterior dorsal is long, and supported by soft rays; the anal fin, which is opposed to the last, is also supported with soft rays. The lips are frequently furnished with filaments. The species of this genus keep themselves hidden in the sand to surprise their prey, like those of the genus *Lophius*, and the wounds inflicted by their spines are said to be dangerous.

LO'PHIODON, an extinct genus of *Mammalia*, nearly approaching in the structure of the teeth to the Tapirs and Rhinoceroses, and in some respects to the Hippopotamus, separated by Cuvier from *Palæotherium* (with which, as well as *Anoplotherium*, it is closely connected) under the name at the head of this article. M. De Blainville named the genus *Tapirotherium*.

Lophiodon differs from *Palæotherium* in that the lower molar teeth, instead of exhibiting a continuous series of double crescents running longitudinally, have transversal elevations (des collines transversales), more or less oblique. Cuvier gives the following as the generic characters of *Lophiodon*:—

1. Six incisors and two canines in each jaw; seven molars on each side of the upper jaw and six in the lower, with a vacant space between the canine and the first molar: points in which they resemble the Tapirs.

2. A third elevation (colline) on the last lower molar, which is wanting in the Tapirs.

3. The anterior lower molars are not furnished with transversal elevations as in the Tapirs, but present a longitudinal series of tubercles, or a conical and isolated one.

4. The upper molars have their transversal elevations more oblique, and in this respect approach the Rhinoceroses, from which they differ by the absence of crochets on these elevations.

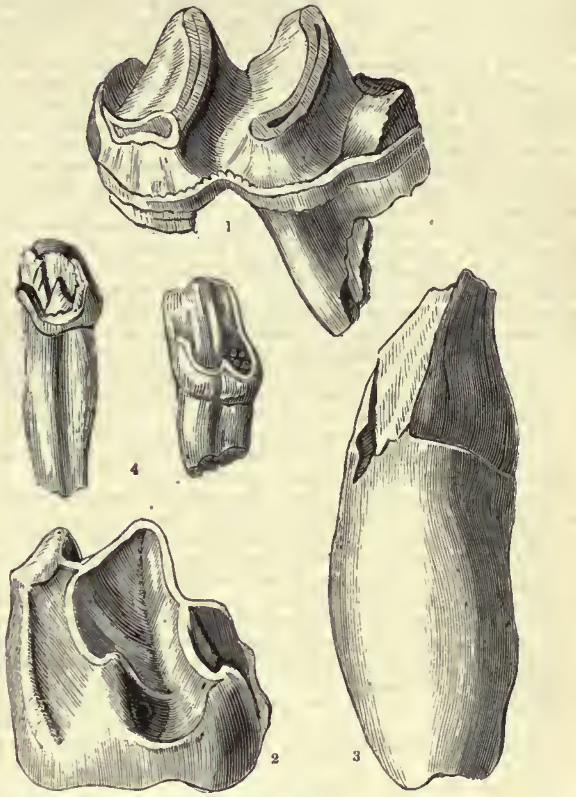
The dental formula of *Lophiodon* then will be—

$$\text{Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{7-7}{6-6} = 42.$$

The rest of the osteology of this extinct form indicates the affinities above-mentioned; but many parts of the skeleton are still unknown, and particularly those essential portions the nasal bones and those of the feet, the number of toes not being ascertained.

No less than 15 species are recorded, 12 of which are named. They belong to the first great fresh-water formation of the Eocene period of Lyell; and if we are to judge from analogy, and the other animal remains (those of reptiles especially) with which they are associated, they must have lived in a temperature suitable to the existence of Crocodiles and fresh-water *Testudinata* (*Emys* and *Trionyx*), creatures which at present inhabit warm climates.

The localities are—Issel for three species, one of which is also found at Epplesheim and another also at Argenton and Soissons; Argenton for three other species; Buchsweiler for two more; Montahusard for two more, one of which is also found at Gannat; Boutonnet near Montpellier for one; Orenburg for one (*L. Sibiricum* of Fischer): these species are named. Others have been found at Argentou, in the Laonnois, near Paris, and near Frankfurt.



1, lower back molar, from the great species of *Lophiodon* of Argenton (Cuvier); 2, upper molar, (back) of the same (Cuvier); 3, canine tooth of the same (Cuvier); 4, incisor teeth of the same (Cuvier).

In the 'Règne Animal,' Cuvier places *Lophiodon* between *Palæotherium* and the *Tapirs*. Professor Owen, in his 'British Fossil Mammals,' refers *Lophiodon* to the *Tapiroidæ*, and describes a species from teeth found in Great Britain. He calls this species *L. minimus*.

LOPHIUS. [LOPHIADÆ.]

LOPHOBRANCHII, a family of Fishes in which the gills, instead of being pectinated, are separated into small rounded tufts, which are arranged in pairs along the branchial arches, and covered by a large operculum, so fixed as to leave only a single small orifice for the passage of the water outwards. The Pipe-Fishes, *Syngnathus*, *Hippocampus*, *Solenostomus*, and *Pegasus*, are the genera included in this family. [SYNGNATHIDÆ.]

LOPHOGNATHUS. [DRACONINA.]

LOPHOPHORUS. [PAVONIDÆ.]

LOPHORINA. [BIRDS OF PARADISE.]

LO'PHOTES, a genus of *Falconidæ* established by M. Lesson; but that term having been previously employed by Giorna to designate a genus of Acanthopterygious Fishes, Mr. Gould and others adopt the title *Lepidogenys*, proposed by Dr. J. E. Gray for this genus. Mr. Gould describes a species among his Australian birds under the name of *Lepidogenys cristatus*. The form is somewhat allied to *Pernis*. [FALCONIDÆ.]

LOPHOTES. [TÆNIOIDES.]

LOPHOTUS, a name applied by G. Fischer to a genus of *Simiadæ*.

LOPHU'RA, a genus of Saurians established by Dr. Gray, but changed by Cuvier for *Istiurus*, because in his opinion the term *Lophura* comes too near to the term *Lophyrus*. [IGUANIDÆ.]

LO'PHYRUS, a genus of Birds. [COLUMBIDÆ.] The term is also employed by Duméril to designate a genus of Saurians (*Agama gigantea*, Kuhl.), and by Latreille as a name for a genus of Hymenopterous Insects.

LORANTHACEÆ, *Loranths*, a natural order of Exogenous Plants, referred by most systematic writers to either the polypetalous or monopetalous sub-class, but by others regarded as more closely in alliance with the apetalous *Santalaceæ* and *Proteaceæ*. They are in nearly all cases true parasites, growing upon the branches of trees, below whose bark they insert their roots, incorporating them with the wood, and feeding upon the vital juices of the plants which they attack. The principal marks of distinction in the structure of *Loranthaceæ* are a 1-celled inferior fruit containing a single erect ovule, a fruit consisting of a peculiar viscid matter resembling birdlime, and a valvate corolla with the stamens opposite the petals. There is but one species, the Common Mistletoe, *Viscum album*, found wild in England; a species of *Loranthus* occurs in the south of Europe; but in the hot dry parts of tropical countries the species abound, swarming over the branches of trees, of which they often form a conspicuous feature, with their long clustered gaily-coloured flowers. As in this country the Mistletoe does not injure in any considerable degree the plant which it attacks unless it exists in unusual quantity, so in India, where *Loranthi* are common, the injury sustained by vegetation is according to the reciprocal size of the parasite and its stock. Mr. Griffith states that a species called *Loranthus Scurrula*, which is generally attached to *Melastoma malabathrica* or other shrubs, frequently destroys them to a considerable extent; others which are minute in comparison with the stock, especially such as grow upon trees, produce no appreciable injury.

Although the nature of the pericarp of plants seldom forms a part of their ordinal distinctions, yet it is here employed—for this reason, that the viscidity of the fruit and the parasitical habits of the order are dependent on each other. The seeds sticking by their own glue to the branches on which they fall insure to the young parasite, when it begins to grow, a suitable substance in which to push its roots; and as the viscidity of the fruit causes the greater part of it to catch upon branches before it falls to the ground, the young plant would die immediately after germination if it were not a parasite, and thus the race would become extinct.

Mr. Griffith has shown ('Linn. Trans.' xviii. 71) that in *Loranthus* and *Viscum* the ovules are not formed till after impregnation has taken place—a most curious and before unheard-of fact.

The order seems to be equally dispersed through the equinoctial regions of both Asia and America, but on the continent of Africa to be much more rare, only two having been yet described from equinoctial Africa and five or six from the Cape of Good Hope. Two are named from the South Seas and one from Australia; but this number requires doubtless to be enlarged. Three only are known in Europe. *Nuytsia floribunda*, a very beautiful shrub with large thyrses of bright orange-coloured flowers, is a singular instance of a plant of this parasitical order growing on the ground. Such is the abundance of the orange-coloured blossoms that the colonists at King George's Sound compare it to a tree on fire; hence it has gained the name of Fire-Tree. The bark of the tree is usually astringent, as in the Common Mistletoe. In medicine they are of little value. There are 23 genera and 412 species.

(Lindley, *Vegetable Kingdom*.)

LORANTHUS (from lorum, 'a strip of leather,' and ἄνθος, 'a flower,' in allusion to the long linear shape and leathery substance of the petals), a genus of Plants the type of the natural order *Loranthaceæ*. It has diœcious or hermaphrodite flowers, the calyx cup-shaped, adnate, with an entire border; the petals 5 or 6, linear, reflexed; the stamens inserted into the middle of the petals; the filaments short, anthers globose; the style thickish; the stigma simple; the berry globose, 1-celled, 1-seeded. The species are evergreen shrubs parasitical on trees.

L. Europæus, the European Loranthus, is a glabrous much-branched plant; the branches terete; the leaves opposite, petiolate, oval-oblong; the racemes terminal, simple; the flowers diœcious, of 6 petals. This plant is an evergreen parasitical plant, and has the habit of the Common Mistletoe (*Viscum album*). It is a native of the southern parts of Europe, and is found on the oak, but inhabits no other tree. "This circumstance," says Burnett, "has led some naturalists to suppose the *Loranthus* to have been the Mistletoe of the Druids, and to believe, as it is not now indigenous to Britain, that when Druidism was suppressed every vestige of that stupendous superstition was so completely swept away that even the sacred plant was extirpated here." The fact however of the scarcity of the mistletoe upon the oak renders it probable that it was on this account more sought after, and thus contributed to make it an object of superstition. Several other species of *Loranthus* have been described, but none of them are easily cultivated on account of their parasitical habits. The seeds of the *Loranthi*, like those of the Mistletoe, contain tannin, and are astringent. *L. tetrandrus* is used for dyeing black in Chili.

(Burnett, *Outlines*; Loudon, *Arboretum et Fruticetum*.)

LORICA'RIA, a subdivision of the Linnæan genus *Cellaria*, proposed by Lamouroux. It is also employed by Linnæus to designate a genus of Malacopterygious Fishes.

LORICATA, the name applied by Merrem and Fitzinger to the Crocodiles, Emydosaurians of De Blainville. [CROCODILIDÆ.]

LORIS. [LEMURIDÆ.]

LORY. [PSITTACIDÆ.]

LÖSS, a peculiar loamy deposit in the valley of the Rhine, and extending to some breadth beyond that area, which may be conjectured to be analogous with accumulations in valleys of South America containing the *Megatherium*, and with other 'valley formations' in different parts of the world. It borders the valley-plain of the Rhine, reaching, though not continuously, from Schaffhausen to Cologne, enters many of the lateral dales, lies against the hills, and constitutes hills itself. In the line between Basle and Bingen it occupies the left bank by Worms, Oppenheim, Flonheim, &c., and the right bank by the Schwarzwald to Basle. Compared to the usual character of diluvium, the Löss is a fine-grained deposit; fine sand, clay, and calcareous earth, easily pulverised, and containing some nodular concretions, constitute the mass of the deposit. It sometimes (at Heidelberg) alternates with gravel.

Principally in the upper parts of the Löss are found shells of land, fresh-water, and marsh *Mollusca* now living in the vicinity. These sometimes retain their colour. Bones and teeth of quadrupeds usually met with in diluvium occur locally in Löss, as at Weinheim and Bensheim. These bones appear sometimes to have been drifted to their present repositories, as at Rixheim, where upon and in cavities in the fresh-water tertiaries bones of stag, rhinoceros, hyæna, elephant, horse, &c., occurred. Cannstadt yielded bones and teeth of elephant, rhinoceros, tiger, hyæna, wolf, bear, stag, roebuck, oxen, horses, boar, mouse, hare, birds, and remains of vegetables. (Meyer, 'Palæologica.')

Between Strasburg and Sulzbad the Löss reaches 600 French feet above the sea, and on the Kaiserstuhl 1200 feet, an elevation supposed to be explained by the volcanic character of the vicinity. The thickness of the Löss is stated to reach 200 or even 300 feet. Near Andernach, Löss alternates with volcanic sediments (Trass), but generally overlies them, and in some places fills old craters (as the Roderberg, near Bonn).

The deposition of Löss in the upper Rheinthal has been often viewed as the effect of a lake supposed to have extended from Basle to Mayence, and to have been drained by the opening of the narrow gorge at Bingen; but from the continuation of this deposit below that gorge, the elevation it has attained on the flanks of the Siebengebirge, and other circumstances, Mr. Lyell, who has specially examined the subject, proposes a different hypothesis. He thinks that the whole country drained by the Rhine has undergone changes of level, such that after having formerly stood for some unknown period with nearly its actual height and physical features, it experienced a great and general depression, so as to receive river deposits in great abundance; and that it was again raised, so as to permit the partial re-excavation of the ancient valleys, and the removal of much of the fluviatile sediments: what remains is the Löss.

(Meyer, *Palæologica*; Lyell, in *Edinb. Philosophical Journal*, 1834, and *Principles of Geology*.)

LOTA, a genus of Subbrachial Malacopterygious Fishes belonging to the tribe *Gadidæ*. It is distinguished by having an elongated body, with dorsal fins and one anal fin, a chin with one or more barbules.

L. molva, the Ling, is a very valuable fish, scarcely less so than the Cod. Large quantities are taken among the Western Islands, the Orkneys, on the Yorkshire coast, and the Scilly Islands; and may be traced nearly all round the Irish coast. The fishing for them is by hand-lines and long-lines; and besides a portion that is consumed fresh, the fish are split from head to tail, cleaned, salted in brine, washed, and dried, but the demand generally falls short of the quantity cured, and the hardy fishermen are but poorly requited. The ports of Spain are the markets supplied; and so valuable an article of commerce was Ling considered formerly that an Act for regulating the price of Ling, Cod, &c., was passed as early as the reign of Edward III. The air-bladders, popularly called Sounds, are prepared separately, and with those of the Cod-Fish are sold pickled. The roes, which are of large size, are also used as food, or preserved in brine, are sold to be used for attracting fish. The liver produces oil, which is used by the poor to supply the cottage lamp, also as a medicine. In Zetland the principal fishing for Ling is from May to August. On the Yorkshire coast the young are called Drizzles. In Cornwall they are caught in January and February, and their favourite haunts are about the margins of the rocky valleys of the ocean.

The Ling is exceedingly prolific, and has a most voracious appetite, feeding on young fish, not sparing anything that has life, and the prey is swallowed whole, so that no great art is required to catch it. It is tenacious of life, and survives great injury. Mr. Couch says he once saw a Ling that had swallowed the usual large hook, shaft foremost, of which the point had fixed in the stomach, and as the line drew it, it turned round, entered the opposite side of the stomach and fastened the organ together in complicated folds; yet having escaped by breaking the line, it survived to swallow another hook and was taken several days after.

The most usual length of the Ling is from three to four feet; Pennant mentions having heard of one which measured seven feet; and Mr. Couch has known them weigh 70 lbs.

The body of the Ling is slender, more elongated than that of the Hake; roundish; head flat; gape large, lower jaw shorter than the upper, with a single barbule at its extremity; teeth in the upper jaw small, and very numerous, those in the lower jaw longer and larger, forming but a single row; lateral line straight, scales small, firmly adhering to the skin; two dorsal fins of equal height, the first short, commencing near the head, not pointed as in the Hake, but with most of the rays even; second long, immediately behind the first, reaching nearly to the caudal; the posterior portion the most elevated; vent in a line with the eighth or ninth ray of the second dorsal fin; the fin immediately behind it is long, resemhling the second dorsal fin, and terminating on the same line with it; caudal rounded at the extremity. The back and sides are gray, inclining to olive; sometimes cinereous without the olivaceous tint; helly silvery; ventrals white; dorsal and anal edged with white; caudal marked near the end with a transverse black bar; the extreme tip white.

L. vulgaris, the Burholt, or Eel-Pout, is the only British species of this unmerous family of fishes that lives permanently in fresh water, and prefers in this country slow running rivers; hut it is neither so generally known, nor so much esteemed and encouraged, as from the goodness of its flesh it deserves. It is said to be found in various parts of the north of Europe, Siheria, Asia, and India. In this country it is rather local. It occurs in the Cam, and in some of the rivers of Norfolk and Lincolnshire. The Trent produces it, and Nottingham market is occasionally supplied with samples for sale. The Burholt is not unlike the eel in some of its hahits, concealing itself under stones, waiting and watching for its prey, which consists of aquatic insects and young fishes, under arches and near eddies, into which such small and weak auimals are likely to be hrought by the current of the water. It feeds principally during the night, and like the eel is most frequently caught by trimmers and night-lines. The Burbolt is sometimes called the Coney Fish, from its habit of lurking and hiding itself in holes like a rahbit. It spawns in February and March, is very teuacious of life, and is said to have lived a considerable time in a cold and damp situation, fed on small fishes and raw meat. In this country it has been known to attain the weight of 4½ lbs., hut a common weight is about 2 lbs. The flesh is firm, white, and of good flavour, and is hy some considered superior to that of the eel. As the Burbolt is extremely hardy, it might be increased in any quantity, while the valne of the fish would amply repay the trouhle and cost of the experiment. It would thrive well and multiply iu large lakes. The length of tho fish is from one to two feet; the head dopressed, smooth; jaws equal; chin with one barbule; the gape large, with small teeth above and below; eyes of moderate size; gill-opening large; the length of the head as compared to that of the hody as one to four; the form of the body cylindrical, compressed posteriorly; the first dorsal fiu is small and rounded, the second elongated, reaching nearly to the tail; both dorsal fins nearly uniform iu height; ventral fins placed very forward, narrow, and pointed; the pectoral fins large and rounded; the anal fin hegins on a line behind the commencement of the second dorsal fin, but euds very nearly on the same plane; the tail oval and slightly pointed; the colour of the body yellowish-hrown, clouded and spotted with darker brown, and covered with a mucous secretion; the under parts lighter; the lateral line indistinct and straight; scales small; the fins partaking of the colour of the part of the hody from which they emanate, those of the lower surfaco being much the lightest.

(Yarrell, *British Fishes*).

LOTUS, a genus of Plants belonging to the natural order *Leguminosæ*. It has a calyx with 5 nearly equal teeth; keel ascending with a narrowed point; the wings are connivent at their upper margin; longer filaments dilated upwards; style knced at the base, filiform, suhulate; pod linear, many-seeded, 2-valved, imperfectly divided hy transverse partitions.

L. corniculatus, Common Bird's-Foot Trefoil, is found in pastures and on dry banks in Great Britain. The claw of the standard is obovate, transversely vaulted; calyx-teeth straight in the bud, subulate from a triangular hase, the points of the two upper ones converging; heads 5-10-flowered. The plant is glabrous or slightly hairy; stem ascending; leaflets obovate; stipules ovate; angle between the two upper calyx-teeth rounded.

L. major has the claw of the standard linear; calyx-teeth spreading like a star in tho bud, subulate from a triangular hase, two upper ones diverging; heads 8-12-flowered; leaflets obovate; stipules roundish-ovate.

L. angustissimus is found in the south of England, near the sea. It has the claw of the standard linear; calyx-teeth straight in the hud, subulate; pod linear, eight times longer than the calyx; beak straight; head about 2-flowered.

L. hispidus is found near the sea in Devonshire and Cornwall. It has the claw of the standard suhulate; calyx-teeth straight in the hud, subulate; pod rugose, teretc, twice as long as the calyx; heak elongate, setaceous, bent downwards; heads few-flowered; leaflets obovate-lanceolate; stipules half cordate; stem procumbent. There are many other European species of this genus, none of which are of any importance.

(Babington, *Manual of British Botany*.)

LOTUS *of the Ancients*. The plant or plants referred to hy classical authors under the name of *Lotus* is a subject which has engaged the attention of numerous commentators as well as of botauists. To the difficulty of ascertaining the identity of a plant but imperfectly described has in this case been added that of the same name having been applied to several very distinct plants. Fée, the latest author ('Flore de Virgile'), enumerates no less than eleven to which the name *Lotus* was applied: it is unnecessary here to enumerate more than the most remarkable. Of these some are herbaceous, others perennial. Among the former are the *L. sativa* and *L. sylvestris* of Dioscorides: the first, he states, is also called *L. trifolium*; it is supposed by some hotanists to be *Melilotus officinalis*, and hy others to be *M. cærulea*. Dr. Sibthorp has fixed upon *M. Messanensis* as the plant.

The *L. sylvestris* of Dioscorides, also called *L. Libyon*, a native of Lihya, and ahout two feet high, with leaves like those of *L. trifolium*, and fruit like that of Fenugreek, is thought to he the *Trigonella elatior* of Sihthorp, which he fouud in Asia Minor and in Cyprus. Both kiuds are descrihed hy the Arahs under the name of Handachocha, or Hundkookee, with Garch and Thusf as other Arahic names. From the great numher of similar plants of the trihe of *Loteæ*, which are employed hy Asiatics as articles of diet or as medicines it is impossihle, without specimens, to identify either of the above, but they are probably allied to the *Melilotus*.

L. Ægyptica, or the Egyptian Lotus, is no doubt one of the *Nymphæaceæ*, heing described as springing up in Egypt in fields inundated by the river, with a stem like that of the Κύαμος, or Egyptian Bean (*Nelumbium speciosum*), and a white liliaceous flower, which rises out of the water at sunrise and sinks down again at its setting; a capsule like that of the poppy, in which are contained seeds which the Egyptians roast and make into hread; with a root which is likewise eaten, both in a dressed and undressed state. The plant is no douht the *Nymphæa Lotus* of botanists; but as in the most ancient monuments a blue-coloured lotus is likewise represented, there is no douht that the Egyptians were also acquainted with the *Nymphæa cærulea*. At the present day the seeds of several Nymphæas roasted in sand are eaten hy the natives of India, as are likewise the stalks aud the rootstocks, which is said to have been the case with the Egyptian species. As the flowers of the *Nymphæaceæ* are so highly esteemed by the Hindoos, and notices respecting them constantly occur in their poetry and mythology, it is possible that an Eastern legend may have giveu origiu to the transformation of the nymph Lotis flying from Priapus into the 'aquatica lotos.' (Ovid, 'Metamorph.,' ix. 341.)

The Egyptian *Lotus* however is not so celebrated as another less-known tree, to which exaggerated description has assigned a fruit of the most delicious kind, upon which the Lotophagi lived, and which, when strangers had once tasted, they ceased to wish to return to their native country. This is specially descrihed as a tree, but there is no douht that several have beeu confounded under this uame. One is described both hy Dioscorides and Pliny as a native of Italy of great size, forming excellent wood, with fruit ahout the size of pepper and resembling that of the cherry. This description applies very olosely to the *Celtis australis*, or European Lote or Nettle-Tree, which is one of the largest timber-trees of the south of Europe, with wood of considerahle hardness and toughness. It produces herries about the size of small cherries, and with long stalks like them, eaten both hy birds and children.

This however comes far short of the character of the *Lotus* of the Lotophagi, of which the best description, according to Sprengel, is that of Polyhius, who states that it was a moderate-sized thorny tree, with leaves like those of *Rhamnus*, hut hroader; that the fruit at first was like the white berries of myrtle, hut heeame as large as an olive, of a reddish colour, and containing a small nut; taste sweetish, resembling that of figs or dates; and that a wine was prepared from it. That this tree was a native of Africa we know from the Lotophagi, who employed the fruit as thcir chief food, being a people of the African coast near the Syrtes. (Herod., iv. 177.) Arabian authors, in their translation of the works of the Greeks, give the synonyms in both languages, and we have, in the chapter of Serapion, rctranslated iuto Latin, 'De Loto Arbore,' the name Sidr, or Sidar, given as the Arahic name of the tree, and Nahach, Nibuk, or Nahk as that of its fruit. This name has heen long known as that of a species of *Zizyphus*, and has heen applied hy hotanists to one species, *Z. Napeca*. Dr. Shaw, in his 'Travels in Barhary,' figures a species of *Zizyphus*, which he calls 'Seedra Arabum, quæ et Lotus Verterum.' It is a prickly hranching shruh, with fruit of the size of a wild plum, and of a sweetish taste and saffron colour. He fouud it sold in the markets, cattle fed with it, and a liquor drawn from it. Desfontaines also found this *Z. Lotus* ou the same coast, and has fully deserihed it. Mungo Park found a species of *Zizyphus* in the interior of Africa, which forms a large tree with yellow farinaceous berries of a delicious taste. The natives, he says, convert them into a sort of bread, hy exposing them some days to the sun, aud afterwards poundiug them gently in a mortar until the farinaceous part is separated from the stone. This meal is then mixed with a little water and formed into cakes, which when dried in the sun resemble the sweetest gingerhread. It may be added, that the fruit of several species of *Zizyphus* is eateu in India. One kind, commonly known hy the name Ber, forms a moderate-sized tree in a cultivated state, with oval fruit of a yellowish or reddish colour, and ahout the size or somewhat smaller than a common plum, which is much esteemed. Tho tasto is mild and sweet, with a slight degree of acidity, probahly coming nearer to the taste of dates thau any other fruit. In Persian works Berree and Jharree aro given as its Hindustanee, Kinar and Khial as its Persian, and Sidr as its Arahic name, with Nehhe for the fruit. The fruit of the wild kind is dried and powdcred, as was done with the *Lotus* of the Lotophagi. This powder, in Arahic, is called Savikoon-Nebbek; iu Persian, Arud-i-Kinar; and in Hindoo, Ber-Choonee.

LOUGH DIVER, a name for *Mergus albellus*. [DUCKS.]

LOUSE. [PEDICULUS; ANOPLURA.]
LOUSE PLANT. [APHIS.]
LOUSE-WORT. [PEDICULARIS.]
LOVAGE. [HALOSCIAS.]
LOVE-APPLE. [SOLANUM.]
LOXA-BARK. [CINCHONA.]
LOXIA. [LOXIADÆ.]

LOXIADÆ, Mr. Vigors's name for a family of Birds placed by him as the extreme of the tribe of *Conirostres*, which is the third tribe of his *Insessores*, or Perching Birds, and intervenes between the Dentirostral and Scansorial tribes in his system.

Mr. Vigors remarks, that notwithstanding their inferiority of size, some species of the family may be observed to equal even the Hornbills, allowance being made for their relative proportions, in the extreme enlargement of the bill. "The curved and serrated bill of the latter family" (Hornbills), says Mr. Vigors, "perceptibly shortening itself, as we have perceived in *Momotus*, is still carried on to a corresponding group in the present, the *Phytotoma*, Gmel., where these characters are preserved, though the curve is slighter and the serration less strong. United to that genus by some intermediate but uncharacterised species, the *Coccothraustes*, Briss., conducts us to several groups, among which *Pitylus*, Cuv., *Strobilophaga*, Vieill., the true *Loxia* of authors, and *Psittirostra*, Temm., may be distinguished; whence we pass to the shorter-billed groups, among which *Colius*, Linn., and *Cissopis*, Vieill., may be particularised. These are but few of the natural genera which abound in this extensive family. Many intervening species, possessing strong genuine distinctions, may be introduced among these groups, which at length terminate in some of the shorter and stronger-billed species of the Linnean Tanagers. These, it will be remembered, commenced the present tribe (*Conirostres*) by their union with the *Fringillidæ*: and thus here also the circular succession of affinities extends uninterrupted through the whole sub-division." ('Natural Affinities that Connect the Orders and Families of Birds,' 'Linn. Trans.,' vol. xiv.)

Mr. Swainson ('Classification of Birds') appears to reject the family altogether; for we find *Phytotoma* among the *Phytotomina*, a sub-family of *Musophagidæ*; *Coccothraustes* under the sub-family *Coccothraustinæ*; *Pitylus* under the sub-family *Tanagrinæ*; *Strobilophaga* under the 'Generic names not adopted;' *Loxia* and *Psittirostra* in the sub-family *Pyrrhulinæ*; *Colius* in the sub-family *Colinæ* (family *Musophagidæ*); *Cissopus* (*Cissopis*) cancelled; and the Tanagers under the sub-family *Tanagrinæ*; the sub-families, with the exception of the two placed under the *Musophagidæ*, being arranged under the family *Fringillidæ*. Mr. Swainson's *Conirostres* (his second tribe of *Insessores*) consist of the families *Corvidæ*, *Sturnidæ*, *Fringillidæ*, *Musophagidæ*, with their sub-families, and *Buceridæ*.

The most important genus is *Loxia*, of which M. Temminck remarks that its characters exclude all other species, being proper to the Crossbills only. Illiger, he observes, in his 'Prodromus' is also of this opinion.

Loxia (Crossbill).—Bill moderate, strong, very much compressed; the two mandibles equally curved, hooked, and the elongated points crossing each other. Nostrils basal, lateral, rounded, concealed by hairs directed forwards. Feet with three toes before and one behind, anterior toes divided. Wings moderate, the first quill longest. Tail forked.

M. Temminck, who gives the above generic character, records two species, *L. Pytiopsittacus* and *L. curvirostra*, in his second edition (1820), and *L. leucoptera* in his third part of that edition (1835). The same three species, the first under the name of *L. pinetorum*, are recorded by Mr. Swainson.

The species are found in the north both of Europe and America. One species however, *L. curvirostra*, is found in Japan as well as in Europe.

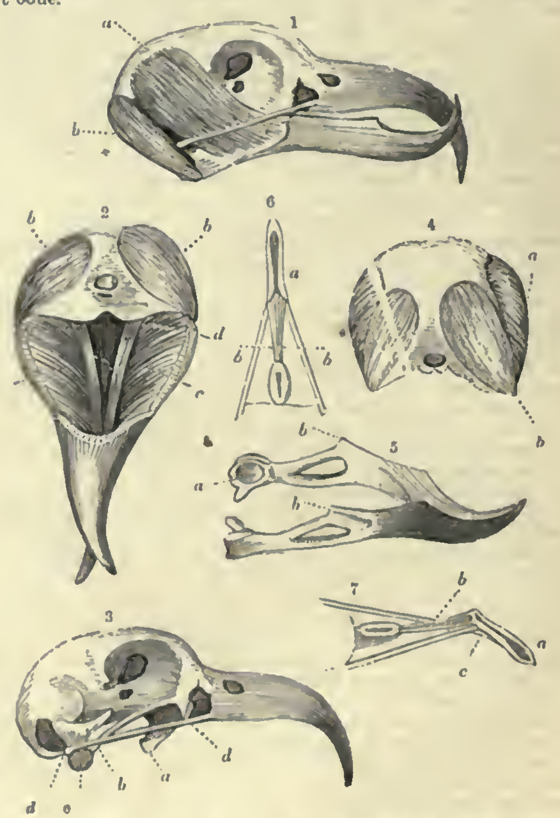
L. curvirostra, the Common Crossbill. Buffon speaks of the bill in these birds as an error and defect in nature—a deformity. If he had ever kept these birds in a cage, he would soon have found that no instrument could have been better adapted to the work required of it; and if they had ever visited his orchards he would have been convinced to his cost of its efficacy in splitting fruits for the purpose of getting at the kernels.

Mr. Yarrell has well illustrated the structure and moving power of this organ, which, conjoined with the peculiar tongue, will be found a most perfect and beautiful piece of mechanism for attaining the end in view.

"The beak of the Crossbill," (*L. curvirostra*) writes the author last mentioned, "is altogether unique in its form; the mandibles do not lie upon each other with their lateral edges in opposition, as in other birds, but curve to the right and left, and always in opposite directions to each other. In some specimens the upper mandible is turned to the right, the lower mandible curved to the left; in others, the position of the mandibles is reversed as to their direction. In the specimen I examined the upper mandible curved downwards and to the left, the under portion turned upwards and to the right. When holding the head of this bird in my fingers, I found I could bring the point of the under mandible in a line underneath and touching the point of the upper, but not beyond it towards the left side; while on its own side the point passed with ease to the distance of 3-8ths of an inch. The upper mandible has a limited degree of motion on the cranium, the superior maxillary and nasal bones being united to the frontal by flexible bony laminæ."

Head of Crossbill.

Mr. Yarrell then proceeds to the details of the anatomy, which he illustrates by the seven figures copied below. He first notices the peculiarity of the form, as well as of the magnitude of the processes of some of the bones of the head in this bird, and points out that the pterygoid processes of the palatine bones are considerably elongated downwards (*fig.* 3, *a*) to afford space for the insertion of the large pterygoid muscles. The os omoideum (*fig.* 3, *b*) is strongly articulated to the os quadratum (*fig.* 3, *c*), affording firm support to the moveable portion of the upper mandible. The jugal bone (*fig.* 3, *d d*) is united to the superior maxillary bone in front, and firmly attached by its posterior extremity to the outer side of the os quadratum. Thus, when the os quadratum is pulled upwards and forwards by its own proper muscles, the upper mandible is elevated by the forward pressure of that bone.



1. Skull of Crossbill, side view; *a*, temporal muscle; *b*, great pyramidal muscle.
2. Head viewed from below; *b*, great pyramidal muscle; *c*, *c*, pterygoid muscles; *d*, *d*, gracilis muscles.
3. Head viewed from the side; *a*, pterygoid process; *b*, os omoideum; *c*, os quadratum; *d*, *d*, os jugale.
4. Head viewed from behind; *a*, right temporal muscle; *b*, great pyramidal muscle.
5. Lower jaw, side view; *a*, cavity for articulation; *b*, *b*, coronoid processes.
6. Tongue, seen from above; *a*, horny scoop; *b*, *b*, extensor muscles.
7. Tongue, side view; *a*, horny scoop; *b*, extensor muscles; *c*, flexor muscle.
(Yarrell, 'Zool. Journ.,' vol. iv.)

In most other birds the inferior projecting process of the os quadratum, to which the lower jaw is articulated, is somewhat linear from before backwards, and compressed at the sides, permitting vertical motion only upwards and downwards; but in the Crossbill these processes are spherical (*fig.* 3, *c*), and the cavity in the lower jaw destined to receive the process is a circular cup (*fig.* 5, *a*): from the union of these two portions there results an articulation with all the motion and flexibility of the mechanical hall-and-socket joint.

The lower jaw is very strong and the sides or plates are elevated; the coronoid processes (*fig.* 5, *b*, *b*) are prominent, and to these, as well as to the whole outer side of the plates, the temporal muscle is attached. In a head of this hird which had heen divested of all the soft parts, Mr. Yarrell found that, on slidiug the lower jaw laterally upon the other, as performed hy the hird, hefore the coronoid process is hrought into contact with the pterygoid process on its own side, the extreme points of the mandihles were separated laterally to the extent above mentioned (3-8ths of an inch).

The right side of the head was that to which the lower jaw inclined in the specimen examined hy Mr. Yarrell, and on that side the temporal and pyramidal muscles were considerahly larger than those on the left (*figs.* 1, 2, 4, *a*, *b*), indicating hy their hulk the great lateral power which the hird is capahle of exerting. The pterygoid muscles (*fig.* 2, *c*, *c*), on each side were unusually large, the great distance to which the articulated extremities of the lower jaw were removed affording ample space for them, and as the food of the hird consists of small seeds, a narrow pharynx is sufficient for the purposes of deglutiton. For depressing the lower mandible three muscles are called into action; hut only one of these, the great pyramidal (*figs.* 1, 2, 4, *b*), which covers two other small ones, the triangular and square muscles, is visihle. All three have their origin on the occipital portion of the cranium, aud are inserted hy strong tendons on the under and hack part of each extremity of the lower jaw, hehind the centre of motion; they consequently, hy their simultaneous contraction, raise the point to which they are attached, and depress the anterior part of the mandihle. The lower parts of the ossa quadrata are pushed rather forwards hy this compression, with the help of two small muscles (not figured), hut whose situation may he explained hy a reference to *fig.* 3. One of these, a small flat muscle, arises from the septum of the orhits hehind the small aperture in the septum, aud passes downwards for insertion upon the projecting styloid process of the os quadratum; the second is a small pyramidal muscle, arising also from the septum, anterior to the other muscle; and passing downwards and hackwards, is inserted upon the os omoideum: hoth these, when they contract, pull the os quadratum forwards, aud so elevate the other mandible. Thus the depressors of the lower jaw, and the elevators of the upper jaw, act together to separate the mandibles. To close them, the temporal and pterygoid muscles elevate the lower jaw, assisted hy the slender slips (*fig.* 2, *d*, *d*), which, extending forwards to the superior maxillary bones, act in concert hy hringing them down. To work the lateral motion, the great pyramidal muscle on the right side pulls the extremity of the lower jaw, to which it is attached, hackwards, the pterygoid muscles of the left side at the same time powerfully assisting hy carrying that side of the lower jaw inwards.

Mr. Yarrell then quotes Mr. Townson, to show the adaptation of these parts to the wants of the hird in feeding. "The great piue-forests, such as the Hartz in Germany," says Mr. Townson, "are the natural places of residence of the crossheaks, and the seed of the cones of these trees their food; and it is to pull out the seeds from hetween the squamæ, or scales of the cones, that this structure is given them. Their mode of operation is thus:—they first fix themselves across the cone, then hring the points of the maxillæ, from their crossed or lateral position, to he immediately over each other. In this reduced compass they insinuate their beaks hetween the scales, aud then opening them, not in the usual manner, hut hy drawing the inferior maxilla sideways, force open the scales or squamæ." It is at this stage of the proceeding, ohserves Mr. Yarrell, that the aid of the tongue hecomes necessary; and here again we have another instance of heautiful adaptatiou. There is articulated to the anterior extremity of the os hyoides, or hone of the tongue, an additional portion, formed partly of hone, with a horny covering (*figs.* 6, 7, *a*). This is narrow, and ahout 3-8ths of an inch in length, extending forwards and downwards, with the sides curved upwards, and the distal extremity shaped like a scoop somewhat pointed and thin on hoth edges, the proximal extremity ending in two small processes elongated upwards and hackwards above the articulation with the hone of the tongue, each process having inserted upon it a slender muscle (*figs.* 6, 7, *b*) exteuding hackwards to the glottis and attached to the os hyoides; and these muscles, hy their contraction, extend and raise the scoop-like point. "Underneath the articulation of this horny grooved appendage," continues Mr. Yarrell, "is another small muscle (*fig.* 7, *c*), which is attached at one extremity to the os hyoides, at the other to the moveahle piece, and hy its action, as an antagonist to the upper muscles, hends the point downwards and hackwards; whilst therefore the points of the beak press the shell from the hody of the cone, the tongue, hrought forward hy its own muscle (genio-hyoideus) is enabled, hy the additional muscles described, to direct and insert its cutting scoop heneath the seed, and the food thus dislodged is transferred to the mouth: it will he seen hy a reference to the first figure, that when the mandibles are separated laterally in this operation, the hird has an uninterrupted view of the seed in the cavity, with the eye on that side to which the under mandihle is curved." So much for Buffon's "error aud defect of nature, aud deformity."

Loxia curvirostra has the following characters:—

Adult and Old Male.—Principal colours of the plumage ash strongly tinged with greenish; front, cheeks, and eyehrows gray, with yellowish and whitish spots; hack, small coverts of the wings, and scapulars greenish; rump yellow; lower parts yellowish-green; abdomen gray, with deeper spots; wing- and tail-feathers hlackish, hordered with greenish; great and lesser coverts hordered with yellowish-white; iris and feet hrown; hill horn-colour. Length, about 6 inches.

Male from its first Moult to the Age of One Year.—All the upper and lower parts of the hody hrick-red, more or less tinged with greenish and yellowish; wing and tail-feathers hlack, hordered with reddish-green; lower ooverts of the tail white, with a great brown spot in the centre.

Young of the Year.—Upper parts gray-hrown, clouded with greeuish; rump yellowish; lower parts whitish, with longitudinal hrown aud hlack spots.

Female.—In all ages differing hut little from the young; the plumage is clouded with greenish and yellowish tints. Neither in this species nor in *L. Pytiopsittacus* does the female ever assume the red livery, which is only peculiar to the male after its first moult up to the age of oue year.

Loxia curvirostra (male). Upper figure, young of the year; lower, adult.

Such is M. Temminck's description in the second editiou of his 'Manuel' (1820); hut in the third part (1835) he states that the principal tints under which the male presents itself are more or less of a brick- or vermilion-red, the middle of the helly heing whitish. The males of a year old are of a tarnished-red, of a yellowish-red, of a greenish-yellow, or tarnished-yellow clouded with reddish. The old females have the upper part of the hody deep gray, the rump of a yellowish-green, the lower part of the hody of a hright-gray clouded with greenish. M. Temminck adds that he has seen males with the summit of the head, helly, aud rump of a heautiful yellow, with a large hrown hand hehind the eyes, and the rest of the plumage like the old female. M. Temminck says (in the same part) of the genus generally, that the red or reddish livery of the males is not, as had heen erroueously helieved, peculiar to a limited period of life, hut is the perfect state of plumage in the male sex: after quoting M. Brehm's proofs of the nidification, M. Temminck goes on to state that the old males have a red plumage; the young a reddish plumage, reddish-yellow, or yellowish; the females a yellowish-green, and the young a gray or grayish plumage.

Mr. Gould ('Birds of Europe') ohserves that in the minds of many naturalists some douhts still exist, and that they existed till lately iu his own, as to whether the rich rosy-red colouriug assumed hy this hird is characteristic of the hreeding season, or the permanent livery of the adult male. He states that during his recent visit to Vienna he had an opportunity of ohserving both sexes in every stage, an examination of which afforded him ahundant proofs that the red plumage is acquired during the first autumn, for he saw many lately fledged that had their plumage thickly spotted; others that had partially lost their spotted appearance, and had partly assumed the red colouring; and others that had their feathers entirely tinted of this colour; while the adults, as most ornithologists have stated, were characterised hy a plumage of olive-green, which appears to he permanent.

This bird is *Loxia curvirostra* of Linnæus; Becco in Croce, Crocione, and Crosiero, of the Italians; Bec Croisé and Bec Croisé Commun of the French; Fichten Kreuzschnabel, or Kreutzschnabel, and Mittlerer Gebirgs-und-Fichten-Kreutzschnabel, of the Germans; Kruisvink of the Netherlanders; Mindre Korsnabb of the Scandinavians; Crossbill, Common Crossbill, or Shell-Apple, of the English; and Gylfingroes of the Welsh.

Willughby, who notices its change of colour, says that it is a most voracious bird; much delighted and feeding very fat with hemp-seed. "It also," he adds, "loves fir-kernels. . . . They say that with one stroke of its bill it will in a trice divide an apple in halves, that it may feed upon the kernels, by that means doing a great deal of mischief in orchards." Mr. Townson, who kept some, states that the degree of the lateral power of these birds is surprising; that they are fond of exercising it for mere amusement; and are therefore not a little mischievous. "My pets," says the last-mentioned author, "would often come to my table whilst I was writing, and carry off my pencils, little chip-boxes in which I occasionally kept insects, and other similar objects, and tear them to pieces in a minute. Their mode of operation is by first pecking a little hole; in this they insert their bill, and then split or tear the object by the lateral force. When I treated them, as I often did, with almonds in their shells, they got at the kernel in the same manner; first pecking a hole in the shell, and then enlarging it by wrenching off pieces by the lateral power." Mr. Yarrell—who, in his paper in the 'Zoological Journal,' from which we have taken the organisation of the bill, observes that, notwithstanding Buffon's assertion to the contrary, they can pick up and eat the smallest seeds, and shell or husk hemp and similar seeds—gives the following interesting account of the habits of a pair in captivity. We must premise that Willughby also remarked that when kept in cages they climb up and down the sides with their bills and feet, after the manner of parrots. "My friend Mr. Morgan," says Mr. Yarrell, "kept a pair of these birds for some time, and had opportunities for observing their curious habits. They were impatient under confinement, and restless, climbing over the wires of their cage, by the use of their beak and claws, like parrots. One of their principal occupations was twisting out the ends of the wires of their prison, which they accomplished with equal ease and dexterity. A short flat-headed nail that confined some strong net-work was a favourite object on which they tried their strength; and the male, who was usually pioneer in every new exploit, succeeded by long-continued efforts in drawing the nail out of the wood, though not without breaking off the point of his beak in the experiment. Their unceasing destruction of cages at length brought upon them sentence of banishment. During the period of their captivity a complete change took place in the colour of their plumage, without the shedding of a single feather."

The nest is generally placed in the fork of a lofty branch in fir and other trees; it is built of moss, lichens, and other such materials, and lined with feathers. Eggs four or five, grayish or dirty white, with irregular bright blood-red patches at the larger end, and smaller specks dispersed over the remaining portions. Temminck says that in Livonia it builds in the month of May, but the general period of nidification mentioned by authors is during the winter or very early in spring. Whilst they are at work on the fir-cones their note is a gentle twitter, and they may be seen climbing about the branches like parrots; but they are said besides to have a pleasant song, which is only poured forth in the winter months, or at the season of incubation.

M. Brehm declares that the nidification and laying of eggs takes place in all seasons, and he attributes this peculiarity to the comparative abundance or scarcity of food. It appears to be certain that Crossbills make their nests in December, as well as in March, April, and May.

Localities.—Germany, Poland, Sweden, &c., America (?), and Japan, in which last locality it is called Isuga. Prince C. L. Bonaparte notes it as very rare and accidental in Italy, appearing only in the coldest winters near Rome; but as not rare in Philadelphia in the winter. It can only be considered as an occasional visitant to the British Islands. Willughby says, "Sometimes they come over to us, and in the western part of England, especially Worcestershire, make bad work, spoiling a great deal of fruit in our orchards." About the commencement of the present century a large flight came to the south of Ireland in the autumn, and did much damage to the apples, &c.; numbers of these birds were taken and kept in cages at that time. Mr. Selby notices the immense flocks that visited England and Scotland in 1821. They spread themselves through the country, and were to be seen in all woods and plantations where the fir-tree abounded. Their first appearance was in the early part of June, and the greater part of the flocks seemed to consists of females and the young of the year (the males possessing the red plumage assumed from the first moult to the end of that year). Many of the females killed by Mr. Selby showed plainly, from the denuded state of their breasts, that they had been engaged in incubation some time previous to their arrival; which circumstance, he observes, agrees with the account given of the early period at which they breed in higher latitudes. They continued in Britain till towards the autumn, but kept moving northward, for Mr. Selby found them in September particularly abundant in all the fir-tracts of Scotland after they had nearly disappeared south of the Tweed. Since that time (he writes in 1825) none had come under his observation. He alludes to the great havoc they commit in the apple and pear orchards in their occasional visits to the south, by splitting the fruit in halves for the sake of the inclosed pips. Mr. Hoy, of Stoke by Nayland, in Suffolk, who gives an interesting account of the habits of these birds, says that from 1821 to the middle of May, 1822, Crossbills were very numerous in that county, and, he believes, extended their flights into many parts of England. (Loudon, 'Magazine of Nat. Hist.,' January, 1834.) Mr. Knapp notices its occasional visits in small parties, and the damage it does to the orchard. He says that a pair was brought to him very early in August, and the breasts of the female being nearly bare of feathers, as is observed in sitting birds, he thinks it is probable that she had a nest in the neighbourhood. There are a few instances recorded of its breeding here.

The flesh of the Common Crossbill is well flavoured. Mr. Gould saw in the bird-market of Vienna multitudes of Crossbills exposed for sale with swallows, martins, and many others of the smaller birds, for the purposes of the table; of these the Crossbill appeared to be especially in request from its superiority of size and its sweet and well-tasted flesh, to the good qualities of which Mr. Gould bears testimony. The same author notices it as seeming to be of all the small birds the least distrustful of man, and states that when flocks arrive in this country numbers are taken by a bird-limed twig attached to the end of a fishing-rod.

LOXOCLASE, a Mineral belonging to the anhydrous silicates of Alumina. It has nearly the form of Felspar, but is distinguished by a cleavage parallel with the longer diagonal. It contains 8 per cent. of soda and 3 per cent. of potash. It is found at Hammond in the state of New York, in company with Pyroxene, Graphite, and Calcspar.

LOXONE'MA (Phillips), a group of spiral *Gasteropoda*. The species occur in Silurian, Devonian, and Carboniferous strata. (*Palæozoic Fossils of Devonshire.*)

LOYDIA, or LLOYDIA, a genus of Plants belonging to the natural order *Liliaceæ*. The perianth is persistent and patent; stamens inserted at the base of the perianth; anthers erect; style filiform; stigma trigonous; seeds angular above, flat beneath.

L. serotina is native of Welsh mountains. It is a rare plant, but is found on Mount Snowdon. The root-leaves are semicylindrical; stem-leaves dilated below and sheathing; flowers mostly solitary, nectary a transverse plait. The height of the plant is 5 or 6 inches. Stem and leaves springing separately from the root; stem-leaves several, short; flowers white, with reddish lines internally.

(Babington, *Manual of British Botany.*)

LUCA'NIDÆ, the family of Stag-Beetles, a name popularly applied to these insects on account of the very large and powerful mandibles with which the males are furnished. These in the genera *Chiasognathus* and *Pholidotus* equal the entire length of the body, and in the *Lucanus cervus* of our own country are very formidable instruments of offence. They live during the day in the trunks of trees and old wood, and take flight at dusk. The females are sluggish, and not so numerous as the males, which fight with great ferocity among themselves for possession of their mates. The larva, which is supposed to have been the animal called *Cossus* by the Romans, and esteemed by them as a delicacy, lives in the willow and the oak, and remains untransformed for several years. When full grown it forms a cocoon of the dust of wood which it has ground down by its powerful jaws, and after remaining some time as a pupa it undergoes its final transformation to pass a very brief portion of its life as a perfect insect. Some of the foreign genera of Stag-Beetles are remarkable for their brilliant colouring. In Britain we have four species, which belong to as many genera. (Westwood, *Introduction to the Modern Classification of Insects.*)

LUCE. [Esocidæ.]

LUCERN. [Medicago.]

LUCERNARIADÆ, a family of Helianthoid *Anthozoa*, including the single genus *Lucernaria*, which is characterised amongst all other Polyps by its species having the tentacles arranged in little tufts. The body is somewhat campanulate, and fixed when at rest by a narrow disc or stalk; the mouth is quadrangular, in the centre of an umbellar expansion; the tufts of tentacula are arranged around the expanded margin of the mouth.

Three species are described by Dr. Johnston as inhabiting the British coasts.

L. fascicularis has the peduncle of the body produced; tufts of tentacula in pairs, about a hundred in each. Professor E. Forbes says it is common in Zetland, and has been found on various parts of the British coast. When irritated in the dark it gives out brilliant flashes of bluish phosphorescent light.

L. auricula has a campanulate disc, with eight tufts of tentacula with intermediate tubercles.

L. campanulata has a sub-sessile campanulate body, eight tufts of tentacles, without intermediate tubercles. It inhabits sea-weed at low-water mark. It has been taken at Torbay, Berwick, the Isle of Wight, and other parts of the English coast.

Dr. Johnston gives the following account of this species:—

"It is about an inch in height, of a uniform liver-brown colour smooth, adhering by a circular disc, above which there is a deep stricture, or short peduncle; the disc even, strengthened by an interior cartilaginous lamina, which rises up the short peduncle, and forms a minute hollow firm centre. The margin of the oral expansion is somewhat thickened, and divided into eight equal arms, each furnished with a tuft of numerous short tentacula tipped with a gland, and brighter-coloured than the body. The interior is hollowed like the blossom of a flower, the square extensible mouth projecting in the centre; and in the space between the arms there is a complicated structure composed apparently of two series of foliaceous processes, arranged on each side of a white line, that seems to spring from the sides of the mouth.

"These processes are formed by the complicated foldings of a thin membrane attached by one side in the manner of a mesentery; there are no vessels in the membrane, but some portions of it exhibit when magnified a kind of net-work of irregular cells, and the outer and free edge is bounded by a thread-like line. The white central line which divides them is formed of small roundish bodies arranged in two or three close series, and some of these ova can at times be traced along the margin of the circumference to the tentacula.

"The latter are cylindrical, and terminated with a globular head, which is seemingly imperforate. The stomach is a loose thin plaited extensible bag, having attached to its inner surface numerous filiform cæca, that, after their removal from the body, retain their irritability for a long time, and writhe themselves like a lot of worms."

Dr. Coldstream says of it :—"I find the animal very hardy; it is constantly in a state of expansion, and does not contract except when very rudely handled. One specimen has lived with me for three weeks, although the water has not been very often changed. When I first procured it, the two rows of spots running from the mouth along each arm were prominent, and of a dark reddish-brown colour. Since that time they have increased in size, and have become studded with numerous white oval bodies which I suppose to be ova. I see some of these have made their way into the web connecting the arms, but I have not observed any expelled from the body."

In his 'History of British Zoophytes,' Dr. Johnston makes the following observations on the general structure and habits of these curious animals :—

"The *Lucernariæ* are of a gelatinous consistence. The skin, or corium, is smooth and thickish. After covering and giving form to the body it is reflected over the oral disc, and incloses within the duplicature formed by this reflection the internal viscera. The body is more or less distinctly campanulate, and is prolonged inferiorly into a pedicle, very variable in length, which has its bottom conformed into a sucker. From this point four ligaments, probably of a muscular nature, rise up within the peduncle, dividing at the expansion of the body into eight distinct fasciculi, one proceeding to each arm. These fasciculi are composed of long parallel fibres, are analogous to the lamellæ of the *Actiniæ*, and like them divide the body into eight equal compartments, for the inner fold of the corium is intimately connected with them on both sides. The vermiform cæca lie in these compartments, and the ova appear also to be generated in them, but whether they have an appropriate ovary is doubtful.

"A specimen which had undergone a certain degree of putrefaction and dissolution exhibited these ova forming a complete circle round the mouth, with rows running up the arms to the base of the tentacula. The ova were proportionably large, roundish, or oval, and irregularly grouped. The change produced in the appearance of the tentacula was considerable, for the globular apex had disappeared, and all had assumed a linear or conical figure, the centre filled with an opaque granular matter forming a dark speck at the apex, and covered with a clear mucous skin. The vesicle presented precisely the same structure, but no aperture was visible in either part.

"The *Lucernariæ* can swim with some rapidity in the water by alternate dilatations and contractions of the body, but they are usually found adherent to sea-weeds, the first species in a dependent position, the two latter invariably erect, so that Lamarck is in error when he describes the mouth as being inferior. When in a state of expansion few marine worms exceed them in beauty and singularity of form; when contracted they are shapeless, and easily overlooked. They feed on small crustaceous animals brought within reach by the tide, and to arrest them more certainly the tentacula are widely displayed; but no sooner have they felt the prey than they instantly contract, envelope it in their joint, embrace, and carry it to the mouth by an involution of the whole marginal circumference. I have found that the glands with which the tentacula are tipped perform the office of suckers, as Lamarck conjectured, and thus retain their captives with greater certainty."

Mr R. Q. Couch says, "Their mode of progression differs under different circumstances. If intending to move to any great distance, they do so by loosening their attachments, and then by various and active contortions they waft themselves away, till they meet with an obstruction where they rest; and if the situation suits them, they fix themselves—if not, they move on in the same manner to some other spot. If the change be only for a short distance, as from one part of the leaf to the other, they bend their campanulate rims, and bring the tentacula in contact with the fucus, and by them adhere to it. The foot-stalk is then loosened and thrown forward, and twirled about till it meets with a place to suit it; it is then fixed and the tentacula are loosened, and in this way they move from one spot to another. Sometimes they move like the *Actiniæ*, by a gliding motion of the stalk. In taking their prey they remain fixed with their tentacula expanded, and if any minute substance comes in contact with any of the tufts, that tuft contracts, and is turned to the mouth, while the others remain expanded watching for prey."

LUCINA. [LUCINIDÆ.]

LUCINIDÆ, a family of Conchiferous *Mollusca*. The species have a free-closed orbicular shell; hinge-teeth 1 or 2, laterals 1-1, or obsolete; interior dull, obliquely furrowed; pallial line simple; muscular impressions 2, elongated, rugose; ligament inconspicuous, or sub-internal. The animal has mantle-lobes open below, with one or two siphonal orifices behind; the foot elongated, cylindrical, or strap-shaped, protruded at the base of the shell; gills one (or two) on each side, large and thick, oval; mouth and palpi usually minute.

The animals belonging to this family are distributed chiefly in tropical and temperate seas. They live in sand or mud, and are found from the shallowest parts of the sea to the lowest depths at which life can inhabit its abysses. Woodward, in his treatise on 'Shells,' includes the following genera in this family:—*Lucina*, *Corbis*, *Tancredia*, *Diplodonta*, *Ungulina*, *Kellia*, *Montacuta*, *Lepton*, and *Galeonura*. The four last genera are referred by some authors to the family *Kelliadæ* (Forbes and Hanley). [KELLIADÆ.]

Lucina has the following characters :—

Shell suborbicular, inequilateral, with small pointed oblique umbones. Two divergent cardinal teeth, one bifid, and which are variable or disappear with age. Two lateral teeth; the posterior one more approximated to the cardinal teeth. Two very separate muscular impressions, the posterior of which forms a facial prolongation, which is sometimes very long.

M. Deshayes observes, that the genus *Lucina*, as Lamarck and Bruguières perceived, is very natural; the shells have a particular contour (facies); they are obicular, the interior surface of the valves is punctuated or striated, sometimes deeply; the pallial impression is always simple, which is an essential character of the genus, as well as the form and position of the muscular impressions. When the genus is studied by means of a great number of species, one soon perceives that the hinge varies much, and that the characters afforded by this part in other groups are here but of small value. Some species have the hinge toothless, others have one or two cardinal teeth, at first obsolete or rudimentary, afterwards larger and more constant. To these cardinal teeth are added, according to the species, the anterior or posterior lateral tooth; and the hinge is not complete, that is to say, is not provided with cardinal and lateral teeth, except in a small number of species. Notwithstanding these continual variations of the hinge, one may perceive that the 86 species, both recent and fossil, actually known, bear so natural a relation to each other, that they could not be better placed elsewhere, neither could they constitute other genera. Some zoologists, after the example of Cuvier, retain the genera *Lucina* of Bruguières and *Loripes* of Poli. But M. Deshayes observes, that though the animals of the principal *Lucinæ* are not known, one may conclude by analogy and from the resemblance of the shells, that the identity of the two genera cannot be well contested. He therefore thinks that, as it is not convenient to retain both genera, and as that of Bruguières is best known and as old as Poli's, Bruguières's name should be preferred.

Linnæus placed the greater part of the *Lucinæ* among his *Veneres*. In separating these genera, Bruguières, Lamarck, and the other conchologists left among the *Veneres* some shells which have all the characters of the *Lucinæ*.

The number of species recorded by M. Deshayes in his 'Tables' is 20 recent and 59 fossil (tertiary): of these *L. tigrina*, *L. punctata*, *L. columbella*, *L. divaricata*, *L. lactea*, *L. gibbosula*, *L. squamosa*, *L. radula*, and *L. amphidesmoïdes* are noticed as recent and fossil (tertiary).

Mr. Lea adds six species from the tertiary of Alabama.

In a recent state *Lucina* has been found at depths varying from 5 to 11 fathoms in sandy-mud and mud. Species occur principally in the seas of warm climates.

Woodward gives 70 recent species and 200 fossil, and the locality the Upper Silurian Rocks.

The following species are British: *L. borealis*, *L. spinifera*, *L. divaricata*, *L. flexuosa*, *L. leucoma*, *L. ferruginosa*.

Corbis has an oval ventricose subequilateral shell, with concentrically sculptured margins, denticulated within; hinge-teeth 2, laterals 2, in each valve; pallial line single, umbonal area with an oblique furrow; muscular impressions round and polished; pedal scars close to adductors. The animal has the mantle open below, doubly fringed; foot long, pointed; siphonal opening single, with a long retractile tubular valve; lips narrow; palpi rudimentary; gills single on each side, thick, quadrangular, plaited, united behind. There are two recent species inhabiting the seas of China, India, Australia, and the Pacific. There are 80 fossil species chiefly in the Lias.

Diplodonta has a smooth suborbicular shell; a double rather long submarginal ligament; hinge-teeth 2—2, of which the anterior in the left valve and posterior in the right are bifid; muscular impressions polished, anterior elongated. The animal has the mantle margins nearly plain, united; pedal opening large, ventral; foot pointed, hollow; palpi large, free; gills 2 on each side, distinct, the outer oval, inner broadest in front, united behind; branchial orifice small, simple; anal larger, with a plain valve. *D. rotundata* is found in the British seas. There are 12 recent species found in the West Indies, the Mediterranean, Red Sea, India, Australia, and America. Fossil species have also been found in the tertiaries.

(Forbes and Hanley, *History of British Mollusca;* Woodward, *Rudimentary Treatise on Recent and Fossil Shells.*)

LUCU'LIA, a genus of Plants belonging to the natural order *Cinchonaceæ*, tribe *Cinchoneæ*, and sub-tribe *Eucinchoneæ;* thus indicating the close affinity of this genus to that of the trees yielding Peruvian Bark, or true Cinchonas, in which indeed the only known species, *L. gratissima*, was placed by Dr. Wallich and figured in his 'Tent. Fl. Nepal,' t. 21.

It is found in great abundance on Nag-Urjoon and some of the other smaller hills in the valley of Nepaul; also at Bechiaco and Koolakan. It delights in exposed rather naked situations, blossoming, according to the situations where it is found, nearly the whole year round. It is also found on the Pandooa Hills in Silhet, flowering in the month of September. As seen by Dr. Wallich it attains a height of 16 feet, but he was informed of its growing to a larger size. It has been introduced into and has flowered in this country; but from the nature of the climate where it is indigenous, it is only suited to the greenhouses of England. Its locality and affinity are interesting, particularly when coupled with the prevalence in the same mountains of two other genera, *Hymenodictyon* and *Hymenopogon*, belonging to the same sub-tribe *Eucinchoneæ*, and therefore equally allied to the true Cinchonas; all indicating the part of the Indian territory where these valuable plants might most certainly be grown, and yield a profitable article of commerce. "It is impossible to conceive anything more beautiful than this tree when covered with its numerous rounded panicles of pink-coloured very fragrant large blossoms." (Wallich, l. c., p. 30.)

LU'CUMA (a native name for one of the species), a genus of Plants belonging to the natural order *Sapotaceæ*. It has a 5-parted calyx; a 5-cleft corolla; 10 stamens, 5 of which are sterile and 5 fertile, alternating with each other; an ovarium 5-10-celled; the fruit 1-10-seeded; nuts or seeds bony, marked by a large umbilical areola without albumen. The species are trees, yielding a milky juice, with scattered entire coriaceous leaves, and 1-flowered axillary or lateral peduncles.

L. Mammosa, the Common or Mammee Sapota, has obovate-lanceolate oblong-cuspidate glabrous leaves, with solitary flowers. This plant grows from 50 to 100 feet in height. It is a native of the tropical parts of South America, and of many of the West India Islands, where it is also cultivated. The fruit of this tree is eaten in the West Indies. It is of a large size, oval-shaped, and covered with a brownish rough skin, under which is a soft pulp of a russet colour, very luscious, and which, on account of its flavour, is called Natural Marmalade. P. Browne calls a variety of this tree Bully-Tree, because it grows the tallest of all the trees in the woods of Jamaica.

Several other species of this genus have been described. They are all natives of various districts of South America, and yield edible fruits similar to the preceding species. They were at one time referred to the genus *Achras*, the species of which also yield edible fruits. [ACHRAS.]

(Don, *Dichlamydeous Plants.*)

LUDLOW ROCKS. The upper part of the Silurian System of Sir Roderick Murchison is thus designated. They include the three following terms:—

Upper Ludlow Rock, a thick mass of laminated arenaceous deposits, seldom acquiring considerable hardness, and suggesting the notion of having been deposited as a muddy sediment; from which circumstance it has also been called Mudstone by Sir R. Murchison. It is very rich in fossils.

Aymestry Limestone, a concretionary and polypiferous limestone, of local occurrence and small thickness, merely separating the other terms. Many fossils.

Lower Ludlow Rock, chiefly an argillaceous, shaly, and flaggy deposit, with a few calcareous nodules, yielding shells.

The Limestone of Wenlock and Dudley lies below. [SILURIAN SYSTEM.]

LUFFA, a genus of Plants belonging to the natural order *Cucurbitaceæ*. The male flowers are panicled and yellow; the tube of the calyx hemispherical, segments longer than the tube; petals distinct, dropping off by the base; stamens 5, distinct; anthers very wavy. The female flowers are solitary; the tube of the calyx oblong, clavate, segments shorter than the tube; stamens abortive; stigmas reniform; gourd ovate, 3-celled, fibrous, internally operculate.

L. amara is found in hedges and dry uncultivated places in the East Indies. It has several stems, slender, running to a great extent, but with few branches, pretty smooth, 5-sided; tendrils 3-cleft; leaves slightly 5 7-lobed, rough; stipules axillary, solitary, cordate, with glandular marks on one side. Male flowers pretty large, yellow, on long erect axillary racemes; the pedicels with a glandular bract near the base, and articulated a little above it. Female flowers rather larger, axillary, solitary, pedunculated; fruit oblong, 3 or 4 inches long, and 1 inch in diameter, tapering equally towards each end, 10-angled; when ripe dry, gray, and filled with dry fibres; the operculum deciduous; seeds blackish-gray, with elevated minute black dots; every part is extremely bitter. The fruit is violently cathartic and emetic; the juice of the roasted young fruit is applied to the temples to cure headache by the natives of India; the ripe seeds are used either in infusion or substance by them to vomit and purge.

L. Bindaal is a native of Hindustan. It is a climbing diœcious plant; the leaves are toothed and 5-angled. Male flowers in racemes. Female flowers solitary; fruit round, echinate, with long, straight, ciliate bristles. It it considered in northern India a powerful drastic in cases of dropsy. The leaves of *L. acutangula* are a favourite potherb of the natives of India, and are esteemed very wholesome.

LUG-WORM. [ARENICOLA.]

LUIDIA. [ECHINODERMATA.]

LUMACHELLE. [MARBLE.]

LUMBRICARIA, a genus of fossil *Annelida*, from the Silurian Strata of Tyrone. (Portlock.)

LUMBRICUS. [ANNELIDA.]

LUMINOSITY OF ORGANIC BEINGS. Organic bodies under certain circumstances become luminous, and upon the supposition that this appearance depends on the combustion of phosphorus at a low temperature, the phenomenon has been called phosphorescence. This luminosity is very constantly developed under the same circumstances in both animals and plants. It is observed both during the decomposition of the bodies of plants and animals as well as whilst they are still living. The oldest observations on this subject were made on the wood of trees whilst in a state of decay. This however takes place only under peculiar circumstances. It generally occurs when the wood of trees is buried in the earth whilst they are in a green state, and does not take place when wood is allowed to decompose in the usual way and in free contact with the air. It is also found that the phosphorescence does not take place when the wood is allowed to decompose in a damp place. Wood exhibiting this property will retain it for a long period when kept in a dry place. Albrecht observed luminosity in a tree during the night at a spot where one of its branches had been torn off. Decaying fungi have been often observed to emit this light. Travellers in tropical climates have observed that when plants containing a milky juice are wounded, the juice frequently becomes luminous, whilst it is descending the sides of the tree. The cause of this phenomenon in decaying plants is probably owing to a slow decomposition of the tissues attended with a union of oxygen gas, but what determines the development of light under these more than other circumstances is still unknown.

In living plants luminosity has been frequently observed. It is most constant amongst some forms of fungi, especially of the genus *Rhizomorpha*. In the coal-mines in the vicinity of Dresden the species of *Rhizomorphæ* are so numerous as to "dazzle the eye by the brilliant light they afford." [BYSSACEÆ.] The light from decaying wood, as also from the living *Rhizomorphæ*, continues although they are immersed in irrespirable gases, linseed oil, phosphoric acid gas, oxygen, &c. The phenomenon in both the living and the dead plants is probably due to the same cause.

Another class of plants in which light has been observed is the Mosses. Several species of the genus *Schistostega*, which grow in caverns and other damp places, have been observed to give out light. Mr. Babington and other botanists have observed it in this country in the *S. pennata;* whilst Funk, Brandenburg, Nees von Esenbeck, Hornschuche, Struve, Unger, Bridel-Briderei, and Agardh, have observed it on the continent of Europe. The two latter attributed this light to a small alga, which Bridel-Briderei called *Catoptridium smaragdinum*, and Agardh called *Protococcus smaragdinus*, which they supposed was parasitic on the moss. Unger however has examined the moss accurately, and finds that at certain seasons the utricles of this moss assume a globular form, and being partly transparent, the light is refracted and reflected in such a way as to present a luminosity on the surface of the vesicles.

Another class of these phenomena is that which is exhibited by the flowers of some plants. The first observation on this subject was recorded by Linnæus, and made by his daughter Christina Linnè. She was walking in the garden one hot summer's evening, when she observed the flowers of *Tropæolum majus* to give forth a stream of light. This was attributed by many to an optical illusion, but the fact has since been repeatedly observed on this as well as other plants. We are not perhaps in a position to say this was not an optical illusion; but if it was, one would expect that it should be more constant. It has also been seen by several observers at the same time in different positions, and when one has seen it, the others have seen it also. A correspondent of the 'Gardener's Chronicle,' Oct., 1843, says, "I have frequently observed the luminous appearance of garden plants, and have looked for it in each succeeding summer on the double marygold, and more especially on the *Papaver pilosum*, the hairy red poppy, in my garden at Worcestershire. In the evening after a hot dry day, the flashes of light have afforded much amusement to myself and others." It is to this phenomenon that Coleridge alludes in the following lines:—

"'Tis said on summer's evening hour
Flashes the golden-colour'd flower
A fair electric flame."

Decaying animal bodies frequently emit a luminous appearance, which has generally been attributed to the presence of phosphate of lime in their skeletons, which become decomposed and yield phosphorus when exposed to the action of organic compounds in a state of decomposition. It is to this cause that the luminosity of putrefying fish is attributed. But the emission of light is a very constant phenomenon of many of the invertebrate animals under peculiar circumstances. Thus during warm weather, when a vessel passes through the ocean, the waves frequently exhibit a diffused lustre with here and there streaks and stars of a brighter light. This occurs in our own climate, but the phosphorescence is much more brilliant in tropical seas. Pöppig, in his 'Reise in Chili, Peru, und auf dem Amazonstrome,' describes this phenomenon in an equatorial sea. "Whilst one side of the vessel is still illuminated by the last fading rays of the evening sun, and the opposite side darkened by the shade of the sails, the sea in this direction already becomes brilliant. One spot after another begins to be illuminated, indistinct stripes of light commence glimmering from greater depths, till at last, with the approach of night, a new creation seems to be called into existence. These illuminated beings move in various directions, sometimes appearing like sparks, sometimes like a radiating ball of fire, at others darting through the dark surface of the water like a rapid flash of lightning. A great number of these beings are undoubtedly true night animals which conceal themselves during daylight in the dark depths of the ocean."

These lights in the sea are principally produced by various species of the family *Acalephæ*, or Jelly-Fishes. [ACALEPHÆ.] The light emitted by these animals seems to be due to the secretions on the surface of their bodies, for when this secretion is removed it retains for some hours its luminous character, and will even impart it to milk or water. But this property is not confined to the *Acalephæ*; many species of *Polypifera*, some of the *Echinodermata*, and the lower forms of *Mollusca* also exhibit this appearance. Some few of the *Crustacea* and even Fishes have been observed to possess the same property.

Amongst insects this phenomenon is not uncommon. Those which possess the greatest luminous power belong to the *Coleoptera*, the Beetle-Tribe, and of these the two families represented by the Fire-Fly—the *Elateridæ*, and the Glow-Worm—the *Lampyridæ*, are the most distinguished. [ELATERIDÆ; LAMPYRIDÆ.] Some of the species of the tribes of *Myriapoda* and *Annelida* give out light occasionally, as the Centipede and the common Earth-Worm.

(Meyen, *Pflanzen-Physiologie*, Band ii.; Carpenter, *Animal Physiology;* Lankester, in *Gardener's Chronicle*, 1843).

LUMME, a name for the bird called the Speckled Diver, or Speckled Loon (*Colymbus Arcticus*, Linn.). [COLYMBIDÆ.]

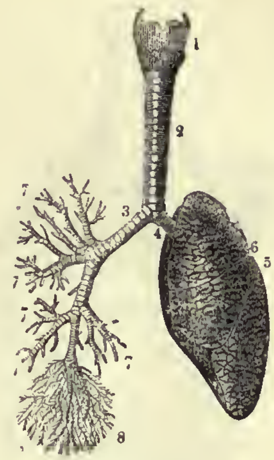
LUMP-SUCKER. [DISCOBOLI.]

LUNGS, the organs of respiration in the higher animals. In man, whose lungs may be taken as a type of those of all *Mammalia*, they are thus formed:—The trachea, or windpipe, is a rounded tube continued from the larynx [LARYNX], and commencing about an inch above the upper edge of the breast-bone. Its front and sides are chiefly composed of portions of cartilage forming about three-fourths of rings an eighth of an inch wide; and its back part consists of transverse and longitudinal fibres of elastic (and, according to some, muscular) tissue. The rings are connected by tough cellular and elastic tissues, and by numerous strong longitudinal bands; and the whole tube, as well as its farthest ramifications, is lined by a mucous membrane continued from the larynx, and covered on its free surface by a fine epithelium composed of cells with vibrating ciliæ attached to them. [CILIA.]

The trachea divides into two main branches, the bronchi, one of which goes to each lung, and in it divides into smaller and smaller branches, whose structure is in all essential respects similar to that of the trachea. (*Fig.* 1.) Around the extremity of each of the finest branches of the bronchial tubes there are arranged a number of delicate rounded cells or vesicles, all opening into the end of the branch, but having no communication with each other. On the walls of these cells the blood circulates in the minutest capillary divisions of the pulmonary artery and veins, and it is also in these cells that the air, which is admitted to them through the bronchial tubes, comes nearly into contact with the blood. For the mode in which the blood is conveyed to the lungs see the article HEART. The pulmonary artery arising from the right ventricle carries to the lungs all the blood that has been circulating through the body; one main branch goes to each lung, and, accompanying the bronchus, divides, like it, to extreme minuteness. At the last its branches terminate in the capillaries, which are arranged in the most delicate network on the walls of every pulmonary cell. Each of these cells is about $\frac{1}{40}$ of an inch in diameter; the capillary vessels are about $\frac{1}{3000}$ of an inch in diameter; and the network which they form is so close that its meshes are not more than $\frac{1}{3000}$ of an inch wide. In its passage through these the blood undergoes the changes which convert it from venous to arterial, and render it again fit for the maintenance of life. [BLOOD.] From the capillaries it passes into the pulmonary veins, and through them to the left side of the heart.

Kölliker in his 'Manual of Human Histology' gives the following account of the bloodvessels of the lungs:—"They occupy," he says, "a unique position, inasmuch as they possess two complete vascular

Fig. 1.



1, larynx; 2, trachea; 3, right bronchus; 4, left bronchus; 5, left lung, the fissures denoted by the two lines which meet at 6, dividing it into two lobes, and the smaller lines on its surface marking the division of the lobes into lobules; 7, large bronchial tubes; 8, minute bronchial tubes terminating in the air-cells or vesicles.

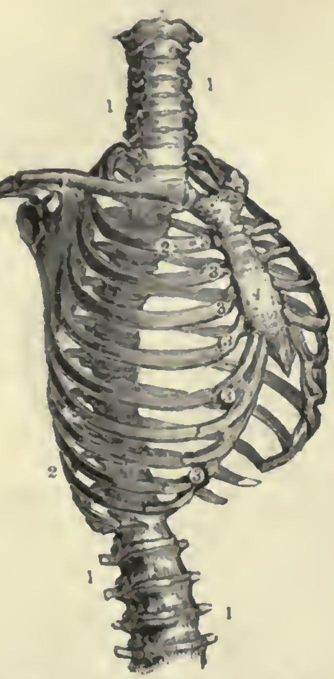
systems for the most part distinct from each other—that of the bronchial vessels, for the nutrition of certain portions, and that of the pulmonary vessels for the fulfilment of their proper function. The branches of the pulmonary artery follow pretty nearly the course of the bronchial tubes, which are most usually placed below and behind them, with this difference, that they divide dichotomously with greater frequency, and consequently diminish more rapidly in diameter. Ultimately a twig goes to each secondary lobule, which then subdivides into still finer ramuscles, in general corresponding in number with the smallest lobules, and supplying the individual air-cells. The course of these finest lobular arteries, as they may be termed, is very easily traced in injected, inflated, and dried preparations; and it is apparent that, whilst traversing the uniting tissue between the lobules (infundibula), they supply not one lobule alone, but always two, or even three of them with finer twigs. These penetrate from without, upon, and between the air-cells, divide repeatedly while running in the larger elastic trabeculæ, anastomosing also occasionally, though not regularly with each other, or with branches of other lobular arteries, and finally terminate in the capillary plexus of the air-cells. This plexus, which is one of the closest existing in man, as estimated in moist preparations, presents rounded or oval meshes 0·002‴—0·008‴ wide, and vessels of 0·003‴—0·005‴ in diameter. It lies in the wall of the air-cells at a distance of about 0·001‴ from the epithelium, in the middle of the fibrous tissue, and is continuous, not only over all the alveolæ of one of the smallest lobules, but also, at all events in the adult, is partially in connection with the plexuses of the contiguous lobules. The pulmonary veins arise from the above described capillary plexus, with roots which lie more superficial than the arteries, and more externally. On the smallest lobules these run deeply between them and unite with other lobular veins into larger trunks, which proceed in part with the arteries and bronchial tubes, in part more isolated by themselves, through the pulmonary parenchyma.

"The bronchial arteries are distributed, firstly, to the greater bronchiæ, whose vessels present the same conditions as those of the trachea, then to the pulmonary veins and arteries, the latter of which in particular possess an extremely rich vascular plexus, which may be traced as far as branches of $\frac{1}{3}$‴ and less; lastly, to the pleura pulmonalis, the branches destined for which are some of them given off even at the hilus and in the fissures between the main lobes, some also from the vessels accompanying the bronchiæ coming out between the secondary lobules. Small vessels moreover which are not derived from the bronchial arteries pass on the pulmonary ligaments to the pleura."

The lungs are thus mainly composed of air-cells and of branches of the pulmonary artery and veins. Each lung is divided into two or three large portions called lobes (the right lung has almost always three lobes, the left two lobes), each of which receives one of the main divisions of the bronchus, artery, and vein; and these are again divided into lobules, the outlines of some of which are marked by the angular figures on the surface of the lung. Lastly, the cells are grouped together in still smaller lobules not more than a quarter of an inch in diameter.

The lungs are placed in the two principal cavities of the chest. The annexed figure (*fig.* 2) represents the bony frame-work of the chest, bounded behind by the spine and the ribs as far outwards as their angles, in front by the sternum, or breast-bone, and the cartilages of the ribs, and on each side by the bodies of the twelve ribs. The space which is left below in the skeleton is, in the entire subject, filled up

Fig. 2.



1, spinal column; 2, ribs; 3, cartilages of ribs; 4, sternum.

by the diaphragm, a large muscle represented in *fig.* 3 whose form may be roughly compared to that of the expanded part of an umbrella

Fig. 3.

1, cavities of the thorax; 2, portion of cavity of the abdomen; 3, lateral or muscular portions of the diaphragm; 4, central or tendinous portion of the diaphragm.

having its concavity downwards. The diaphragm forms a moveable partition between the cavity of the chest and that of the abdomen, permitting only the passage of certain vessels, &c., from the one to the other. By its alternate contractions and relaxations it increases and diminishes the capacity of the chest.

The spaces between the several ribs are filled by the intercostal muscles, of which two are represented in *fig.* 4. Between each two ribs there are two layers of muscle, the fibres of each of which cross those of the other. The fibres of the outer layer, which are represented between the two upper ribs in the annexed figure, pass obliquely from above downwards, and from behind forwards; those of the inner layer, here drawn between the two lower ribs, pass with a similar obliquity from before backwards.

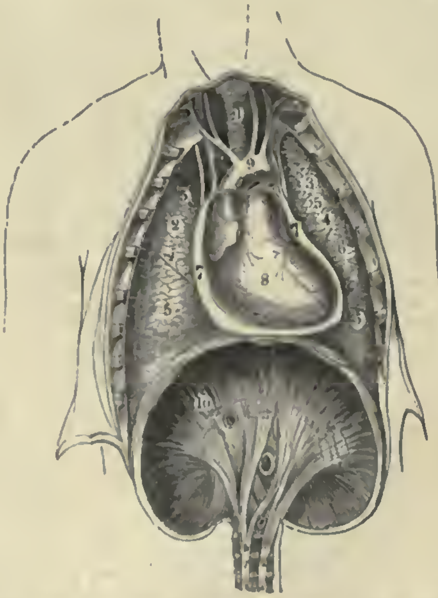
The upper aperture of the chest between the spine, first ribs, and sternum (*fig.* 2) is that at which the trachea passes into the chest to the lungs, and at which the great arteries of the head, neck, and arms pass out of the chest from the aorta. The spaces left between these and the bones are occupied by the œsophagus, by certain muscles and nerves, by the great veins of the upper part of the body, and by cellular tissue.

The whole chest thus forms a cavity closed on all sides, but permitting the passage of certain tubes (the trachea, œsophagus, blood-vessels, &c.) through its walls. This cavity contains within it three subordinate cavities; the middle one contains the heart in the pericardium, and each of the two at the sides contains one of the lungs. These are called the pleural cavities.

Fig. 4.

Each lung is as it were hung into the cavity appropriated to it by its bronchus and by the trunks of its pulmonary artery and veins, which, inclosed together by cellular tissue, form what is called the root of the lung. The lung exactly fills the cavity in which it is placed, so that their surfaces are everywhere in contact, or separated only by the very small quantity of fluid necessary to keep them sufficiently slippery to move upon each other without difficulty. For the sake of more easy motion, the wall of the cavity is lined and the surface of the lung is covered by a fine smooth membrane, the pleura, which is arranged like other serous membranes [MEMBRANES], that is, having lined the cavity, it is reflected upon the root of the lung, and then passes over its surface and those of its great divisions or lobes.

Fig. 5.



1, trachea; 2, right lung; 3, left lung; 4, fissures dividing each lung into large portions (5) termed lobes; 6, smaller divisions termed lobules; 7, pericardium; 8, heart; 9, aorta; 10, diaphragm separating the cavity of the thorax from that of the abdomen.

The pleural cavities are completely closed on all sides, so that no air can enter them, but the lung in each communicates with the external air by its bronchus, which leads to the trachea and larynx; and hence, when the chest is enlarged by the contraction of the diaphragm, the elevation of the ribs, &c., the air passes not into the cavity of the chest, but through the windpipe into the interior of the lung. It is as if one had a pair of bellows with the valve closed, and the tube of the nozzle opening, not as it usually does, into all the space inclosed by the boards and leather, but into a bladder contained within that space. In this case, when the handle of the bellows is raised so as to enlarge the cavity, the air will pass into the bladder, and distend it so as to keep it everywhere in contact with the interior of the cavity containing it.

The acts of breathing are—inspiration, by which air is drawn into the lungs, and expiration, by which it is again expelled from them. In inspiration the muscles that are attached to and form part of the walls of the chest contract, and by raising the ribs and sternum, and flattening the diaphragm, increase its capacity. The air within the lungs (which are never empty even after the deepest expiration) is thus for the instant rarefied; but by the proportionally increased pressure of the atmosphere upon the upper part of the larynx, a fresh quantity of air immediately passes into the air-tubes, and maintains the equilibrium of pressure between the air within and that without the lungs.

As soon as the action of the muscles of inspiration has ceased, expiration commences; the lungs, distended in inspiration, contract by their own elasticity, and expel a volume of air which in ordinary circumstances is equal to that which they had just previously received. As fast as they contract they are followed by the walls of the chest, which collapse partly by their elasticity, and partly by the pressure of the atmosphere upon their exterior, which, when the lungs begin to contract, is no longer exactly balanced by the pressure exerted through the medium of the lungs upon their interior. The lungs having thus contracted to a certain extent, the parts are restored to the same condition as before inspiration, and in ordinary circumstances that action is soon again commenced.

The enlargement of the cavity of the chest in common inspiration is thus effected: the diaphragm (*figs.* 3, 5) contracts; its muscular fibres, which are attached on the one hand to the interior of the lower ribs, the tip of the sternum, and the front of the spine, and on the other around a tendon (4, *fig.* 3) in its middle, shorten, and thus (as the first set of attachments are fixed) they draw down the middle of the muscle, lessen its convexity towards the chest, make it flatter, and press its under surface upon the contents of the abdomen, so that the abdominal walls become more prominent. At the same time, or just previously, the intercostal muscles contract; the two upper ribs, being quite or nearly fixed at one end to the spine, and at the other to the upper part of the sternum (*fig.* 2), serve as fixed points towards which the upper intercostal muscles contracting draw the second ribs; these being thus fixed, the second pair of muscles contract, and draw up the third ribs; and so on through the whole of the ribs, the lowest serving, at the same time that they are drawn upwards, for fixed points, towards which the diaphragm, contracting all round its tendon, may draw down its middle part and become flatter.

The effect of the contraction of the intercostal muscles is not so much to approximate the ribs (which would decrease the capacity of the chest) as to force them further outwards and forwards, and thus give the chest a greater width and depth at each part. In *figs.* 2 and 4 it is seen that the ribs descend obliquely outwards and forwards from the spine, and then ascend towards the sternum. They increase in obliquity as they are taken from above downwards, and, except the four last, they also increase in length in the same succession. The length of the arc represented by each rib from the spine to the sternum is fixed, for the substance of the ribs is bony or cartilaginous, and almost unyielding; when therefore one rib is fixed, and the intercostal muscles between it and the one next below it contract, they must not only draw the latter upwards, but must also turn it somewhat outwards, and raise the sternum, which is fixed to its anterior extremity. The direction of the rib becomes less oblique, but its length remaining the same, the distance from the spine to the moveable sternum must be increased at the same time with the distance from each rib to the corresponding one on the opposite side.

By these actions the cavity of the chest is increased in every direction; in height by the descent of the diaphragm; in width by the turning outwards of the ribs; in depth by the ascent of the sternum. In quiet inspiration the greater part is effected by the diaphragm; in deep inspiration not only are all the muscles already mentioned contracted, but a number of others capable of raising the ribs are called into play, and the capacity of the chest is thus yet further increased in the manner just described.

In their medium state the lungs of a person of ordinary size and in good health contain about twelve pints of air; in perfectly easy breathing about a pint is drawn into them at each inspiration; but from this the quantity may vary to as much as seven pints, according to the force of inspiration, increased as it is, for example, when preparing for a great muscular effort, or during singing, or before coughing.

Quiet expiration does not need any muscular exertion; the elasticity of the lungs, of the cartilages of the ribs, and of the other parts distended in inspiration, is sufficient to restore them all to their previous state. A limit is set to the collapse of the lungs by the unyielding tissues of the walls of the chest. These cannot follow the contracting lungs beyond a certain extent, and the elasticity of the lungs is not sufficient for them to overcome the unbalanced pressure of the atmosphere upon their interior, which it would be necessary for them to do before they could contract from the interior of the walls of the chest. If a wound be made into either pleural cavity, the lung at once collapses completely, and expels nearly all the air it contained; for in this case the atmospheric pressure being admitted alike to the exterior and the interior of the lung, its elasticity has but little to overcome, and the air-cells and tubes immediately contract to the smallest size of which they are capable. By the same means, when both pleural cavities are opened at once death speedily follows, in consequence of the collapse of both lungs and the suspension of all breathing.

The limit which the rigidity of the walls of the chest sets to the elastic collapse of the lungs is never reached in ordinary respiration, nor in extraordinary cases, except by the influence of other expiratory powers besides those of the lungs. These powers are supplied chiefly by the muscles of the abdomen, which contract with great force, and through the medium of the contents of the abdomen force up the diaphragm to an unusual height into the chest, at the same time that certain muscles capable of depressing the ribs and sternum draw them down and decrease the capacity of the chest in its depth and width. Efforts of this kind are observable in coughing, sneezing, and all other strong expiratory acts.

For an account of the chemical changes accompanying these actions see RESPIRATION.

The development of the lungs has been recently investigated, and the following is Kölliker's summary of what is known:—

"In the *Mammalia* the lungs appear a little after the liver, in the form of two hollow protrusions of the anterior wall of the pharynx, which are in close apposition, and soon become furnished with a common peduncle—the rudiment of the larynx and trachea—and in the composition of which the epithelial tube and the fibrous membrane of the intestine take an equal share. In the further course of development there springs from the extremities of the original protrusions a continually-increasing number of arborescent processes, which differ entirely in what may be observed in most other glands. From their first formation they are always hollow, and in the sixth month the air-cells are developed from their invariably clavate dilated extremities. During this growth of the glandular elements the interior epithelium extends itself by spontaneous multiplication of its cylindrical cells (probably by division), whilst at the same time the fibrous layer surrounding them also grows, and finally constitutes the fibrous membrane of the bronchiæ and air-cells, together with the vessels and nerves. In the second month, in the human embryo, the large pulmonary lobes are already formed; and besides them smaller divisions also, 0·16‴ in size, may be recognised, originating in the dilated extremities of the bronchiæ, which even at this time are considerably ramified. As development proceeds, and the ramifications of the bronchiæ are multiplied, these gland-granules, as they are termed, become more and more numerous, and ultimately, in the fifth month, are aggregated so as to form smaller lobules of 0·24‴—0·48‴ in size, each of which in all probability is produced from a single gland-granule, or bronchial termination, of the second month. Each of the gland-granules of these lobules, which correspond with the secondary lobules of the future lung, by continued budding, finally constitutes a primary lobule, which, with air-cells of 0·025‴—0·03‴ in size, first becomes distinctly visible in the sixth month, although up to the time of birth new alveoli are constantly superadded. In the new-born child the secondary lobules measure 2‴—3‴—4‴; the alveoli, before they are filled with air, 0·03‴, and after the first inspiration, 0·03‴—0·04‴—0·06‴; the latter at this time appear to exist in the same number as in the adult, the further increase of the lungs proceeding only from the expansion of all its parts.

"The investigation of the lungs," continue the translators of Kölliker, "presents no real difficulty, except in one point; that is, with respect to the relation of the pulmonary cells to the terminations of the bronchiæ; but here the difficulties are very considerable. In recent preparations it is obvious that the air-cells communicate in many ways, and in any case that they are not merely terminal on the extremities of the bronchiæ. If it be desired to investigate the whole subject, inflated and dried lungs (it is better in an inflated lung to tie off an end and dry it by itself), or corroded preparations, or lungs injected with uncoloured substances (wax and resin), are most suitable; and with such a definite result will be obtained, after a series of observations. Before the injection of the bronchiæ is proceeded with the air must be exhausted in the air-pump, for which purpose also, though less conveniently, a well-fitted syringe may be employed. The injection of the bloodvessels is readily effected, and the preparation should be kept wet; sometimes when injected with opaque material, sometimes following the processes of Schröder and Harting, with transparent substances (Prussian blue, &c), dried preparations are to be preferred. The air-cells and bronchiæ, the larynx and trachea, are readily examined. The epithelium of the air-cells is obtained in large quantities in every section through the lung, as well as ciliated cells. If it be wished to study the alveoli, the air must previously be carefully removed. These are best displayed in man, in whom also all other parts, such as cartilage, elastic elements, muscles, and glands, are easily obtainable."

(Kölliker, *Manual of Human Histology*, translated for the Sydenham Society by Busk and Huxley.)

LUNG-WORT. [PULMONARIA.]

LUNULITES. [CELLARLÆA.]

LUPEA. [PORTUNIDÆ.]

LUPI'NUS, a very extensive genus of hardy annual, perennial, and half-shrubby Plants, belonging to the natural order *Leguminosæ*, commonly cultivated in gardens for the sake of their gaily-coloured flowers. The species inhabit Europe, the basin of the Mediterranean, and the temperate parts of both North and South America, especially of the former, where they are extremely abundant; but they are unknown in a wild state throughout all the tropics, except on mountains, and in the principal part of Asia, Australia, and South Africa. Figures of great numbers have appeared in the volumes of the 'Botanical Register and Magazine,' and there is a monograph of the genus published at Lund by the younger Agardh in 1835, under the name of 'Synopsis Generis Lupini.'

The calyx is profoundly bilabiate; corolla papilionaceous, the vexillum with reflexed sides, and the keel acuminated; the stamens monadelphous, with the tube or sheath entire, 5 of the anthers are smaller, rounder, and earlier, and the other 5 oblong and later; style filiform; stigma terminal, roundish, bearded; legume coriaceous, oblong, compressed, obliquely torulose; cotyledons thick, but converted into leaves at the time of germination. The species have digitate leaves, constantly composed of from 5 to 15 leaflets, very rarely simple. The leaflets are complicated before expansion, and while asleep, or through the night. The flowers are alternate or verticillate, sessile or pedicellate, disposed in racemes and spikes, with one bractea under each pedicel, and with two bracteoles adhering laterally to the calyx, which are caducous, or wanting. It is a very extensive genus, and many species are cultivated in our gardens for the purpose of decorating flower-beds.

L. albus, the White Lupine, has alternate pedicellate flowers destitute of bracteoles; the upper lip of the calyx entire, lower one tridentate; leaflets obovate, oblong, usually 7 or 8, villous beneath. It is a native of the Levant, and is cultivated in the south of Europe. The flowers are white, and almost sessile. It is grown in Italy and some other parts of the south of Europe as food, also in France, on poor dry plains, as an ameliorating crop to be ploughed in for the sake of improving the land. This is an ancient Roman practice which existed in the time of Pliny.

L. Termis, Egyptian White Lupine, has alternate pedicellate bracteolate flowers; the upper lip of the calyx entire, lower one somewhat tridentate; leaflets 5 or 6, obovate, oblong, villous beneath. It is a native of Egypt. The flowers are white, but with the vexillum tipped with blue. Termis is the Arabic name of the plant. The peduncles after being peeled are eaten raw, and the seeds are boiled as other pulse by the Arabians. The Greeks, who called them Thermos, employed Lupines not only as an article of food, but medicinally, esteeming them vermifugal and emmenagogue, &c. (Dioscor., lib. i., c. 132). What species was cultivated by them is unknown; their wild Thermos is supposed by Sibthorp to be the *L. angustifolius*. The two species most common in Greece now are *L. hirsutus* and *L. pilosus*.

Lupines are said to derive their name from 'lupus,' a wolf, because of their devouring the substance of the land on which they are grown.

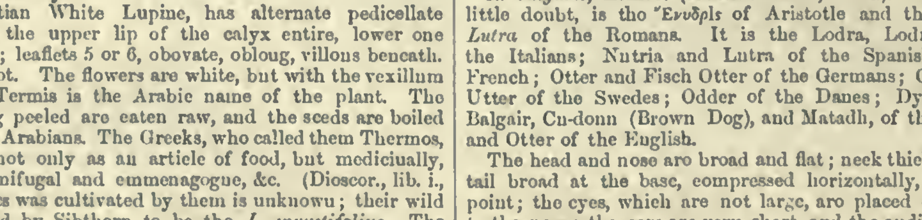
(Don, *Dichlamydeous Plants.*)

LUPONIA. [CYPRÆIDÆ.]

LUPUS. [CANIS.]

LU'RIDÆ, a name given by Linnæus to one of his natural orders of Plants. It is equivalent to *Solanaceæ* of modern botanists. [SOLANACEÆ.]

LUTRA, a genus of *Mammalia* belonging to the family *Mustelidæ*. The species are known by the common name of Otters. They form a natural group of Carnivorous Animals whose habits are aquatic, and whose food is fish. The common term Otter is applied to two forms and nearly allied: the first, including the River-Otters, *Lutra* of Storr; the second, the Sea-Otter, *Enhydra* of Fleming. We shall first describe the genus *Lutra*. In the skull of *Lutra* the suborbital hole is larger than it is in the badgers, the grisons, and the martens, almost as large, indeed, as it is in the rodents; their muzzle is shorter, and the anterior part of the cranium between and behind the orbits more compact; their tympanic cavities are less convex; their entire cranium more depressed, and its base wider and flatter. The lachrymal bone is entirely within the orbit, and its aperture is above the interior suborbital hole. The circular aperture is blended externally with the spheno-orbital hole, but internally it is separated by a considerable interval from it by a bony plate. The internal pterygoid process is soldered. The whole skull has a good deal in common with that of the Seal (*Phoca vitulina*); and its relationship is to be traced in the short muzzle, the compression of the interorbital region (which is carried still farther in the seal), the width and flatness of the cranium, and the flatness and enlargement of the whole inferior region, with the exception of the tympanic cavities, which in the seal are large and convex.



Skeleton of European River-Otter (*Lutra vulgaris*).

In the other parts of the skeleton there is nothing needing a detailed description, the variations being such as might be expected to suit the habits of an aquatic, carnivorous, hairy quadruped. Thus, the articulation of the limbs admits of such freedom of motion, that the animal can turn them in almost any direction, and bring them with ease on a line with the body, so as to act like fins.

The teeth of the Otters are sharp and strong, and the tubercles of the molars very pointed, a modification necessary to secure the prehension and speedy destruction of their agile and slippery prey. In the length of the intestines there is a difference between the Common Otter and the Sea-Otter; the latter, like the seal, has very long intestines. Sir Everard Home gives the length of the intestines of the Sea-Otter as twelve times that of the animal; but those of the Common Otter as only three times and a quarter the length of the animal. ('Phil. Trans.') Professor Owen however informs us that in a female Common Otter dissected by him, the intestines were 9 feet 6 inches, the body from nose to vent being 1 foot 5 inches; and we should expect, physiologically, to find longer intestines in a Common Otter than in one of the land *Feræ*.

The kidney is lobulated or conglomerated, consisting, in fact, of an aggregation of small kidneys, connected by cellular substance; but these small kidneys are not so numerous as in the seal and porpoise. (Home, on the 'Sea-Otter,' 'Phil. Trans.'). In the Museum of the Royal College of Surgeons (Physiological Series, No. 2519) is a preparation exhibiting the reproductive organs of a male of the Common Otter.

The genus *Lutra* has the head compressed; eyes rather large; ears very short; whiskers very stiff; tongue rather rough; body very much lengthened; legs short; the feet with five toes and webbed; tail long, stout, flattened horizontally, and covered with short hair.

$$\text{Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{5-5}{5-5} = 36.$$

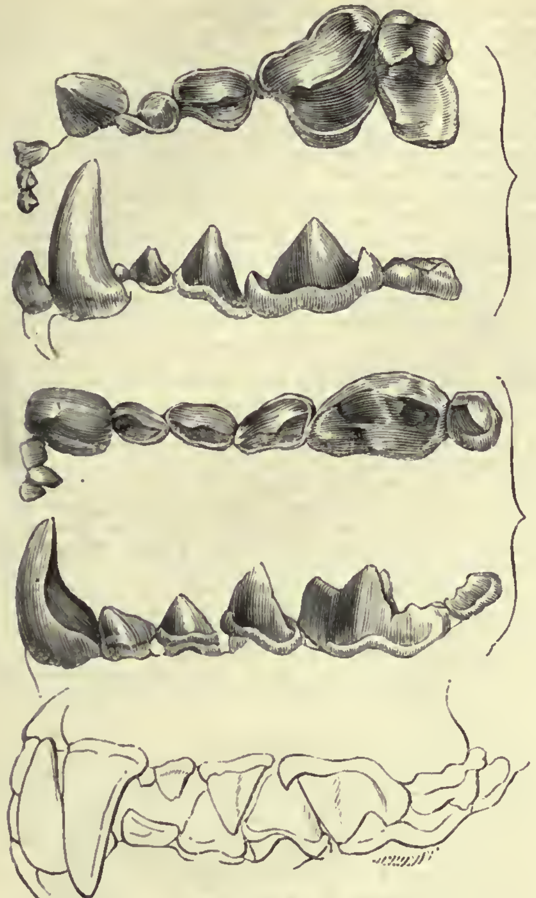
L. vulgaris, Erxleb. (*Mustela Lutra*, Linn.). This, there can be little doubt, is the Ἐνυδρὶς of Aristotle and the Greeks, and the *Lutra* of the Romans. It is the Lodra, Lodria, and Loutra of the Italians; Nutria and Lutra of the Spanish; Loutre of the French; Otter and Fisch Otter of the Germans; Otter of the Dutch; Utter of the Swedes; Odder of the Danes; Dyfgi of the Welsh; Balgair, Cu-donn (Brown Dog), and Matadh, of the Northern Celts; and Otter of the English.

The head and nose are broad and flat; neck thick; body elongated; tail broad at the base, compressed horizontally, and tapering to a point; the eyes, which are not large, are placed comparatively near to the nose; the ears are very short, and the auditory opening rather narrow; the mouth is small, and the lips are capable of being firmly closed together; the whiskers are very long; the legs very short, strong, stout, and muscular; the 5-toed feet are furnished with strong broad webs, like those of water-fowl which have these accessories best developed. Hence Somerville terms the Otter 'goose-footed.'

The colour is brown (deepest on the upper parts), with the exception of two small patches of white on the lips, one on each side of the nose.

This species varies much in size. The length of one sent to Mr. Bell from Sutherlandshire was 2 feet 1 inch and 6 lines. Mr. Macgillivray notes the length of two males; one measured 42 inches, and the other 38 inches. By the same author, the length of a female is given at 40 inches. These measurements are from the nose to the point of the tail. Mr. Bell states that the usual weight of a fine male English Otter is from 20 to 24 lbs., and that of the female about 4 lbs. less; adding however that Pennant records one found, in 1794, in the river Lea between Stratford and Ware that weighed 40 lbs.

The natural food of the Common Otter is fish, for the chace and capture of which its whole frame is beautifully adapted. How silently is the water entered! The eyes are so placed that whether the animal is swimming below its prey, behind it, above it, or beside it, their situation, or, at most, the least motion of the head and neck, brings it within the sphere of the pursuer's vision. The whole frame-work of the animal, its short fin-like legs, oary feet, and rudder of a tail, enable it to make the swiftest turns, nay, almost bounds in the water, according as the rapidity of its agile prey demands a sudden downward dive, an upward spring, or a side snap. The short fur, which is close and fine, keeps the body at a proper temperature, and the longer and outer hairs directed backwards enable it to glide



Teeth of Otter. F. Cuvier.

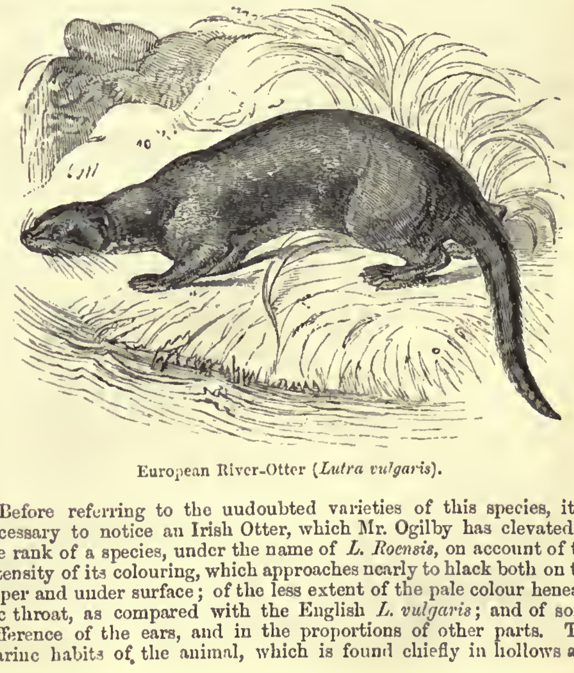
through the water, when propelled horizontally by its webbed feet beneath the surface, noiselessly and speedily. Easy and elegant in its motions, there are few objects more attractive in menageries than the pond, especially if it he kept clean and supplied with clear water, wherein the Otter is seen to hunt its living prey. When it has seized a small fish, it instantly leaves the water and devours it, hegiuning with the head, whilst the body is held between the fore paws. Larger fish are held down hy the paws, and the head and tail are often left uneaten. The havoc made hy these animals in the rivers and ponds is great; for they will go on killing, and eat but a small portion of each fish, if it he large, when they fiud pleuty of prey. When fish is scarce, and it is pressed hy hunger, Mr. Bell states that the Otter has been known to resort far inland, to the neighbourhood of the farm-yard, and attack lambs, sucking-pigs, aud poultry. Mr. Macgillivray tells us, also, that it has heen known to attack young domestic animals, and the latter zoologist found the stomach of one, which was killed in June, filled with a curious collection of larvæ and earth-worms. The period of gestation is said to be nine weeks, and the number of young produced varies from three to five. The Otter's places of refuge near rivers and lakes are beneath the roots of trees or in holes.

But it must not be supposed that the Common Otter is, as it has been asserted, confined to the fresh-waters. They are known to frequent the sea in the north of Scotland, and to hunt far out. Iu the south of England (Cornwall) the Otter will go a mile from the shore in the summer and good weather after its prey, according to Mr. Couch. On the sea-shore, rocky coves with scattered blocks, hollows, and cavities under large stoues are its haunts. These Marine Common Otters must not he confounded with the Sea-Otter (*Enhydra*).

That the Common Otter is capahle of domestication and attachmeut we have ample testimony. Alhertus Magnus, Aldrovandus, Gesner, aud others attest this. Every angler will rememher the passage iu Walton, where good Mr. Piscator is anxious to possess himself of oue of the young otters which the huntsman, after the death of the 'hitch otter,' had found:—"'Look you,' says the huntsman, 'hereabout it was she kennelled; look you, here it was indeed, for here's her young ones, no less than five; come, let's kill them all.' 'No,' exclaims Piscator, 'I pray, Sir, save me one, and I'll try if I can make her tame, as I know an ingenious gentleman in Leicestershire, Mr. Nich. Seagrave, has done; who hath not only made her tame, hut to catch fish, and do many other things at pleasure.'" Buffon, who could be as hard of belief in some points as he was credulous in others, dishelieves the Otter's capability for domestication. The testimouy above noticed has beeu confirmed hy a cloud of modern witnesses. Goldsmith mentions an otter which went into a gentleman's pond at the word of command, drove the fish up into a corner, and having seized on the largest hrought it out of the water to its master. Daniel, Bewick, Shaw, record instances of the animal's docility in this way. Mr. Bell and Mr. Macgillivray hoth corroborate the fact. The latter has collected the following anecdotes:—"Mr. M'Diarmid, in his amusing 'Sketches from Nature,' gives an account of several domesticated otters, one of which, helouging to a poor widow, when led forth plunged into the Urr or the neighbouring burns and hrought out all the fish it could find. Another, kept at Corshie House, Wigtonshire, evinced a great fondness for gooseherries, fondled ahout her keeper's feet like a pup or kitteu, and even seemed inclined to salute her cheek, when permitted to carry her freedoms so far. A third, helonging to Mr. Monteith, of Carstairs, was also very tame, and though he frequently stole away at night to fish by the pale light of the moon and associate with his kindred hy the river side, his master, of course, was too generous to find any fault with his peculiar mode of speuding his evening hours. In the morning he was always at his post in the kennel, and no animal understood hetter the secret of keeping his own side of the house. Indeed his puguacity in this respect gave him a great lift in the favour of the gamekeeper, who talked of his feats wherever he went, and avowed hesides, that if the hest cur that ever ran 'only daured to girn' at his protegé he would soon 'mak his teeth meet through him.' To mankind however he was much more civil, and allowed himself to he gently lifted hy the tail, though he ohjected to any interference with his snout, which is prohably with him the seat of honour." They are however dangerous pets; for, if offended, they will hite grievously.

The capacity of the Otter for domestication being proved, there is no doubt that the animal might he trained to catch fish or assist in fishing. For this purpose Mr. Bell states the following method has heen recommended:—They should he procured as young as possihle, and be first fed with small fish and water. Then bread and milk is to he alternated with the fish, and the proportion of the former gradually increased till they are led to live entirely on bread aud milk. They are then taught to fetch and carry, as dogs are traiued, and when they are brought to do this well a leather fish stuffed with wool is employed as the thing to he fetched. They are afterwards exercised with a dead fish, and chastised if they attempt to tear it. Finally they are sent into the water after living fish.

As an article of food, though the flesh is rank and fishy, the Otter was not rejected hy the Roman Catholics. Their church permitted it to he eaten on maigre days; and Pennant saw one in the kitchen of the Carthusians near Dijon, under preparation for the dinner of the religious of that rigid order, who, hy their rules, are prohihited during their whole lives from eating flesh. Mr. Macgillivray states that he knew a man in Harris who procured a considerable numher every year, when the skins were more in request than now, and who generally cooked the flesh, of which Mr. Macgillivray ouce partook with the family. It was "dark-coloured, rank, sapid enough, but uot agreeahly so.;" aud under the skin was a layer of fat, as in the Seals, which might, he adds, render it pleasant food to a Greenlander or starving Hebridian.



European River-Otter (*Lutra vulgaris*).

Before referring to the uudoubted varieties of this species, it is uecessary to notice an Irish Otter, which Mr. Ogilby has elevated to the rank of a species, under the name of *L. Roensis*, on account of the intensity of its colouring, which approaches nearly to hlack both on the upper and under surface; of the less extent of the pale colour heneath the throat, as compared with the English *L. vulgaris*; and of some difference of the ears, and in the proportions of other parts. The marine habits of the animal, which is found chiefly in hollows aud caverns formed by scattered masses of the basaltic columns of the east coast of Antrim, where a price is set upon its head, in consequence of its destruction of the salmon, strengthen Mr. Ogilby in this opinion, from which Mr. Bell differs, observing that Mr. Ogilby states that he had not had an opportunity of comparing it with the Common Otter, that he (Mr. Bell) does not find in the stuffed specimen presented by Mr. Ogilby characters sufficiently distinct to lead to the belief that it is more than a very dark and handsome variety, and that two skins of Zetland otters (which are equally marine in their habits) presented to him (Mr. Bell) are almost as dark-coloured; Mr. Bell adds that these skins are larger than those usually found in England, and that the fur is nearly as fine at those imported from America.

The variety spotted with white is supposed to be the 'King of the Otters' of the Scotch vulgar, who hold that it bears a sort of charmed life, in so far that its death is never unaccompanied by the death of a man or some other living creature. The skin is considered precious as an antidote against infection, wounds, and the dangers of the sea. One of these spotted otters is in the Museum at Paris, near which place it was found. Mr. Macgillivray says that he has heard of white otters, but had never seen an albino.

In the older annals of sporting in this country otter-hunting holds no inconsiderable place. Somerville describes it at some length and with much unction in his fourth book ('Chace') towards the end. It is now fast dying away, but is still kept up in some places, as in Wales and Scotland. The pretty vignette at the close of Mr. Bell's interesting history of the Otter was taken as one of the memoranda of a day's sport in Glamorganshire. Mr. Macgillivray informs us that Mr. Lomare hunted the Dumfriesshire rivers in 1833, 1834, and 1835, and that Lord John Scott keeps a pack of otter-hounds for the streams in Roxburghshire.

The Common Otter is found generally throughout Europe.

L. Nair has the fur deep-chestnut, lightest on the sides; lower part of the neck and cheeks, as well as the throat, reddish bright-brown; above the eye a ruddy yellow or yellowish-white spot.

This is the Nir-nayie of the people of Pondicherry, and is probably the species seen by Bishop Heber, who passed a row of nine or ten large and very beautiful otters, tethered with straw collars and long strings to bamboo stakes on the banks of the Matta Colly. "Some were swimming about at the full extent of their strings, or lying half in and half out of the water; others were rolling themselves in the sun on the sandy bank, uttering a shrill whistling noise as if in play. I was told that most of the fishermen in this neighbourhood kept one or more of these animals, who were almost as tame as dogs, and of great use in fishing; sometimes driving the shoals into the nets, sometimes bringing out the larger fish with their teeth." Another proof, if any were wanting, of the feasability of taming these animals and rendering them useful to man.

It is a native of the East Indies. Colonel Sykes notes, in his list of *Mammalia* obtained in Dukhun (Deccan), "*Lutra Nair*, F. Cuv., Juhl Marjur, or Water-Cat of the Mahrattas. The Otter of Dukhun differs only from the *Nair* in wanting the white spots over the eyes, in having a white upper lip, and in being somewhat larger." ('Zool. Proc.,' 1830-31.)

L. Capensis (genus *Aonyx* of Lesson), the Cape Otter, has the fur soft, full, and thick, chestnut-brown, deepest on the rump, limbs, and tail, brighter on the sides, and brownish-gray upon the head; under part of the body white. Length 2 feet 10 inches from the muzzle to the tail, which is 1 foot 8 inches.

M. Lesson allows that this species, which he has elevated to the rank of a genus, possesses the same general characters as the *Lutræ*, such as the dentary system and form of the body; and makes the difference solely consist in the form of the feet and toes, which he says are hardly joined by a membrane. He states that the second toe would seem conjoined to the third throughout its first articulation. These toes are both more elongated than the succeeding ones, and all the toes are without claws, or rather, a vestige of a rudimentary nail is only observed on the second and third toes of the posterior feet. He records the species as *Aonyx Delalandii* (*L. inunguis* of G. Cuvier and F. Cuvier), 'Dict. Sc. Nat.' But Cuvier, in his last edition of the 'Règne Animal,' writing on the Cape Otter (*L. Capensis*, F. Cuvier), remarks that the white of the throat, the sides of the head, and of the neck, is more pure than that of the Javanese Simung (*L. Leptonyx*, Horsfield), and that there is some of this colour at the end of the nose; but, he adds, what most distinguishes it is that (at a certain age at least) it has no nails, a character on which M. Lesson established his genus *Aonyx*. Nevertheless, continues Cuvier in conclusion, young individuals have been brought from the Cape which have nails, and it remains to be proved whether these are of the same species. This species haunts the salt pools of the sea-shores of the Cape, and lives on fish and crustaceans.

L. Canadensis (Sabine), the Canada Otter; the Loutre de Canada of Buffon; Land-Otter of Warden; Common Otter of Pennant ('Arct. Zool.'); *Lutra Brasiliensis* of Harlan; the American Otter of Godman; Neekeek of the Cree Indians; and Capucca of the inhabitants of Nootka.

Sir John Richardson, who gives these synonyms, states succinctly the various opinions of authors as to this species, and concludes by following Colonel Sabine's opinion that it is peculiar to the northern districts of America.

It has the fur above and below shining brown, and much resembling that of the Beaver. Size much larger than that of the European Otter, *Lutra vulgaris*. Length from nose to tip of tail (which is 18 inches) about 5 feet.

In its habits and food Sir John Richardson states that the Canada Otter resembles the European species. In the winter season it frequents rapids and falls for the advantage of open water; and when its usual haunts are frozen over it will travel to a great distance through the snow in search of a rapid that has resisted the frost. When seen and pursued by the hunters, as it is on these journeys, it throws itself forward on its belly and slides through the snow for several yards, leaving a deep furrow behind it. This movement is described by Sir John as being repeated with so much rapidity, that even a swift runner on snow-shoes has much trouble in overtaking it. It also doubles on its track with much cunning, and dives under the snow to elude its pursuers. When closely pressed it will turn and defend itself obstinately. When Sir John Richardson's party were at Great Bear Lake, in the spring of 1826, these otters robbed their nets which had been set under the ice a few yards from a piece of open water. They generally carried off the heads of the fish, leaving the bodies sticking in the net.

The female brings forth one litter in the year, consisting of two or three.

The Mackenzie and other rivers nearly to the Arctic Sea are the common residence of this otter. There appears however to be no difference between the skins obtained on the shores of the Pacific and those in the neighbourhood of Hudson's Bay. ('Fauna Boreali-Americana.')

The fur is valuable, and a considerable article of commerce; it varies with the season. In summer the hair is very short, and then it is almost black; in winter it becomes a rich reddish-brown, with the exception of the grayish spot under the chin. The fur is nearly as fine as beaver-wool, but not so long, and consequently is not so well adapted for felt. Sir John Richardson says that 7000 or 8000 are annually exported to England.

L. Brasiliensis (Ray). It has the fur short and close, of a bright ruddy yellow deepening into chestnut towards the extremity of the limbs and tail; lower part of the neck and throat pale yellow. Length, male, 3 feet 6¾ inches; tail, which is very thick, 18 inches. The largest female possessed by D'Azara was 34 inches long, including the tail, which was 15 inches. Another measured 36 inches, 12 inches for the tail.

M. Lesson states that this is the only otter which is deprived of the glandular apparatus round the nostrils.

This is the Lobo de Rio (River-Wolf) of the colonists; but D'Azara observes that it is not a wolf, but an otter, belonging to the same family as the European species, from which it differs; and he accordingly calls it *Nutria*. It is the *Mustela Lutra* (*Brasiliensis β*) of Gmelin.

D'Azara says that this species lives in troops, which sometimes, rising to the surface of the water, lift their heads and bark like dogs, with a hoarse voice, in a menacing and snapping manner, without however injuring voyagers or swimmers. Each family seems to possess a separate domain. It spends nearly as much time in the water as it does upon land, where it devours the fish which it has taken, and rears its young in holes which it excavates in the banks. The same author was informed by the Payaguas Indians, who sail continually up and down the river, and are better acquainted with this animal than others, that the female brings forth two at a birth covered with hair, and that many females bring forth and rear their young at the same time and in the same place, their usual resort throughout the year. The motions of this otter are generally slow, and it drags, as it were, its belly and muzzle along the ground: when it runs it is not at all swift.

D'Azara further states that a neighbour of his purchased a young whelp which at six months old was 34 inches long. It was permitted to run loose about the house, and was fed with fish, flesh, bread, mandioca, and other food, but it preferred fish. It would walk into the street and return, knew the people of the house, came when called by name, and would follow them like a dog, but its short legs soon failed it, and it soon grew weary. It would amuse itself with dogs and cats as well as with their masters; but it was a rough play-fellow, and required to be treated cautiously, for it bit sharply. It never harmed poultry or any other animal excepting sucking-pigs, which were not safe within its reach, and it would have killed them if it had not been prevented. It entered all the rooms, and slept always below the bed, was very cleanly, and always visited one particular spot for the deposit of its excrements.

According to D'Azara it inhabits the lakes, rivers, and rivulets of Paraguay, who at first stated that he did not believe that it entered salt-water, and that its geographical range did not extend to the river Plata; but in his French abridgement he states that the species is found in that river.

From M'Culloch's lists it appears that the number of otter-skins exported from Quebec in 1808 amounted to 7230, at 1*l.* per skin. In 1826 the numbers were less, 1698 having been exported from that place in that year. In 1829, 14,862 were imported into Britain: of these 39 came from Germany, 13,104 from the British North American colonies, 1707 from the United States, 2 from Buenos Ayres, and 49 from all other places. They were almost wholly re-exported to Germany and the Netherlands. Mr. Bell states that the number of otter-skins imported into this country in 1830 was 713,115; in 1831, 494,067; in 1832, 222,493; and in 1833 only 23,889. In 1850 the importation did not exceed 18,000.

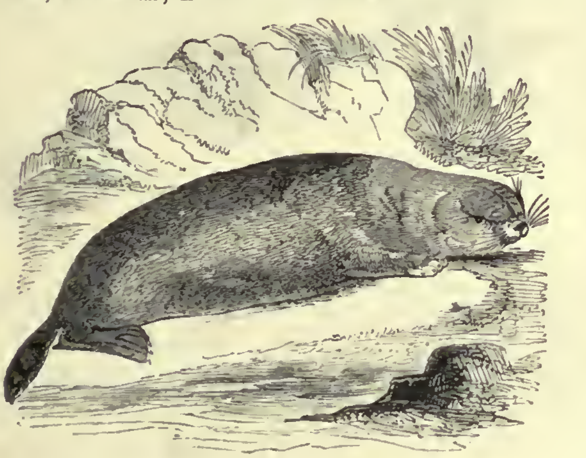
Fossil Otters.—Jäger notices the remains of a *Lutra* in the Bean iron-ore (Bohnerz) of the Rauh Alp (tertiary); and Messrs. de Serres, Dubrueil, and Jean-Jean record an extinct species (*L. antiqua*) in the bone-caverns of Lunel-Vieil. The form was also detected in the Puy-de-Dome by Messrs. Croizet and Jobert. The remains of *L. vulgaris* are common in the fens of Cambridgeshire.

Enhydra.—Dr. Fleming gives the following generic character of the Sea-Otter under the above name:—Six incisors above, and four below. Tail much shorter than the body. No anal scent-bags.

In Cook's 'Voyage' it is stated that a young Sea-Otter was brought on board with six lower incisors. Steller and succeeding systematists give four as the number in the lower jaw. Sir John Richardson suggests that two of the lower ones may drop out before the animal becomes adult.

The fur is thick, woolly, and very soft, with the addition of a few silky hairs of a lustrous black; most of the upper parts are of a deep velvety maroon-brown, and the anterior parts silvery-gray. Body elongated; tail short and stout; hinder feet very short.

E. marina is the Sea-Beaver of Kraschenínikoff; the Sea-Otter of Cook, Pennant, Meares, Menzies, and Godman; the Kalan of the Kamtchatkadales; *Mustela Lutris* of Linnæus; *Lutra marina* of Steller, Erxleben, and Harlan; Loutre du Kamtchatka of the French.



Sea-Otter (*Enhydra marina*).

Captain Cook, in his last voyage (chapter on King George's Sound Nootka), says: "It might have been sufficient to have mentioned that this animal (the Sea-Otter) abounds here, as it is fully described in different books, taken from the accounts of the Russian adventurers in their expeditions eastward from Kamtchatka, if there had not been a small difference in one that we saw. We for some time entertained doubts whether the many skins which the natives brought really belonged to this animal; as our only reason for being of that opinion was founded on the size, colour, and fineness of the fur; till a short while before our departure, when a whole one, that had been just killed, was purchased from some strangers who came to barter; and of this Mr. Weber made a drawing. It was rather young, weighing only 25 lbs.; of a shining or glossy black colour, but many of the hairs being tipt with white gave it a grayish cast at first sight. The face, throat, and breast were of a yellowish-white or very light-brown colour, which in many of the skins extended the whole length of the belly. It had six cutting teeth in each jaw; two of those of the lower jaw being very minute, and placed without, at the base of the two middle ones. In these circumstances it seems to disagree with those found by the Russians, and also in not having the outer toes of the hind feet skirted by a membrane. There seemed also to be a greater variety in the colour of the skins than is mentioned by the describers of the Russian Sea-Otters. These changes of colour certainly take place at the different gradations of life. The very young ones had brown hair, which was coarse, with very little fur underneath; but those of the size of the entire animal which came into our possession, and just described, had a considerable quantity of that substance; and both in that colour and state the Sea-Otters seem to remain till they have attained their full growth. After that they lose the black colour, and assume a deep brown or sooty colour; but have then a greater quantity of very fine fur, and scarcely any long hairs. Others, which are suspected to be still older, were of a chestnut-brown; and a few skins were seen that had even acquired a perfectly yellow colour. The fur of these animals, as mentioned in the Russian accounts, is certainly softer and finer than that of any others we know of; and therefore the discovery of this part of the continent of North America, where so valuable an article of commerce may be met with, cannot be a matter of indifference."

The Sea-Otter haunts sea-washed rocks, lives mostly in the water, and approximates to the seals more than to the otters in its habits. The food is fish. The female brings forth on land, and notwithstanding the general marine habits of the animal it has been occasionally seen very far from the shore.

It is found in the North Pacific, from Kamtchatka to the Yellow Sea on the Asiatic side, and from Alaska to California on the American coast. (Richardson.)

The fur was eagerly sought after, and is still prized, but not so highly as formerly. Coxe quotes Pallas for the fact that the old and middle-aged sea-otter skins were sold at Kiachta by the Russians to the Chinese at from 80 to 100 roubles a skin, or from 16*l.* to 20*l.* each. Sir John Richardson observes that the trade was for a considerable period in the hands of the Russians, who, soon after the discovery of the north-west coast of America by Behring and Tschirikow, sent mercantile expeditions there. The passage above quoted from Captain Cook's 'Third Voyage' drew the attention of the English, and both private merchants and the India Company sent vessels to collect skins on the American coast and transport them to Canton. Pennant's hint at the profitable trade which might be carried on with China by a colony, were it possible to penetrate to that part of America by means of rivers and lakes, seems not to have been lost. Sir Alexander Mackenzie having traversed the continent of America and reached the Pacific, his partners in trade established fur ports in New Caledonia and a direct commerce with China; but, as Sir John Richardson remarks in conclusion, the influx of furs into that market soon reduced their price.

LUTRARIA. [Pyloridea.]

LUTRICOLA. [Pyloridea.]

LU'ZULA, a genus of Plants belonging to the natural order *Juncaceæ.* It has a 1-celled 3-valved capsule, without dissepiments, with three seeds at the base of the cell. Several species of this genus have been described.

L. sylvatica, the Great Wood-Rush, has linear-lanceolate hairy leaves, the panicle sub-cymose, doubly compound; peduncles elongated; segments of perianth bristle-pointed, as long as the ovate mucronate capsule; filaments very short; seed minutely tubercled at the end. It is the *Juncus sylvaticus* of Hudson. It has an underground woody stem.

L. Fosteri has a 1-flowered erect peduncle, with both flower- and fruit-style equalling the stamens; capsules acute; seeds with a straight blunt crest.

L. Borreri has a peduncle 1-2-flowered, the upper ones reflexed after flowering; style equalling the stamens; filaments about half as long as the anthers. The seeds are as large as those of *L. Fosteri,* and with a long crest folded back upon the seed.

L. pilosa has peduncles 1-3-flowered; capsules blunt, scarcely as long as the perianth; seeds with a falcate crest.

L. campestris has a panicle of 3 or 4 ovate, dense, sessile, or stalked clusters; filaments much shorter than the anthers; seeds nearly globular, with a basal appendage. The root of this species has a popular reputation as a diuretic, and is used in China and the north of Europe.

L. multiflora is known by the filaments being about as long as the anthers; seeds nearly twice as broad, with a basal appendage.

L. spicata has a panicle with an oblong lobed nodding spike. It is found in mountainous districts.

L. arcuata has a sub-umbellate panicle of few 3-5-flowered clusters on long drooping peduncles; the stem is slender, 2 to 5 inches long. It is found on the highest summits of the Cairngorum and Sutherland Mountains. All the species here described are British.

(Babington, *Manual of British Botany.*)

LYCAON. [Hyæna-Dog.]

LYCESTA, Savigny's name for a genus of *Crustacea* which M. Desmarest views as coming very near to the genus *Mæra* of Leach.

LYCHNIS (from λύχνος, a lamp), a genus of Plants belonging to the natural order *Caryophyllaceæ,* and to the sub-order *Sileneæ.* It has a 5-toothed naked calyx; 5 petals, clawed; 10 stamens; 5 styles; the capsules 1-celled, or half 5-celled, opening at the top with 5 or 10 teeth. The species are smooth, hairy, or woolly herbs, with terminal corymbs of flowers, rarely solitary.

L. Chalcedonica, the Scarlet Lychnis, is a smoothish clammy plant, with corymbose flowers in bundles; the calyx cylindrical, clavate, ribbed; the calyx 2-lobed, the carpophore long; the leaves lanceolate, slightly cordate at the base, and clasping the stem. This plant, which produces scarlet, rose-coloured, or white flowers, and is a great favourite in our gardens, is a native of Siberia and Japan. Several varieties of this plant have been named.

L. grandiflora is a glabrous plant, the flowers solitary or ternate, terminal and axillary; the calyx terete, clavate, ribbed; the petals lacerated; carpophore elongated; the leaves ovate, almost sessile. It has large beautiful scarlet flowers, and is a native of China and Japan.

L. Flos Cuculi, Ragged Robin, has deeply 4-cleft petals, with a very short carpophore. It has rose-coloured petals, and is an abundant plant in the moist meadows and pastures of Great Britain, as well as the whole of Europe.

L. vespertina, White Campion, has the petals half-bifid, and the calyx-teeth of the fertile flowers linear-lanceolate, elongated; the capsule conical; the teeth erect. It is a common plant in the hedge-banks of Europe. This and the following species are frequently regarded as varieties, and then named *L. dioica*.

L. diurna, Red Campion, has the petals half-bifid; the calyx-teeth of the fertile flower triangular; the capsule nearly globular; the teeth reflexed.

The other British species of the genus *Lychnis* are—*L. Githago*, the Corn-Cockle, a pretty plant blossoming in corn-fields from June to September; *L. alpina*, found on the mountains of Forfarshire; and *L. Viscaria*, a rare plant.

Many of the foreign species are cultivated in our gardens. They thrive well in a light rich loamy soil, and may be propagated by cuttings or seeds.

(Don, *Dichlamydeous Plants;* Babington, *Manual of British Botany*.)

LYCIUM, a genus of Plants belonging to the natural order *Solanaceæ*. It has an urceolate calyx regularly 5-toothed, or irregularly 3-5-cleft; permanent corolla funnel-shaped or tubular; limb 5- or 10-cleft, or toothed, imbricate in æstivation, sometimes plicate; stamens 5, usually exserted; filaments banded and widened at the base; stigma peltately depressed, or capitate, bisulcate; berry roundish, 2-celled, propped by the permanent calyx; placentas adnate; seeds numerous, reniform. The species are trees or shrubs usually spinose. Corollas white, yellow, rose-coloured, purple, blue, or scarlet.

L. Europæum has erect loose branches; buds spinescent; leaves fascicled, obovate, lanceolate, obtuse, or spathulate, bent obliquely; flowers twin or solitary; corolla funnel-shaped; stamens exserted, but shorter than the limb. It is a native of the south of Europe and the north of Africa: in the Grecian Islands common in hedges, but scarcely indigenous. The calyx is 5-cleft, ruptured at the side: the corollas pale violet, reticulated with red veins; tube greenish. Clusius says that the young shoots are eaten in Spain with oil and vinegar.

L. Barbarum has dependent branches; buds spiny; leaves lanceolate, flat, glabrous, acute; flowers twin, extra-axillary, pedicellate; corolla funnel-shaped; stamens exserted, about equal in length to the limb. It is a native of the north of Asia, Africa, and south of Europe. There is a variety having pale corollas and yellowish red berries.

There are about 30 species of this genus described, many of which are to be found in our gardens. They are commonly known by the name of Box-Thorn.

LY'CIUM. Many ancient authors, and among others Dioscorides, describe under the above name a substance as used in medicine, which is stated to be of two kinds; one obtained from Lycia and Cappadocia, and the other from India. The former is said to be the produce of a thorny shrub called *Pyxacantha*. The latter is stated to be more valuable and efficacious as a medicine, and to be produced also by a thorny shrub which is called *Lonchitis*.

Most modern authors have stated these plants and the substance they produce to be totally unknown; others consider species of *Rhamnus*, or the Common Box, to be alluded to. Prosper Alpinus thought *Berberis Cretica* to be one of the plants; while Garcias ab Orto thought Catechu to be the substance, and *Acacia Catechu* the plant yielding it. It is possible that some species of *Rhamnus*, as *R. infectorius*, of which both the root, wood, and berries possess medicinal properties, and which are in the present day used for dyeing yellow, may have formed one of the kinds of Lycium, as it is common in the countries where the first kind is said to have been produced, and some species of *Rhamnus* were by the older botanists called *Lycium*. Though there is uncertainty about the Lycium of Asia Minor, that of India seemed to have been quite unknown until the publication of a paper 'On the Lycium of Dioscorides,' by Dr. Royle, in the 'Linnæan Society's Transactions' for 1833, where it is stated that there is no proof that Catechu was the Λύκιον Ἰνδικόν (*Lycium Indicum*) of the ancients; in fact is incompatible with the evidence adduced on the subject from Oriental writers. The Greek authors on medicine having been translated into Arabic, and from this language into Persian, and these, with additions, forming the works now in use in India, we may expect to find in them some trace of Lycium; and in fact in that called Makhzun-al-Udwieh, Loofyon is mentioned as the plant which yields Huziz, and in Persian it is called Feel-Zukreh. Loofyon is evidently written for Lookyon, through an error of the transcriber in a diacritical point, in the same way that Filafoos (Philip of Macedon) has been changed in some of these works into Filakoos. This is further evident indeed from referring to the Latin translations of Serapion and Avicenna, where Hadad and Feel-Zuhuruj are translated *Lycium* and *Lycium Indicum*. In the Persian work, Hoozuz or Hooziz (the same word as Hadad) is described as being of two kinds: one from India, of which the Hindoo name is Rusot; and the other from Arabia. The Persian name Feel-Zuhreh is translated in our best dictionaries 'box-thorn,' that is, *Pyxacantha*. The best kind of Rusot is said, in the Makhzun-al-Udwieh, to be brought from Nuggur-Kote in the neighbourhood of Lahore, and that it is an extract made from a decoction of the fresh wood of Dar-Huld. On inquiring in the shops of the druggists in the bazaars of India, Dr. R. learned that both the wood Dar-Huld and the extract Rusot were imported into the plains of India from the Himalayas. On travelling in these mountains, and on wishing to be shown the plant which produced the wood called Dar-Huld as well as that from which the Rusot was procured, species of Barberry were immediately pointed out, and it was stated that both the wood and the extract were procured indifferently from *Berberis Asiatica*, *B. aristata*, *B. Lycium*, and *B. pinnata*. On cutting into the wood of each, and having some converted into extract, he found both to correspond in every respect with what be had bought in the plains under the name of Dar-Huld and Rusot. The extract Rusot is procurable in the bazaars of India, being much employed by the native practitioners of medicine in India, as an external application rubbed over the swollen eye-lid either simply or in combination with opium and alum and a little water or oil, both in incipient and chronic inflammation of the eye. The wood of Barberry being employed both in Europe and India as a yellow dye, it has been suggested by Mr. E. Solly, in a paper read before the Royal Asiatic Society, that the root, wood, or extract might be imported from India for the use of the manufacturers of Europe. This notice may appear disproportioned to the importance of the subject, but it is interesting as showing the knowledge which the Greeks had of the products of India, at the same time that it proves the great extent to which the influence of their own works has spread.

LY'CODON, a genus of Ophidian Reptiles, of which *L. Capensis*, Smith (*L. Horstokii*, Schlegel), may be taken as an example. This snake is shining greenish-brown above, head without variations, and the scales along the middle of the back less distinctly marked with white specks than those of the sides.

Lycodon Capensis, var. Smith.

Dr. Smith, who recorded this species in 1831, in the 'South African Quarterly Journal,' figures and describes, in the 4th number of the 'Illustrations of the Zoology of South Africa' (1838), a variety of a shining blackish-green colour above, tinged with purple, the head reticulated with white lines, and the scales white at the tips; greenish-yellow below; eyes livid-green. Length from nose to tail 12 inches; of the tail 2 inches.

The variety above described was found among decayed wood, near a small stream, immediately beyond Kurrichane, about 25° S. lat.

"When," continues Dr. Smith, "by the removal of some of the rotten masses, the reptile was exposed, it moved slowly among the remaining ones in search of a place of concealment; and when it was interrupted in its advance, it simply coiled itself up without manifesting any disposition to resist the opposition offered; a similar course I had previously observed others of the same species pursue when attempts were made to secure them; and neither did the one here described nor the others ever move with any considerable rapidity, nor appear much in fear of their assailants. All the specimens which I have seen of this species were obtained in damp situations, and never remote from localities where they could rapidly and without much exertion conceal themselves if necessary; and in the latter respect they resemble most of the innocuous snakes of South Africa, which are not endowed with the powers of effecting rapid movements."

LYCOPERDACEÆ, or GASTEROMYCETES, an order of Plants belonging to Lindley's Alliance *Fungales*, characterised by having the spores generally quaternate on distinct sporophores; hymenium inclosed in a peridium. [FUNGI.]

LYCOPERDINA. [EUMORPHUS.]

LYCOPERDON, a genus of Fungi, emitting when burst, either by violence or natural dehiscence, a quantity of dust-like seeds or spores, whence the species are commonly called Puff-Balls. The old botanists collected under this name a variety of plants, very different from each other in many respects, although agreeing in the circumstance just mentioned; recent writers have distinguished them as so many distinct genera. The only two which it is necessary to mention here are the Common Puff-Balls, which burst irregularly, and the Starry Puff-Balls, which split in a definite stellate manner. They are each inhabitants of meadows, pastures, woods, lawns, &c., and some of the species are exceedingly common. When the Common Puff-Ball, *L. gemmatum*, first appears, it forms a whitish ball, looking like a common eatable mushroom, but by degrees it changes colour, becomes brown, and tearing irregularly at the apex, discharges a cloud of brownish dust, consisting entirely of its spores. The Geasters, Starry Puff-Balls, are much less common; instead of bursting irregularly at the apex when ripe, their outer rind separates into a definite number of lobes, which spread open, curve backwards, and at last elevate upon their centre a bag containing the spores. No use has ever been made of any of the Lycoperdons, except in the case of *L. giganteum*, a very large indehiscent species, often many feet in circumference, and filled with a loathsome pulpy mass, which has been employed as a styptic, and for tinder.

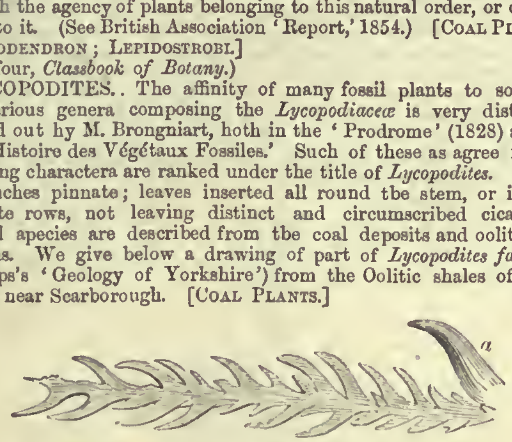
LYCOPODIACEÆ, *Club-Mosses*, a natural order of Vascular Acrogens, consisting of plants with creeping stems or corms, which produce leafy branches somewhat resembling Mosses. The leaves are small, sessile, and imbricated or verticillate; the fructification occurs in the axil of leaves and often in a spike-like form, and consists of kidney-shaped 2-valved cases, which contain antheridian or spermatozoidal cells, and roundish or 4-sided bodies called oophoridiæ, opening by two valves, and containing four large spores. In the interior of the latter a pro-embryo is developed, in which archegonia are produced, and thereafter impregnation gives rise to the germinating body. The species are natives both of cold and warm climates, and are abundant in the tropics, especially in insular situations. There are about 200 of them. Some have emetic and purgative properties. The powdery matter contained in their fructification is inflammable. This family has an especial interest from its resemblance to an extinct race of gigantic plants found in the coal beds, and called *Lepidodendron*.

Evidence is daily increasing which renders it probable that a large proportion of the coal in this and other countries has been deposited through the agency of plants belonging to this natural order, or closely allied to it. (See British Association 'Report,' 1854.) [COAL PLANTS; LEPIDODENDRON; LEPIDOSTROBI.]

(Balfour, *Classbook of Botany.*)

LYCOPODITES. The affinity of many fossil plants to some of the various genera composing the *Lycopodiaceæ* is very distinctly pointed out by M. Brongniart, both in the 'Prodrome' (1828) and in the 'Histoire des Végétaux Fossiles.' Such of these as agree in the following characters are ranked under the title of *Lycopodites*.

Branches pinnate; leaves inserted all round the stem, or in two opposite rows, not leaving distinct and circumscribed cicatrices. Several species are described from the coal deposits and oolitic formations. We give below a drawing of part of *Lycopodites falcatus* (Phillips's 'Geology of Yorkshire') from the Oolitic shales of Gristhorpe near Scarborough. [COAL PLANTS.]



a, leaf magnified, to show the direction of the nervures.

LYCOPODIUM, a genus of Plants belonging to the natural order *Lycopodiaceæ*. It has 1-celled 2-valved capsules, containing powder, or 3-valved, containing 1 to 4 granules.

L. clavatum, Common Club-Moss, has scattered leaves, incurved, with a filamentous point; spikes stalked, 2 or 3 together, cylindrical; scales ovate, triangular, membranous, finely incised, serrated. The stem is prostrate and long; branches short and ascending; spikes on long stalks, pale-yellow; scales on the stalks irregularly disposed in whorls. The powder contained in the spore-cases is highly inflammable: shaken out and collected it is employed under the name of Lycopode, or Vegetable Brimstone, on the Continent, in the manufacture of fireworks, and in pharmacy to roll up pills, which when coated may be put in water without being moistened. The plant has long been used as an emetic; a decoction of it is said to be serviceable in removing Plica Polonica.

L. annotinum has scattered lanceolate leaves; spikes sessile, solitary, terminal; scales roundish, with an alternated point, membranous, and jagged. The branches are rather long and erect, each year's growth is marked by a spot where the leaves are adpressed. The spikes are cylindrical, greenish-yellow, not persistent. It is found on stony mountains in Cumberland and Caernarvonshire, and is common in the Highlands of Scotland.

L. alpinum, Savin-Leaved Club-Moss, has leaves in four rows, imbricated, acute, keeled, entire; spikes sessile, solitary, terminal; scales ovate-lanceolate, flat; branches erect, clustered, forked, level-topped. The stem is prostrate and long. Fertile branches usually twice dichotomous, each division ending in a short cylindrical yellowish-green spike, rather thicker than the branch. It is found on elevated mountains in Great Britain.

L. Selago, Fir Club-Moss, has leaves in eight rows, crowded, uniform, linear-lanceolate, acuminate; capsules not spiked, but in the axils of the common leaves; stem erect, forked, level-topped. The stem is short, erect, or slightly decumbent, densely leafy. Occasionally in sheltered positions the stem becomes elongated. In the Highlands of Scotland it is made into an irritating ointment, which is applied with advantage to the neighbourhood of the eyes as a counter-irritant. Internally administered it acts as an emetic and cathartic. Linnæus says the Swedes find the decoction serviceable as a detergent lotion, and in destroying the vermin that infest cattle.

L. inundatum and *L. selaginoides* are the other British species, both found in boggy places. The most remarkable species is the *L. rubrum* of Chamisso, *Yatum condenado*, Great Devil. Sir William Hooker, who calls it *L. catharticum*, states that it acts most violently as a purgative, and has been administered successfully in Spanish America in cases of elephantiasis. According to Vastring, Club-Mosses are likely to become of importance in dyeing: he asserts that woollen cloths boiled with Lycopodiums, especially with *L. clavatum*, acquire the property of becoming blue when passed through a bath of Brazil-Wood. *L. phlegmaria* is reputed an aphrodisiac. *L. squamatum* is remarkable for its hygrometrical properties, rolling up into a ball when dry and expanding when moisture is applied.

(Balfour, *Classbook of Botany*; Babington, *Manual of British Botany*; Lindley, *Vegetable Kingdom.*)

LYCOPSIS, a genus of Plants belonging to the natural order *Boraginaceæ* and the tribe *Anchuseæ*, which have their 4 nuts placed on a hypogynous disc, with an excavated space surmounted by a tumid ring at their base.

Lycopsis has the calyx in 5 deep segments; the tube of the corolla curved; the limb oblique. The species closely resemble those of *Anchusa*, except in the above characters.

L. arvensis, the Bugloss, has lanceolate erose-dentate very hispid leaves; the calyx of the fruit is bell-shaped, erect. The flowers are small and blue. The whole plant is very hispid, with strong hairs, each rising from a scaly tubercle. It is common in the fields and hedges of Great Britain and Europe.

LYCOPUS, a genus of Plants belonging to the natural order *Labiatæ*. It has a 4-fid corolla, scarcely longer than the equal 5-toothed calyx; stamens 2; anther-cells parallel or ultimately divergent; 2 upper stamens wanting, or rudimentary, or rarely perfect.

L. Europæus inhabits wet ditches and sides of ponds, and is known popularly under the name of Gipsey-Wort, because gipsies are said to stain their skins with its juice. It has stalked ovate-oblong leaves, glabrous or pubescent, opposite. Flowers small, in dense whorls. It is found on banks of streams and ditches in Great Britain.

LYCO'RIS, Savigny's name for a genus of Dorsibranchiate *Annelida* (Nereids, properly so called) of Cuvier.

LYCUS. [LAMPYRIDÆ.]

LYDIAN STONE. [FLINTY SLATE.]

LYGODYSODEA'CEÆ, a natural order of Plants closely allied to *Cinchonaceæ*. It differs from this order in possessing an ovary composed of two confluent carpels, 1-celled, with two ovules, and a single style; the pericarp, brittle, bursts in four directions from the base, not adhering to the seeds, 1-celled; two free placentæ rising up between the pericarp and the back of the seeds; two seeds pendulous from the apex of the placentæ, with the embryo straight, foliaceous, compressed; the radicle short, inferior. The species are twining shrubs, and have single stipules between the petioles.

This little order was constituted by Bartling, but was afterwards examined by De Candolle, who thought there was no reason for separating it from *Cinchonaceæ*. "According to De Candolle, what Bartling calls pericarp is calyx, and his seeds are carpels, and consequently all the most remarkable features of the order disappear, with the exception of the absence of the albumen." (Lindley.) This is a subject that merits further investigation. The only genus of this order is *Lygodysodea*, of which two species, *L. fœtida* and *L. ciliata* have been described. They are both natives of Peru and Mexico.

LYME-GRASS. [ELYMUS.]

LYMNEA. [LIMNEADÆ.]

LYMNO'REA, a genus of Fossil *Zoophyta*, proposed by Lamouroux ('Expos.,' p. 79). Also the name of a genus of recent *Medusæ*. (De Blainville, *Actinologie*, p. 290.)

LYMPH, the fluid found in that part of the absorbent system of the higher animals called Lymphatics. [ABSORBENT SYSTEM.] The lymph, with the chyle [DIGESTION], is carried into the thoracic duct before being poured into the circulating fluid. When taken from the lymphatics it forms a colourless or yellow fluid, which is only red when blood-globules are accidentally mixed with it. Its reaction is usually alkaline; it coagulates from 4 to 20 minutes after its discharge. Floating about in it can be seen fat-globules and small granular bodies, such as are seen in chyle, and also the true lymph-corpuscle.

Lymph is very difficult to procure in its pure condition—hence the variety of descriptions which have been given of its character and contents. The chemical constituents of the lymph in general are very similar to those of the blood without its red corpuscles. The substance which spontaneously coagulates in it is perfectly identical with the fibrine of the blood. The albumen of the lymph has the same general properties as that of the blood. According to Geiger the lymph contains a large quantity of the strongly basic albuminate of soda, which, in the absence of other alkaline salts, communicates no alkaline reaction to the solution, and even when coagulated retains much alkali. The fat of the lymph is in small quantities, and that for the most part in a saponified form; chloride of sodium is the preponderating mineral ingredient. Lymph contains a larger amount of water than blood. In human lymph Marchand found 96·926 and L'Heritier 92·436 of water: in the lymph of horses the quantity has been found to vary from 92 to 98 parts in 100.

The elementary granules found free in the chyle and lymph are immeasurably minute. They are said by H. Müller to consist of fat and a protein envelope. They are very much more abundant in chyle than in lymph. Besides these Kölliker describes free nuclei from 0·001‴—0·002‴ in size: these are found principally in the lacteals, and never in the thoracic duct. The lymph-corpuscles, or chyle-corpuscles—for they both have the same characters—are found everywhere in the lymph. They are rounded pale cells 0·0025‴—0·0055‴ in diameter. When examined in their native fluid they appear homogeneous or finely granular, and contain a usually indistinct transparent homogeneous slightly-glistening round nucleus. On the addition of water the nucleus and contents are rendered turbid by a granular deposit; and on that of acetic acid they become transparent and pale, exhibiting the strongly-granulated contracted nuclei with extreme distinctness, bursting at the same time and allowing the contents to escape. This change also frequently takes place in the smaller cells on the addition of water, preceded by the apperance of clear albuminous drops. In size, quantity, and shape the lymph-corpuscles present diversities according to situation. With regard to the origin of the lymph-corpuscles, Professor Kölliker says they are formed like cells, by the development of membranes around free nuclei, a process which is effected, in the first place, in the commencement of the lymphatic vessels, but also, and chiefly, in the vasa efferentia of the lymphatic gland. To this is added the multiplication of cells by division, which does not always take place.

The importance of the lymph-corpuscle in relation to the blood has been pointed out by Mr. Wharton Jones in a paper on the 'Blood-Corpuscle' in the 'Philosophical Transactions' for 1846. In this memoir he says:—"The lymph-corpuscle of the *Vertebrata* is identical with the corpuscle of their blood. In the Oviparous *Vertebrata* it occurs, like the corpuscle of their blood, in the three phases of granule-cell, nucleated-cell, and free cellæform nucleus. The only difference that exists between the corpuscle of the lymph and the corpuscle in the blood is, as regards the Oviparous *Vertebrata*, the little degree of coloration which the coloured stage of the nucleated cell as yet presents; and as regards the *Mammifera*, the small degree of coloration which the coloured stage of free cellæform nucleus has yet attained." In the same paper Mr. Jones describes what has since been observed by other investigators, that the lymph-corpuscle presents a power of moving its cell-wall similar to that possessed by some of the lower forms of plants and animals, as the *Amœbæ*, *Nostochineæ*, &c.

From these observations it will be obvious that the old notion that the function of the lymphatics was to carry the effete matters of the tissues into the blood is erroneous. The chemical analysis of the lymph, as well as the nature of its morphological elements, forbids this view. Lehmann, in his 'Physiological Chemistry,' concludes from his analyses of the blood and lymph, that "the function of the lymphatics consists not merely in conveying those parts of the tissues which have become effete into the blood, from which after undergoing further changes they are separated by the organs of excretion, but also in elaborating the still plastic portions of the blood into cells, namely, the blood-corpuscles; for how, if this were not the case, could cells occur directly in the lymph if it merely carried off the disintegrated remains of the tissues? For what purpose would its action through the lymphatic glands be suspended, or at all events considerably impeded, if the absorbents were not, like the lacteals, organs for the elaboration and formation of the blood?"

(Kölliker, *Manual of Human Histology*, translated for Sydenham Society; Lehmann, *Physiological Chemistry*, translated for Cavendish Society.)

LYMPHATICS. [ABSORBENTS.]

LYNX. [FELIDÆ.]

LYO'NSIA, a genus of Conchiferous *Mollusca* belonging to the Myaceous group. Mr. G. B. Sowerby has described two species: one, *L. picta*, found by Mr. Cuming at the island of Muerte attached to particles of sand in eleven fathoms water, and which becomes rather irregular in form as it increases in size; and the other, *L. brevifrons*, found at St. Helena, in sandy mud, at depths ranging from six to eight fathoms, attached to particles of sand.

LYPORNIX, Wagler's name for a genus of Birds with a moderate bill defended by very long bristles, and both mandibles nearly equal, the wings very short and rounded, and the tail narrow. [HALCYONIDÆ.]

LYRIE. [ASPIDOPHORUS.]

LYRIOCEPHALUS. [DRACONINA.]

LYRURUS. [BLACK-COCK.]

LYSI'DICE, Savigny's name for a genus of Dorsibranchiate *Annelida*, which, with jaws like those of *Eunice* (Cuvier), or even more numerous than in that form, and often unequal in number, have only three tentacles, and cirrhi for branchiæ. [ANNELIDA.]

LYSIMACHI'A, a genus of Plants belonging to the natural order *Primulaceæ*. It has a 5-parted calyx, a rotate corolla with scarcely any tube, and a 5-parted limb; the stamens are inserted at the base of the corolla, and are 5 in number; the capsules open with 5 valves.

L. thyrsiflora is distinguished by its axillary stalked dense racemes; its leaves are opposite and lanceolate; the corolla is divided almost to the base into narrow petals, often separated by a minute tooth, which as well as the calyx is yellow, spotted with orange. It is found in marshes in the north of England.

L. vulgaris has an erect stem, with compound terminal and axillary panicles; ovate or ovate-lanceolate leaves, nearly sessile, or 3 or 4 in a whorl; the petals are entire, with glabrous edges; the stamens 5, and combined for half their length. This species is the *L. punctata* of some botanists, and probably the Λυσιμάχιον Ἄνθος Χρυσοειδὲς of Dioscorides, lib. iv. cap. 3.

L. Nummularia, Money-Wort, has a prostrate creeping stem, solitary axillary flowers, ovate-acute sepals, and glandular filaments connected at the base; the leaves are opposite, roundish, and shortly stalked; the peduncles shorter than the leaves. It is found in damp places in Great Britain.

L. nemorum has linear-lanceolate sepals, smooth distinct filaments, and opposite ovate-acute leaves. It is found in woods and damp shady places in Great Britain. *L. atropurpurea* is the Λυσιμάχιον Ἄνθος Πυῤῥὸν of Dioscorides (lib. iv. cap. 3).

(Fraas, *Synopsis Plantarum Floræ Classicæ*; Babington *Manual of British Botany*.)

LY'SMATA, Risso's name for a genus of Macrurous Decapod *Crustacea* allied to the Shrimps.

LYSTRONICHUS. [CYSTELIDES.]

LYTHE. [MERLANGUS.]

LYTHRA'CEÆ, *Loosestrifes*, a natural order of Polypetalous Exogens, the essential character of which is to have a tubular calyx with conspicuous complete ribs, petals inserted into the orifice of the calyx, stamens springing from its base or middle, and a superior polyspermous ovary. They are most near *Melastomaceæ* and *Onagraceæ*. The order contains few plants of any interest. Some of the genus *Lagerstromia* are handsome Indian large-flowered bushes, represented in South America by *Diplusodon*; a few *Ammannias* have acrid leaves, which act as vesicants when applied to the skin; and the Henné dye used by Oriental women for their nails is the juice of the fruit of *Lawsonia*. *Lythrum Salicaria*, the subject of the following cut, is an English type of the order. It is also found in Australia, and has been prescribed in diarrhœa.

Purple Loosestrife (*Lythrum Salicaria*).

1, a flower-bud; 2, a calyx cut open and showing the insertion of the stamens; 3, a transverse section of an ovary; 4, a ripe capsule, with its four valves.

LYTHRUM (from λύθρον, 'black blood,' from the purple colour of the flowers), a genus of Plants belonging to the natural order *Lythraceæ*. It has a tubular cylindrical calyx, with from 8 to 12 teeth; from 4 to 6 of the teeth are broader than the rest and erect, the alternate ones being subulate and opposite to the petals. It has from 4 to 6 petals and a very short style. The capsules are 2-celled and many-seeded.

L. Salicaria, Purple Loosestrife, has lanceolate leaves from a cordate base, and whorled. The flowers are in whorled leafy spikes, almost sessile. It is a native of Europe, in ditches and watery places, especially about the margins of ponds and rivers, and is found in Britain very plentifully. The colour of the flowers varies from crimson to purple. The herbage is generally almost smooth, and of a dark-green, but in dry situations it becomes hoary and downy, or in some degree hairy, as well as more dwarfy in stature. This species is the *Lysamachia* of Pliny, lib. xxv. cap. 7; lib. xxvi. cap 12, 14.

L. hyssopifolia has alternate linear-lanceolate blunt leaves. The flowers are axillary and solitary, with two minute subulate bracts. The calyx teeth are all short, and the stamens are usually six in number. The flowers are small and of a light purple-colour. The whole plant is glabrous, and is found in damp places in Great Britain.

L. Hunteri, Hunter's Purple Loosestrife, is a native of the East Indies. The leaves are opposite, the calyx tubular and 6-lobed, the stamens 12, and the style subulate. The petals, 6 in number, are of a very beautiful red-colour, and are used for dyeing in India. The hardy perennial species of *Lythrum* are handsome garden-flowers; they grow in any common soil, and are easily propagated by dividing at the root. The seeds of the annual kinds require to be sown in moist situations in the spring.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*.)

M

MAASTRICHT ROCKS. The rock of St. Peter's Mountain is generally of a granular texture, and to geological observers presents a sort of middle character between Chalk and particular parts of the Calcaire Grossier of the Paris basin. The geological relation thus suggested is confirmed by the organic remains, which, with many points of specific resemblance to the ordinary fossils of the chalk, exhibit likewise some generic relations to the Tertiary series. Accordingly, the place in the scale of strata now assigned by common consent to the Maastricht Rocks is in immediate superposition above the Chalk of England, and at some small interval below the Calcaire Grossier of Paris. It may be considered as an upper part of the Chalk Formation, and is paralleled by observed cases in the south-west of France. It is principally to Dr. Fitton ('Proceedings of Geol. Soc. of London,' 1829) that English geologists owe the establishment of this important classification.

St. Peter's Mountain is rich in fossils, some of which lie in flint nodules, and others in the stone. A few years ago the bones of some ruminant quadrupeds were offered for sale at Maastricht, and were described as from this hill, but they did not really belong to the ancient rock. The genuine remains are however very remarkable; in particular the great aquatic reptile, imagined to be a crocodile by Faujas St. Fond, but determined to have other analogies to the *Lacertiadæ* by Cuvier, who named it *Mosasaurus*: vertebræ of this animal have been found in the chalk of England and Sweden. A very large species of marine turtle (*Chelonia*) has also been completely examined by Cuvier from this locality. Beautiful teeth of fishes, shells of *Nautili, Baculites, Belemnites, Hippurites, Inocerami, Ostreæ, Echinida, Terebratulæ*, and *Polypiaria* may by seen in some of the interesting collections at Maastricht, and go far to prove the truth of the prevalent opinion, that the strata of St. Peter's Mountain are more allied to the Chalk than to the Calcaire Grossier—the newest of the Secondary, rather than the oldest of the Tertiary rocks.

(Dr. Fitton in *Geol. Proceedings and Transactions*; Meyer, *Palæologica*; Von Dechen, *Handbuch*, &c.)

MACACO. [LEMURIDÆ.]

MACA'CUS, a barbarous word founded on the term Macaco (written by the French Macaque), which, according to Cuvier and the author of 'Natural History of Monkeys, Lemurs, and Opossums,' appears for the first time in Marcgrave's 'Natural History of Brazil,' as the native appellation of a kind of monkey found in Congo and along the coasts of the Gulf of Guinea. The author of the 'Natural History of Monkeys,' &c., observes that its application to an Asiatic species, of a genus totally distinct from that to which the animal properly bearing it really belongs, is one of the many similar errors of nomenclature committed by Buffon, at that time indeed unavoidable from the very limited knowledge which naturalists possessed on the subject of specific distinctions, and especially from the confusion which reigned in the geographical part of zoology.

Lacépède seems to have been the first who Latinised this term, and he was followed by other French zoologists as well as by those of other countries. The Ouanderow or Wanderow appears to be considered the type of the genus, at least it stands at the head of the heterogeneous species comprehended under the title.

Thus Cuvier arranges under the Macaques the following *Simiadæ*: *Silenus, Sinica, S. radiata, S. cynomolgus* and *S. cynocephalus, S. Rhesus, S. nemestrina*, &c.

Dr. J. E. Gray arranges the genus as the last of his sub-family *Cercopithecina* (family *Hominidæ*).

M. Lesson, who makes the characters of the genus consist in a facial angle of from 40 to 45 degrees; in a very strong development of the supraciliary and occipital crests; the presence of pouches and callosities, and a tail more or less long, gives as its dental formula that which is common to so many of the *Simiadæ*, namely:—

$$\text{Incisors, } \frac{4}{4}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{5-5} = 32;$$

and he arranges under it the following species:—*Silenus, Sinicus, S. carbonarius, S. radiatus, S. cynomolgus, S. Rhesus, S. nemestrinus*, and *S. speciosus*.

Sir William Jardine adopts the genus with the following species:—*Macacus Silenus, M. Sinicus, M. radiatus, M. cynomolgus, M. Rhesus, M. nemestrinus*, and *M. niger*.

Mr. Swainson, who also adopts the genus, gives the species the English appellation of Ape-Baboons; and he considers that they are distinguished by an elongated muzzle, as in *M. carbonarius*, much more prominent than in the *Cercocebi*, and by a tail more or less lengthened; he is also of opinion that they differ from the *Cyanocephali* (*Cynocephali*) of Cuvier, or True Baboons, because their nostrils "open obliquely on the upper part of the muzzle." Mr. Swainson thinks that the form of these animals, nevertheless, shows a strong resemblance to the *Cercocebi*, which is further increased by their possessing a tail; although this member is generally so short that it seldom equals a third of the length of the body. The muzzle, he observes, is so much elongated, that the facial angle does not exceed 45 degrees, and the canine teeth are strong and large. He further remarks that it deserves attention, that some of the species (as *M. Silenus, M. Sinicus*, and *M. radiatus*) are remarkable for having crests, which either assume the form of a mane or of a radiated tuft. The Chinese Bonnet-Monkey has the hairs disposed in this manner, while its elongated muzzle, in Mr. Swainson's opinion, is very characteristic of the genus, and he states that the form of these animals separates them widely from the monkeys: it is, he says, strong and compact, while their disposition is cunning and mistrustful. He concludes by remarking, that the crested species inhabit India, and that the others are African. ('Nat. Hist. and Classification of Quadrupeds.')

The author of the 'Natural History of Monkeys, Lemurs, and Opossums' rejects, for substantial reasons given in that work, the genus *Macacus*, and applies the term Baboons, as usually understood and applied in the English language, to a group of *Simiæ* co-ordinate with the Apes and Monkeys, as described by him, distinguished from the Apes by the equality of their members, their cheek-pouches, and ischial callosities; and from the Monkeys by the short robust make of their bodies and extremities, their tubercular tails, too short to execute the functions usually assigned to that organ, and the mountain rather than sylvan habitat which this conformation necessarily induces.

"The most prominent of these traits of structure," continues the author, "the abbreviated or tubercular nature of the tail, is the idea usually attached to the word Baboon, and it is certainly the most prominent and characteristic attribute of the group; since, as we have frequently had occasion to observe, the comparative development of this organ, if not the immediate cause, is at all events the most certain index of the habits and economy of these animals:" and he makes the Baboons thus defined comprise two distinct genera, *Papio* and *Cynocephalus*, respectively confined, with one or two exceptions, to the continents of Asia and Africa.

The author then introduces to the reader's notice the genus *Papio* as the last and lowest of the groups which inhabit the Asiatic continent and the great islands of the Indian Archipelago, and which appear to occupy in these regions the situation which the *Cynocephali* fill in Africa. Of the forms placed by the author under this genus the Wanderoo and Gelada (*Papio Silenus* and *P. Gelada*) are the only species in which the tail acquires any length: it never reaches, he remarks, beyond the houghs, nor is it ever employed to assist the progressive motions of the animals as among the *Cercopitheci*. Those species therefore, he thinks, cannot be separated with any kind of propriety from the Papios with tuberculous tails, merely on account of their comparative length; because that organ, though rather more developed in the Wanderoo and *Rhesus* than in the Magot and *Papio niger*, is still greatly abbreviated as compared with the tails of the *Cercopitheci*, and entirely devoid of influence as an element in the habits and economy of animal life.

Reverting to the arrangement of the author of the 'Natural History of Monkeys,' &c., we find the Papios divided into two small groups, distinguished by the greater or less length of the tail on the one hand, and its tuberculous form or total absence on the other; of the latter the well-known Magot, or Barbary Ape, is an example, and the Wanderoo (*Macacus Silenus* of authors, *Papio Silenus* of the author of the 'Nat. Hist. of Monkeys') is an illustration of the former.

The Wanderoo has its hair deep black throughout, with the exception of the long beard or mane, which descends on each side of the face in the form of a ruff, extending downwards over the chest, and varying from an ash-gray to a pure white. The upper part of the face between the eyes naked and flesh-coloured; the muzzle perfectly black. Cheek-pouches large, callosities of considerable size, and flesh-coloured. Tail about half as long as the body, and when perfect, which in captivity is not often the case, terminating in a brush of tufted hairs. (Bennett.) It is the Lion-Tailed Baboon of Pennant.

It is an inhabitant of the peninsula of India, Ceylon (?) (Knox) M. Duvaucel saw the animal in the menagerie at Barracpore, and states, according to F. Cuvier, that the Indians give it the name of Nil Bandar, or perhaps, as the author of 'Nat. Hist. of Monkeys' observes, more properly Nyl or Neel Bhunder, signifying the 'dark-blue or black bhunder'; but this, continues the last-mentioned author, evidently refers merely to the colour of the hair, and can scarcely be the real appellation of the animal, which, not being a native of Bengal, is not likely to have a Bengalee name.

Wanderoo (*Silenus veter*).

Father Vincent Maria gives the following quaint account of this species:—"There are found," says the Padre, "four sorts of monkeys on the coast of Malabar; the first is quite black with glossy hair and a white beard round the chin, measuring rather more than a palm in length. The other monkeys pay to this so profound a respect that they are humble in his presence, as though they appreciated his superiority. The princes and mighty lords hold him in much estimation for his endowments of gravity, capacity, and the appearance of wisdom above every other monkey. He is readily trained to enact a variety of ceremonies and affected courtesies, which he goes through with so grave a face and so perfectly, that it is a most wonderful thing to see them so exactly performed by an irrational creature."

The general posture of the species is on all-fours or seated, in which positions it usually takes its food, either by the hands or by bringing the mouth to it. Its first operation in feeding is generally to fill the cheek-pouches.* It sleeps either on its side or sitting, bent forward, and with the head on the breast. Those which we have seen in captivity have exhibited varied temperaments. One in particular was all life, spirit, and mischief, while another was melancholy and staid in its deportment; and yet the health of both these animals appeared to be equally good, nor was there much difference in their ages.

The following species of *Macacus* are given in the 'British Museum Catalogue:'—

M. radiatus, the Zati, or Capped Macaque.
M. Sinicus, the Munga, or Bonnet-Macaque.
M. nemestrinus, the Bruh.
M. cynomolgus, the Macaque.
M. Rhesus, the Rhesus.
M. Oinops, the Oinops.
M. speciosus.
M. Inuus, the Magot.
M. niger.

In the same Catalogue the Wanderoo is referred to *Silenus veter*.

In his 'British Fossil Mammals,' Professor Owen describes a species of *Macacus* under the title of *M. eocenus;* teeth of this extinct species having been found in the Tertiary clay at Kyson, near Woodbridge, Suffolk.

* "First mouthed, last swallowed."—*Hamlet*.

The following is given by M. F. Cuvier as the dental developmen of the Macaques and Cynocephales, and is taken from the Chinese Bonnet-Monkey (Macaque Bonnet Chinois).

Teeth of *Macacus*, &c.

MACAQUE. [MACACUS.]
MACAUCO. [LEMURIDÆ.]
MACAW. [PSITTACIDÆ.]
MACE. [MYRISTICA.]

MACHÆRIUM, a genus of Plants belonging to the natural order *Leguminosæ*. One species, *M. Schomburgkii*, produces the Itaka Wood of Guyana, remarkable for its brown and black streaks, on which account it is employed in cabinet-work.

MACHAIRODUS. [FELIDÆ.]

MACHE'TES, Cuvier's name for the Ruff (*Tringa pugnax*, Linn.). [SCOLOPACIDÆ.]

MACKEREL. [SCOMBER.]

MACLE (*Chiastolite*), a Mineral occuring crystallised. Its primary form is a right rhombic prism. Cleavage parallel to the lateral faces of the primary form. The crystals appear to be composed of two substances: one of a yellowish white, sometimes translucent, and of a glassy fracture; the other bluish black, opaque, and dull. Fracture scaly, slightly conchoidal. Hardness 5·0 to 5·5. Streak white. Lustre vitreous, or vitreo-resinous. Specific gravity 2·944.

The white portion is infusible by the blow-pipe, but becomes whiter; with borax it fuses with difficulty into a transparent glass. The black portion fuses into a black glass. Nitric acid dissolves it entirely.

It occurs imbedded in clay-slate on Skiddaw in Cumberland, in Wicklow, in the Pyrenees, and in many other places.

It yields, by the analysis of Landgrabe:—

Silica	68·49
Alumina	30·17
Magnesia	4·12
Oxide of Iron	2·70
Water	0·27
	105·75

MACLURA, a genus of Plants belonging to the natural order *Moraceæ*. The fruit of *M. aurantiaca*, the Osage Orange, is as large as the fist, orange-coloured, and filled with a yellow fœtid slime, with which the native tribes smear their faces when going to war.

The wood of *M. tinctoria* is the dye-wood called Fustic; it contains morine, a peculiar colouring substance; its fruit is pleasant, and used in North American medicine for the same purposes as the black mulberry in Europe. According to Martius, both the other species of the genus yield fustic in Brazil. (Lindley, *Vegetable Kindgom.*)

MACLUREITE, *Condrodite, Brucite*, a Mineral, occurring imbedded in rounded masses, the larger of which present occasional crystalline appearances of rhombic prisms with dihedral terminations. Cleavage parallel to the lateral planes. Fracture uneven. Hardness 6·5. Specific gravity 3·15 to 3·25. Colour yellowish or brown. Lustre vitreous. Becomes negatively electrical by friction. Transparent, translucent.

Infusible by the blow-pipe, but becomes colourless. With borax fuses into a transparent glass, coloured by oxide of iron. Not affected by acids.

It occurs in New York and New Jersey, and also at Pargas.

Analyses—No. 1, by D'Ohssor, from Pargas; No. 2, from New Jersey, by Seybert:—

	No. 1.	No. 2.
Silica	38·00	32·66
Magnesia	54·00	54·00
Oxide of Iron	5·10	2·33
Alumina	1·50	
Potash	0·86	2·11
Fluoric Acid		4·09
	99·46	95·19

MACO'MA, Leach's name for the *Venus tenuis* of De Blainville, and similar species. [VENERIDÆ.]

MACRA'SPIS (M'Leay), a genus of Coleopterous Insects of the section *Lamellicornes*, and, according to Latreille's classification, belonging to the third division of that group, the *Xylephili*. The genera *Macraspis* and *Chasmodia* constitute two closely allied groups of the family *Rutelidæ*, the species of which inhabit the warmer parts of South America, and are remarkable for the large size of their scutellum. They are of tolerably large size (averaging about three-quarters of an inch in length, or rather more), usually very smooth and glossy, and often exhibit brilliant colours, green, brown, and yellow being the most common hues observable in the various species. There are some however which are of a glossy-black colour, and others which have yellow markings on a black ground (*Macraspis quadrivittata*, Olivier). The body is of an ovate form (the head and thorax having an outline continuous with that of the abdomen, or nearly so), convex above and beneath. The sternum is produced anteriorly into a pointed process, which projects between the anterior pair of legs.

In the genus *Macraspis* the mentum is longer than broad, slightly contracted anteriorly, and without any fringe of hairs on the anterior margin; the mandibles are almost triangular, and have the apex pointed and notched; the maxillæ have several denticulations.

The genus *Chasmodia* (M'Leay) is chiefly distinguished from *Macraspis* by the obtusely terminated mandibles, which have no notch at the extremity; the maxillæ having a tuft of hairs and only two denticulations, and the mentum being of a somewhat ovate form, distinctly contracted towards the apex and furnished with hairs. The claws of the tarsi are simple, whereas in *Macraspis* one of the claws of each tarsus, at least of the four anterior legs, is bifid.

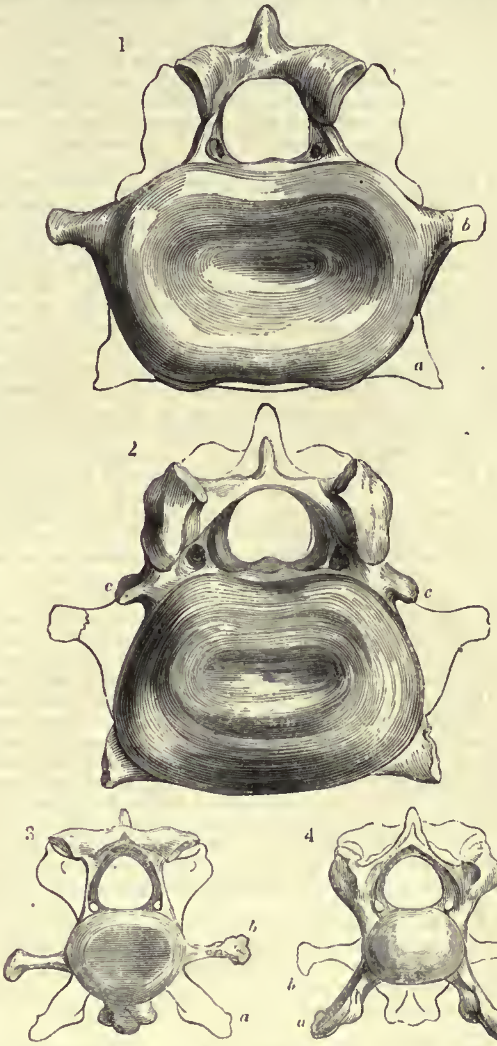
The insects of these two genera fly by day about trees, emitting a humming noise, and feed upon flowers. Collections formed in Brazil usually contain many of these insects.

Dejean, in his 'Catalogue des Coléoptères,' enumerates 26 species of *Macraspis* and 5 species of *Chasmodia*.

MACRAUCHE'NIA, Professor Owen's name for a large extinct Mammiferous Animal, referrible to the order *Pachydermata*; but having affinities with the *Ruminantia*, and especially to the *Camelidæ*.

The remains on which the Professor founded this genus included two cervical vertebræ; seven lumbar vetebræ, all more or less fractured; a portion of the sacrum and ossa innominata; fragments of the left scapula; of the right radius and ulna, and right fore foot; the right femur nearly entire; the proximal and distal extremities of the right tibia and fibula; and a metatarsal bone of the right hind foot. These portions of the skeleton were discovered by Mr. Darwin in an irregular bed of sandy soil, overlying a horizontal accumulation of gravel on the south side of Port St. Julian, on the east coast of Patagonia, and belonged to the same individual.

Professor Owen observes that what is described as a perforation of a single transverse process in a cervical vertebra is essentially a space intervening between two transverse processes, a rudimental rib, and the body of the vertébræ, and the Professor alludes to the manifestation of this structure in the cold-blooded Saurians and in the *Ornithorhynchus*. He observes that the *Camelidæ* differ not only from the other Ruminants, but from all other existing *Mammalia*, in the absence of perforations for the vetebral arteries in the transverse processes of the cervical vetebræ, the atlas excepted; and though it is true that in other *Mammalia* the two transverse processes are manifested on each side with their extremities united by a distinct cartilage, this appears in the fœtal state only, for the cartilage afterwards becomes ossified and anchylosed to them. After referring to the structures of the inferior transverse process, or its representatives, in the Hippopotamus, the Marsupials, and the Giraffe, Professor Owen proceeds thus:—"In the long cervical vertebræ of the Camel and Llama the upper and lower transverse processes are not developed in the same perpendicular plane on the side of the vertebræ, but at some distance from each other; the lower transverse processes (*fig.* 1, *a*) being given off



Cervical Vertebræ (1, 2) of *Macrauchenia*, and (3, 4) of *Auchenia*, one-half natural size.

from the lower part of the anterior extremity of the body of the vertebra; the upper ones (*fig.* 1, *b*) from the base of the superior arch near the posterior parts of the body of the vertebra. The extremities of these transverse processes do not become united together, but they either pass into each other at their base or continue throughout life separated by an oblique groove. This groove would not however afford sufficient defence for the important arteries supplying those parts of the brain which are most essential to life; and accordingly the vertebral arteries here deviate from their usual course, in order that adequate protection may be afforded to them in their course along the neck. From the sixth to the second cervical vertebra inclusive in the *Aucheniæ*, and from the fifth to the second inclusive in the *Cameli*, the vertebral arteries enter the vertebral canal itself, along with the spinal chord, at the posterior aperture in each vertebra, run forwards on the outside of the dura mater of the chord, between it and the vertebral arch, and when they have thus traversed about two-thirds of the spinal canal they perforate respectively the superior vertebral laminæ, and emerge directly beneath the anterior oblique or articulating processes, whence they are continued along with the spinal chord into the vertebral canal of the succeeding vertebra, and perforate the sides of the anterior parts of the superior arch in like manner; and so on through all the cervical vertebræ until they reach the atlas, in which their disposition, and consequently the structure of the arterial canals, resemble those in other Ruminants. The two cervical vertebræ of the *Macrauchenia* present precisely the structure and disposition of the bony canals for the vertebral arteries which are peculiarly characteristic of the *Camelidæ* among existing *Mammalia*." *Fig.* 2 shows the groove and orifices of the canal for the vertebral artery in a section exposing the spinal canal. Professor Owen then goes on to show that the vertebræ of the *Macrauchenia* also closely resemble the middle cervical vertebræ of the Vicuña and Llama in their elongated form; approaching the Auchenial division of the *Camelidæ*, and deviating from the True Camels in the relations of the length of the body of the vertebra to its breadth and depth, and in the much smaller size of the inferior processes. The author observes that, excepting the Giraffe, there is no existing Mammal which possesses cervical vertebræ so long as the Macrauchene; but that the cervical vertebræ of the Giraffe differ in the situation of the perforations for the vertebral arteries, and in the form of the terminal articular surfaces. Both the cervical vertebræ described by Professor Owen are of the same size, and each measures 6½ inches in extreme length, 2 inches 10 lines in breadth, and 2 inches 4 lines in depth. Among the peculiarities of structure, a small longitudinal process (*fig.* 2, *c*) is given off immediately below the base of the anterior process, and this is not observable in any of the cervical vertebræ of the Giraffe or *Camelidæ*. In the form of the articulating surfaces of the bodies of the vertebræ, the Macrauchene deviates from the Giraffe and Camel, but resembles the *Auchenia*. The anterior articulating surface is convex and almost hemispheric in the Giraffe and Camel, whilst the posterior surface is proportionally concave, so that the vertebræ of the neck are articulated by ball-and-socket joints, yet not, as in most reptiles, with intervening synovial cavities, but by means of the concentric ligamentous invertebral substance characteristic of the Mammals. The degree of convexity and concavity in the articular surface of the bodies of these vertebræ in the Llama and Vicuña is much less than in the Camels, and the former consequently carry their necks more stiffly and in a straight line. The anterior articulating surface in *Macrauchenia* is less convex than it is in the Llama, and the posterior surface is less concave. From an analysis of the comparative structure of these vertebræ in the Camels, the Llamas, and the Macrauchene, Professor Owen infers that the latter carried its neck in the same stiff and upright position as is manifested in the Llamas.

There is not in the collection a fragment of dorsal vertebræ, ribs, or sternum; but the seven lumbar vertebræ form a consecutive series from the same individual as that to which the cervical vertebræ belonged; and though these lumbar vertebræ do not possess such distinctive characters as those of the neck, they contribute not unimportantly to the illustration of the osteology of the animal and its affinities. No existing Pachyderm has more than six lumbar vertebræ; the Camels and Llamas only, among the Ruminants, possess seven; and here Professor Owen discovered modifications of form in which the Macrauchene deviates from the *Camelidæ* and approaches the Horse and Hippopotamus. In the *Macrauchenia*, as in the Rhinoceros, Tapir, Hippopotamus, and Horse, the transverse processes of the last lumbar vertebra are of considerable thickness and extent, and are joined by enarthrosis to the transverse processes of the sacrum; but the bony structure of these joints would indicate that they were not subject to be obliterated by anchylosis.

Sufficient of the sacrum and ossa innominata remain to enable Professor Owen to state that the sacrum was anchylosed to the ilia: the lower boundary of this anchylosis is marked below by an external ridge, and by vascular canals and grooves in the substance of the bone, as in the Hippopotamus.

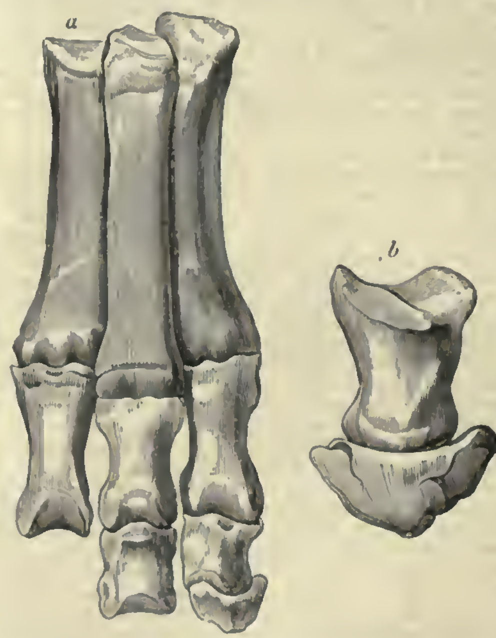
Last lumbar vertebra of *Macrauchenia*, one-third natural size.

Of the remaining portions, the anchylosed fore arm and leg, and the fore foot are the most characteristic. The portion of the antebrachium which is preserved presents a condition of the radius and ulna intermediate to those which respectively characterise the same bones in the Pachyderms and Camels. In the former the radius and ulna are separate bones, united in the same position by a ligament, but so organised that the movement of supination cannot be effected. A bony confluence joins these bones partially in the ordinary Ruminants, but this rarely extends to the proximal extremities. In the Camel and the Llama the anchylosis is complete, so that no trace of the original separation of the radius and ulna is perceptible; and the olecranon, or elbow, appears as a mere process of the radius. The anchylosis in *Macrauchenia* is also complete, but the boundary-line is clearly defined, and the proportion which each of the bones contributes to the great articulating surface for the distal end of the humerus is easily distinguishable.

Professor Owen goes on to remark that the confirmation of the close affinity of the *Macrauchenia* to the Pachydermatous order, which the structure of the cervical vertebræ above might have rendered very doubtful, is afforded by the bones of the right fore foot.

Proximal extremity of anchylosed ulna and radius of the Macrauchene, one-fourth natural size.

These are in so perfect a condition as to make it certain that the Macrauchene had three toes on the fore feet, and not more; and that the fully-developed matacarpal bones are distinct, and correspond in number with the toes, not being anchylosed into a single cannon-bone as in the Ruminants. The bones preserved are the matacarpals, proximal phalanges, and middle phalanges of each of the three toes, and the distil or ungueal phalanx of the innermost toe.



a, bones of the right fore foot of the Macrauchene, one-fourth natural size; *b*, second and last, or ungueal phalanx, one-half natural size.

The author observes in continuation that the bones of the leg of the Macrauchene exhibit the same transitional structure as is afforded by the definable limits of the anchylosed bones of the fore arm. In the Pachyderms the fibula is entire and distinct. In the Ruminants (the small musk-deer excepted, and, in an inferior degree, the elk) the fibula appears only as a short continuous process sent down from the under part of the external condyle of the tibia. In the *Camelidæ* the only trace of the fibula is a still more rudimental state of this process, whilst in the Macrauchene the fibula is indeed entire, but it is confluent with the tibia through nearly its whole extent. The fibula and tibia are distinct bones in both the Palæothere and Anoplothere. It is to the former genus, and especially to *Palæotherium magnum*, that the Macrauchene presents the nearest approach in the general form of the tibia, the principal leg-bone; but in the Macrauchene the tibia is relatively shorter and thicker and straighter, and less expanded at its extremities, especially the upper one, than in any of the Palæotheres.

Of the few bones of the parts which are preserved the astragalus is fortunately one. Professor Owen has compared this bone (which he justly says is the very one that an anatomist would have chosen had his choice been limited to a single bone) with the astragalus of the Giraffe and other Ruminants, the Camel, the Anoplothere, the Hippopotamus, Rhinoceros, Tapir, and Palæothere; and he comes to the conclusion that it is with the Pachyderms having three toes to the hind foot that the *Macrauchenia* agrees in the main distinguishing characters of this valuable bone. The results of a paper of minute detail, great research, and happy combination, are thus summed up by the Professor:—

"Thus we obtain evidence, from a few mutilated bones of the trunk and extremities of a single representative of its race, that there once existed in South America a Pachydermatous quadruped, not proboscidian, which equalled in stature the rhinoceroses and hippopotamuses of the Old World. But this, though an interesting and hitherto unsuspected fact, is far from being the sum of the information which is yielded by these fossils. We have seen that the single ungueal phalanx bespeaks a quadruped of the great series of *Ungulata*, and this indication is corroborated by the condition of the radius and ulna, which are fixed immoveably in the prone position. Now, in the ungulated series there are but two known genera—the *Rhinoceros* and *Palæotherium*—which, like the quadruped in question, have only three toes on the fore foot. Again, in referring the *Macrauchenia* to the tridactyle family of Pachyderms, we find, towards the close of our analysis, and by a detailed comparison of individual bones, that the *Macrauchenia* has the closest affinity to the *Palæotherium*. But the *Palæotherium*, like the Rhinoceros and Tapir, has the ulna distinct from the radius, and the fibula from the tibia; so that even if the Parisian Pachyderm had actually presented the same peculiarities of the cervical vertebræ as the Patagonian one, it would have been hazardous, to say the least, while ignorant of the dentition of the latter, to refer it to the genus *Palæotherium*.

"Most interesting indeed will be the knowledge, whenever the means of obtaining it may arrive, of the structure of the skull and teeth in the *Macrauchenia*. Meanwhile we cannot but recognise in the anchylosed and confluent state of the bones of the fore arm and leg a marked tendency in it towards the Ruminant order, and the singular modifications of the cervical vertebræ have enabled us to point out the precise family of that order with which the *Macrauchenia* is more immediately allied. In first demonstrating this relationship it was shown in how many particulars the *Camelidæ*, without losing the essential characters of *Ruminantia*, manifested a tendency to the Pachydermatous type; and the evidence which the lost genera, *Macrauchenia* and *Anoplotherium*, bear to a reciprocal transition from the Pachyderms to the Ruminants through the *Camelidæ*, cannot but be viewed with extreme interest by the zoologist engaged in the study of the natural affinities of the animal kingdom."

"The *Macrauchenia* is not less valuable to the geologist in reference to the geographical distribution of animal forms. It is well known how unlooked-for and unlikely was the announcement of the existence of an extinct quadruped entombed in the Paris Basin, whose closest affinities were to a genus (*Tapirus*), at that time regarded as exclusively South American. Still greater surprise was excited when a species of the genus *Didelphys* was discovered to have co-existed in Europe with the *Palæotherium*. Now, on the other hand, we find in South America, besides the Tapir, which is closely allied to the Palæothere, and the Llama, to which the Anoplothere offers many traces of affinity, the remains of an extinct Pachyderm, nearly akin to the European genus *Palæotherium*; and lastly this *Macrauchenia* is itself in a remarkable degree a transitional form, and manifests characters which connect it both with the Tapir and the Llama."

(*Zoology of the Voyage of H.M.S. Beagle*, 1839.)

MACROCEPHALI. [AMMONITES.]

MACROCHE'ILUS, a genus of Fossil *Gasteropoda*, proposed by Professor Phillips ('Palæozoic Fossils of Devon') to include several species which occur in the Devonian and Carboniferous strata.

MACROCYSTIS, a genus of Plants belonging to the natural order *Fucaceæ*, and the tribe *Laminaridæ*. The enormous fronds produced by *M. pyrifera* have been spoken of by many navigators. They appear to be from 500 to 1500 feet in length; the leaves are long and narrow, and at the base of each is a vesicle filled with air, without which it would be impossible for the plant to support its enormous length in the water, the stem not being thicker than the finger, and the upper branches as slender as common pack-thread. This plant was seen by Dr. Joseph Hooker in 61° S. lat., in large vegetating patches wherever the water was free of icebergs.

MACRODA'CTYLES, Cuvier's name for a family of Wading-Birds (Echassiers) [GRALLATORES], which have very long feet, formed for running over marshy or water plants, or even for swimming, especially in those numerous species which have the feet fringed or bordered. There is not however any membrane between the bases of their toes, not even between those of the external ones. The bill, which is more or less compressed on the sides, is lengthened or shortened according to the genera, without however arriving at the fineness or weakness of Cuvier's preceding family. [LONGIROSTRES.] The body of these birds is also singularly compressed, a conformation which is governed by the narrowness of the sternum: their wings are moderate or short, and their flight weak. The hind toe in all is rather long. Cuvier observes that this family has been divided into two tribes, according to the presence or absence of the spur on the wing; but he adds that this character is not without exceptions. The following genera are arranged by Cuvier under this family, which terminates his order Echassiers:—*Parra*, *Palamedea* (including *Charina*), *Megapodius*, *Rallus*, *Fulica* (including *Gallinula* and *Porphyrio*), *Chionis*, Forst. (*Vaginalis*, Lath.), *Glareola*, Gm., *Phœnicopterus*. Cuvier's sixth order, *Palmipedes*, immediately succeeds this family, which is somewhat heterogeneous, and composed of birds whose habits are not similar. *Phœnicopterus* cannot be said to be without any membrane "between the bases of the toes," &c., for its anterior toes are united to the nails by a lunated membrane. [DUCKS; COLYMBIDÆ.]

MACRODIPTERYX. [GOAT-SUCKERS.]

MACRODITES. [FORAMINIFERA.]

MACROGLOSSA. [CHEIROPTERA.]

MACRONYX. [ALAUDINÆ.]

MACROPHTHALMUS. [GONOPLACIDÆ.]

MACROPIPER, a genus of Plants belonging to the natural order *Piperaceæ*. *M. methysticum*, the Ava, is the most celebrated of the narcotic Pepper-Worts. It has cordate acuminate many-nerved leaves; solitary axillary spikes, very short, pedunculated, and spreading. The rhizoma is thick, woody, rugged, and aromatic. It is used in tincture against chronic rheumatism. Macerated in water it forms an intoxicating beverage, of which the Otahetians make use as a medicine; they make themselves drunk, after which very copious perspiration comes on: this lasts three days, at the end of which time the patient is cured.

MACROPODIANS. [MACROPODIDÆ.]

MACROPO'DIDÆ, a tribe of Brachyurous Decapodous *Crustacea*, being the first of the family of *Oxyrhynchi* (Milne-Edwards), and nearly corresponding with the genus *Macropus* of Latreille, remarkable for the enormous length of their feet, which has obtained for them the name of Sea-Spiders and Spider-Crabs.

Form of the carapace various, but in general triangular, very often not extending upon the last thoracic ring; the anterior feet short, and nearly always very slender: those of the succeeding pairs always more or less filiform; the length of the second pair often nine or ten times the length of the post-frontal portion of the carapace, and always much exceeding the double of that portion; the succeeding feet in general very long also; the basilary joint of the external antennæ nearly always constitutes the major part of the lower wall of the orbit, and proceeds to solder itself to the front. In the greater portion of the tribe the third joint of the external jaw-feet is inclined to oval or triangular, longer than it is wide, and does not support the succeeding joint on its anterior and internal angle, as in the other *Oxyrhynchi*. (Milne-Edwards.)

The localities of the *Macropodidæ* are considerable depths in the sea, where they lie hid among the sea-weeds; they are also found on oyster-banks. They walk slowly and unsteadily. The weakness of their claws must render them not formidable to other marine animals, and the probability is that they live principally on *Annelides*, *Planariæ*, and small Molluscs. (Milne-Edwards). Several species of this family have been exhibited in the Aquavivarium in Regent's Park, but like other deep-sea creatures, they soon perish. For a short time they are very lively, and the awkwardness of their gait and habits out of water quite disappears when they are plunged in deep water.

This tribe is sometimes called *Leptopodiadæ*, after the genus *Leptopodia*.

Leptopodia (Leach), established at the expense of the genera *Inachus* of Fabricius, and *Macropus* of Latreille. M. Milne-Edwards observes that it is very remarkable for the general form of its body and the excessive length of the feet; and states that it presents in an exaggerated manner all the distinctive characters of the family and of the tribe to which it belongs.

It has the carapace nearly triangular, and not covering the last ring of the thorax; rostrum styliform and of enormous length; eyes large and not retractile; internal antennæ, when folded back, following the longitudinal direction of the body; first joint of the external antennæ very long and completely confounded with the neighbouring parts of the shell, the second inserted at a considerable distance in front of the orbits and below the rostrum; epistome much longer than it is wide; third joint of the jaw-feet nearly triangular, and carrying at its external angle the succeeding joint, which is very much developed. The sternal plastron as long as it is wide, but very much narrowed between the first pair of feet, which are very slender and extremely long, but less than any of the rest; the length of those of the second pair equals nine or ten times the length of the post-frontal portion of the carapace; abdomen in both sexes composed of six joints, of which the first, which is very much developed, and as long as it is wide, occupies the dorsal surface of the body, while the last is formed by the soldering of the sixth and seventh abdominal rings. (Milne-Edwards.)

The species are found on the coasts of America and of the Antilles, as far as is at present known.

L. sagittaria, Leach (*Cancer seticornis*, Herbst.; *Inachus sagittarius*, Fabricius); of which we subjoin a drawing, may be taken as a good example of this genus.

Leptopodia sagittaria.

Latreillia (Ram.).—Carapace triangular, truncated anteriorly, and not covering the last ring of the thorax; epistome much longer than it is wide; second and third joints of the external jaw-feet very narrow; feet filiform and very long; abdomen of the female of five joints only, though the sutures of two others may be distinguished; structure of that of the male not known.

L. elegans is the only species known. Carapace smooth, front armed above with two large divergent horns, and with a spine directed forwards between the antennæ; feet of the last four pairs with the third joint spiny, the penultimate joint a little dilated above towards its extremity, and the tarsus very short; abdomen armed with six spines, two of which are situated on the median line and four near the edges. Length about an inch. Colour yellowish.

It is found on the coasts of Sicily.

M. Milne-Edwards thinks that the *Maia seticornis* of Bosc should be placed near this species.

Achæus (Leach).—This genus is very nearly allied to *Stenorhynchus* and *Inachus*, but is distinguished from all the other genera of this family by the form of the posterior feet and some other characters.

The carapace is, as in the greater part of the family, not extending on the last segment of the thorax, nearly triangular, and convex on the branchial regions. Rostrum nearly null; eyes not retractile, and curved upon rather long peduncles; first joint of the external antennæ soldered to the front and advancing above the level of the internal canthus of the eyes; the second joint inserted on the sides of the rostrum and entirely exposed above. Epistome nearly square; third joint of the external jaw-feet longer than wide, nearly triangular, and giving attachment to the succeeding joint near its anterior and external angle. Sternal plastron suddenly narrowed between the anterior feet, which are slender and short, while those of the succeeding pairs are filiform; the second pair are nearly twice and a quarter longer than the post-frontal portion of the carapace, and terminate by a styliform and entirely straight joint; the succeeding feet are much shorter, and the terminal joint of the last four is large, compressed, and falciform. Abdomen composed of six joints in both sexes. (Milne-Edwards.)

Achæus has hitherto been found only in the British Channel.

A. Cranchii is the only species of the genus. The rostrum is formed of two small triangular teeth, and not extending beyond the second joint of the external antennæ; a spine on the anterior face of the ocular peduncles; genital and cardial regions elevated in the form of tubercles; feet with very long hairs, and hooked. Length from 6 to 8 lines. Colour brown.

It is found at Falmouth in England, and the mouth of the Rance near St. Malo. The species lives among the sea-weeds and oysters.

Stenorhynchus (Lamarck; Latreille).—Carapace triangular, and not prolonging itself above the last thoracic ring. Rostrum advanced, bifid, and sharp; orbits circular, eyes rather projecting and not retractile. Internal antennæ capable of being folded back longitudinally, and the fossets in which they are lodged not completely separated from each other; the first joint of the external antennæ confounded with the neighbouring parts, and very narrow; the second inserted on the sides of the rostrum, and the third much longer than the second. Epistome longer than wide, and the pterygostomian regions rudimentary; buccal frame longer than it is wide. External jaw-feet narrow, third joint oval, and the fourth rather long; sternal plastron narrow between the anterior feet, but afterwards wider, and presenting on the median line a suture which occupies the last segment of it; feet of the first pair short, but much larger than the succeeding ones, the claw (manus) which terminates it convex, and the fingers a little curved inwards; four last pair of feet filiform and extremely long; the length of those of the second pair equal five or six times of the width of the carapace; the others become progressively shorter; their penultimate joint is a little dilated towards the end, and the last joint is styliform and a little recurved. Abdomen in both sexes composed of six joints, the last of which is formed by the union (soudure) of the sixth and seventh rings. (Milne-Edwards.)

The species of this genus are found in the European seas.

S. Phalangium (*Cancer Phalangium*, Pennant; *Cancer rostratus*, Linn.; *Macropus Phalangium*, Latreille; *Macropodia Phalangium*, Leach). This species is found on the coasts of the English Channel.

Stenorhynchus Phalangium.

S. tenuirostris, Bell (*Leptopodia tenuirostris*, Leach), the Slender Spider-Crab, is also found on the British coasts.

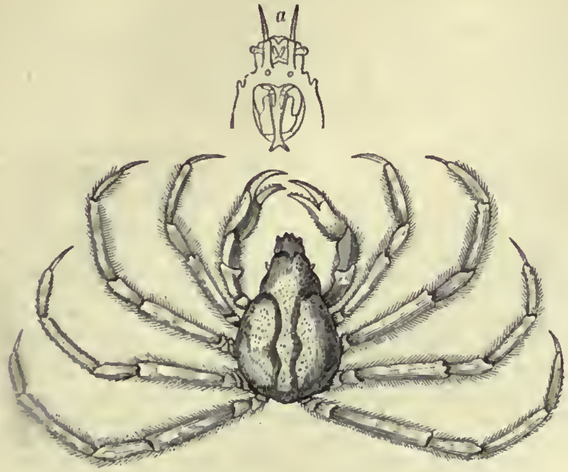
Composcia (Leach; Latreille).—Carapace convex and nearly pyriform, but truncated anteriorly; rostrum rudimentary and scarcely reaching beyond the internal canthus of the orbits. Eyes supported upon peduncles, which are rather long, recurved anteriorly, and very large at their base; they are capable of being reflected backwards, but they are not retractile, for there is no post-foraminary orbital cavity for lodging them, their extremity being only protected by a spine of the lateral part of the carapace. The internal antennæ are reflected a little obliquely forwards; the fossets which lodge them have this particularity, namely, that they are not separated, as they are ordinarily, by a longitudinal portion, and form only a quadrilateral cavity. The first joint of the external antennæ is long and delicate, and is continued nearly as far as the rostrum, carrying at its extremity a moveable stem, which is consequently completely exposed. The epistome is nearly square, and the external jaw-feet are very much elongated, and only close the mouth imperfectly. The feet are slender and very long; in the female the first pair are the shortest, and are not stouter than the succeeding ones; those of the third, the fourth, and the fifth pair are a little longer, and are also terminated by a cylindrical nail slightly curved downwards. Form of the feet of the male, and disposition of the abdomen in this genus, not known. (Milne-Edwards.)

The species are found in the seas of Asia.

C. retusa may be taken as an example.

Eurypodius (Guérin).—A genus forming in certain points a passage between the Macropodians already noticed, and some of the *Maiidæ*, such as *Halimus auritus*; approaching the latter in the form of the feet, and resembling the former in the length of those members and in the disposition of the eyes.

The carapace triangular, twice as long as it is wide, rounded posteriorly, narrow anteriorly, convex and unequal above; rostrum formed by two long and horizontal horns; eyes carried on peduncles of moderate length and not retractile; disposition of the internal and external antennæ nearly the same as in *Stenorhynchus*, *Inachus*, &c.; epistome wider than it is long; third joint of the external jaw-feet nearly square, as wide as it is long, and deeply notched anteriorly and internally, in order to give insertion to the succeeding joint. Anterior feet of the length of the body in the male and much shorter in the female; they are a little convex, and the fingers are slightly curved inwards; the succeeding feet are very long, their third joint is cylindrical, but the fifth is compressed, and dilated below; its greatest width is below the middle; the finger is large, recurved, very sharp, and capable of being bent back against the lower edge of the



Camposcia retusa. *a*, details of head.

preceding joint, after the manner of a sub-cheliform claw; the length of the second pair of feet is nearly twice and a half that of the post-frontal portion of the carapace, and the succeeding feet diminish successively in length but very little; abdomen composed of seven joints in both sexes. (Milne-Edwards.)

E. Latreillii. This species is found in the Falkland Islands.

Eurypodius Latreillii.

Amathia (Roux).—This genus agrees in some respects with the *Pericera* of Latreille; indeed the aspect of both is the same, but the external antennæ of *Amathia* have not the peculiar disposition which is visible in *Pericera*, and the space which the orbits leave between them is scarcely wider than the base of the rostrum, whilst in *Pericera* it is more than double.

It has a carapace in the form of an elongated triangle with a rounded base; its upper surface and its borders beset with enormous spines; the rostrum, which is terminated by two large divergent horns, nearly as long as the post-orbitary portion of the carapace. Eyes small, and partially protected by a spine which occupies their external canthus, but, as in the preceding genera, they are not retractile and always remain projecting. External antennæ presenting nothing remarkable; the basilary joint is long, very narrow, and soldered to the front; the stem is inserted under the rostrum, at some distance before the level of the eyes; it is very slender, and its first two joints are of equal length; epistome large, and nearly as long as it is wide; the third joint of the external jaw-feet is dilated outwards, and truncated at its two internal angles. The first pair of feet are shorter than the succeeding ones; they are filiform in the female, and a little convex or swollen in the male; the succeeding feet are long and filiform; the second pair are more than thrice as long as the post-orbitary portion of the carapace, without including the posterior spine; the others are much shorter, their terminal joint is long, sharp, and without either spines or teeth on its inferior surface; abdomen composed of seven joints in both sexes. (Milne-Edwards.)

A. Rissoana. Carapace armed with thirteen enormous spines, three of which elevate themselves from the stomachal region, one from the cardial, and the others occupy the border of the buckler; one on the intestinal region, three on each side upon the branchial region, and one upon each of the hepatic regions: there is a small spine in front of the eyes, and a larger one at the anterior angles of the buccal frame; feet, as well as the carapace, covered with a sort of down; length about two inches; colour yellowish, with two spots, red upon the front. It has been found at Toulon.

Inachus (Leach).—This genus, as established by Fabricius, comprehended nearly all the *Oxyrhynchi*, with the exception of the *Parthenopidæ*. The genus is now much restricted.

The carapace is nearly triangular, not much longer than it is wide, and highly embossed above; rostrum very short, disposition of the eyes different from that in the previous genera in the system of M. Milne-Edwards, the peduncles being capable of being reflected backwards, and being lodged in an orbitary cavity, which, though not deep, is very distinct; internal antennæ without anything remarkable: the first joint of the external antennæ soldered to the front before the internal canthus of the eyes, and the second advanced on the sides of the rostrum; epistome rather wider than it is long: third joint of the jaw-feet much longer than it is wide, nearly of the form of a triangle, with its base in front, and giving attachment to its succeeding joint near its anterior and external angle; sternal plastron narrowed suddenly between the feet of the first pair, and with its length not equal to its greatest breadth; feet of the first pair very small in the female, but very large in the male, and sometimes thrice the length of the body; the claws always pointed and curved inwards. The succeeding feet cylindrical, slender, and more or less filiform; the second pair, always longer than the first, are three or four times the length of the post-frontal portion of the carapace; the others diminish successively in length, and all terminate in a very long cylindrical joint, which is pointed and but little or not at all curved. The abdomen is composed of only six distinct joints.

All the species are small, and have hitherto been found on the coasts of Europe, particularly those of England and France. In the latter country they have been taken both on the northern and Mediterranean shores. They often haunt coves where there are oysters, and all of them have the body covered with down and hairs, to which sponges and corallines attach themselves; colour brownish. (Milne-Edwards).

M. Milne-Edwards divides the genus into three sections: the first containing one species, having the stomachal region furnished with five spines or tubercles, including one (median and posterior) very strong, and four small ones anteriorly on a transversal line.

I. Scorpio (*I. Dorsettensis*). It has been taken in the British Channel, &c.

Inachus Scorpio.

a, male; *b*, female; *c*, abdomen of male; *d*, abdomen of mature female; *e*, abdomen of immature female.

The second section consists of *I. Dorynchus* and *I. thoracicus*, and the third of *I. leptochirus*. The last is a British species.

Egeria.—This genus is Asiatic in its geographical distribution, and M. Milne-Edwards divides it into two sections: the first with the third joint of the external jaw-feet deeply notched at its anterior and external angle (*E. arachnoides* and *E. Herbstii*), and the second with the third joint of the external jaw-feet not notched at its anterior and internal angle (*E. Indica*). [EGERIA.]

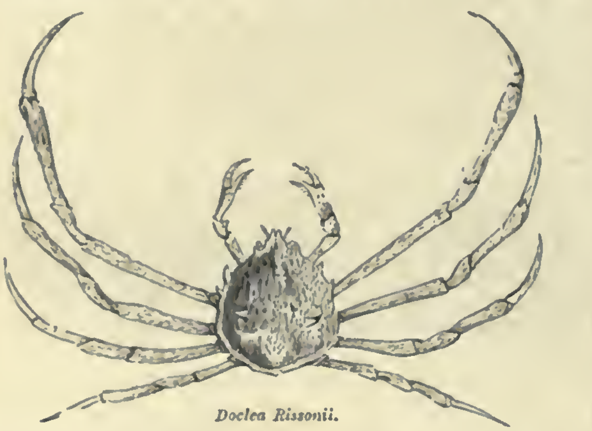
Doclea (Leach).—Carapace nearly globular, hairy, and more or less beset with spines; front raised, and the lateral edges of the carapace, instead of joining the orbits, directed towards the anterior border of the buccal frame; rostrum short and very narrow; the orbits directed obliquely forwards, and entirely lodging the eyes, which are very small, and have no trace of a spine at the anterior angle of their upper border, a character which renders them easily distinguishable from the *Libiniæ*. The basilary joint of the external antennæ advances much beyond the internal canthus of the eyes, and terminates nearly in a point under the front, to which it is intimately united;

the second joint of these antennæ is short, and placed near the edge of the rostrum; the third and the fourth joints are very small. Epistome very little developed, and much wider than it is long; the third joint of the external jaw-feet is nearly square, slightly dilated outwards, and rather deeply notched at the internal and anterior angle; sternal plastron nearly circular; the anterior feet weak and very small, not more than once and a half of the length of the carapace; the hand nearly cylindrical; the succeeding feet very long, though not always equalling those of the *Egeriæ*, slender, and cylindrical; their terminating joint long and styliform; the second pair from twice to thrice as long as the post-frontal portion of the carapace, and the succeeding pairs diminishing progressively. The abdomen varies; sometimes only five distinct joints are to be detected in that of the female; sometimes there are seven, as in the male.

M. Milne-Edwards, who gives the specific character here stated, observes that the *Docleæ* bear the greatest analogy to the *Egeriæ*, and establish the passage between those *Macropodidæ* and *Libiniæ* which belong to the tribe of *Maiiadæ*. [MAIIDÆ.]

The species are found in the Indian Seas.

D. Rissonii, whose locality is unknown, is given as an example.



Doclea Rissonii.

(Milne-Edwards, *Histoire Naturelle des Crustacées*; Bell, *British Stalk-Eyed Crustacea*.)

MACRO'POMA, a genus of Fossil Fishes, proposed by Agassiz. The species belong to the Cretaceous Strata.

MACROPTERUS. [DUCKS.]

MA'CROPUS, the scientific name for the Kangaroos. [MARSUPIATA.] The term is also used by M. Latreille to designate a genus of Brachyurous Decapod Crustaceans. [MACROPODIDÆ.]

MACRORHAMPHUS. [SCOLOPACIDÆ.]

MACRORHINUS. [PHOCIDÆ.]

MACROSE'MIUS, a genus of Fossil Fishes, proposed by Agassiz. From the Oolite.

MACROURA, or MACRU'RA, the scientific name for that section of Crustaceans which have the abdomen, usually called the tail, long, in contradistinction from that section (*Brachyura*) which have the tail short. The Common Lobster is an example of a Macrurous Crustacean, and the Common Crab of a Brachyurous Crustacean. [CRUSTACEA.]

MACROXUS. [SCIURIDÆ.]

MACTRA. [CONCHACEA.]

MADATUS. [CHEIROPTERA.]

MADDER. [RUBIA.]

MA'DIA, a genus of South American Herbaceous Plants belonging to the natural order *Compositæ*, one of the species of which, *M. sativa*, is of value for the oil yielded by its seeds upon pressure. The genus forms the type of *Madieæ*, a division of the Senecionideous Tribe of De Candolle, and is distinguished among its congeners by its roundish 1-rowed Involucre, the bracts of which are keeled and envelop the grains, by a plane receptacle paleaceous at the margin and naked in the middle, and by its bald achenia, which have four or five angles, and taper to the base. *M. sativa*, which forms the only species, is an upright hairy glandular viscid Chilian annual, with oblong entire leaves, half amplexicaul, opposite at the bottom of the stem and alternate at the top; the flower-heads are racemose, and the flowers pale-yellow. It has long been cultivated in Chili, and apparently in California, for the sake of its oil, which is of excellent quality. It has also attracted attention in Europe in consequence of Mr. Bosch, the superintendent of the gardens of the King of Würtemberg, having successfully cultivated it in Germany on a large scale. He found that as compared with rape and poppies the amount of oil yielded per German acre was as follows:—

Rape yields 240 lbs. of oil per German acre.
Poppies yields 264 lbs. of oil per German acre.
Madia yields 442 lbs. of oil per German acre.

This oil does not congeal at 19° below zero of Réaumur, but only becomes a little less fluid, which makes it a valuable material for keeping machines in order. The seeds are sown in October, and from four to six pounds are required per acre (German). The crop is of the easiest management, and the only precaution to be taken by the cultivator, which it is important to notice, is that the seeds must be thrashed out soon after the crop is cut, otherwise the glutinous stalks, when heaped up, ferment and injure the seeds.

(*Gardener's Magazine*, March, 1839, p. 142.)

MADOQUA. [ANTILOPEÆ.]

MADRASTRÆA. This name is given by De Blainville to a subsection of the *Madrephylliœa*, including *Astræa*, *Echinastræa*, *Oculina*, and *Branchastræa*. He attaches but little importance to it as a division. [MADREPHYLLIŒA.]

MADREPHYLLIŒA, the first section of the Stony *Zoantharia* of De Blainville, who styles the other section of this family of *Zoantharia*, *Madreporæa*. [MADREPORÆA.] The Linnæan genus *Madrepora* included nearly all the species, and obviously required analysis, the more so that geological naturalists referred to the same genus a vast number of previously unknown forms, and thus encumbered recent and impeded fossil zoology, and prevented any right notion of the successive forms of zoophytic life on the globe.

Solander proposed some useful divisions of this unmanageable genus, derived from the growth of the coral. Lamarck established many important genera, especially characterising some fossil groups. Lamouroux also laboured to improve the classification. Goldfuss has since described additional fossil groups; and M. De Blainville has reorganised the labours of his predecessors, with a special regard to the soft animal parts figured and described by Lesueur, Quoy, Gaimard, and other voyagers.

The *Madrephylliœa* of this writer seldom acquire that highly ramose figure which belongs to the Lamarckian genera *Madrepora*, *Pocillopora*, &c.; they are furnished with cells of various figure, always however radiated by lamellæ, which are frequently numerous. There is no general distinctive character of the soft parts, or 'polypi,' as they have usually been termed. The following are the principal genera of this group:—

Cyclolites (fossil).—Animal unknown; solidified by a calcareous polypidom, of a short, simple, orbicular, or elliptical figure, flattened, and marked with concentric lines below, convex above, with a great number of very fine entire lamellæ, convergent to a sublacunose centre.

Lamarck founded the genus; Goldfuss includes it with the *Fungiæ*. Only fossil species are known; they occur in the tertiary and upper secondary strata chiefly. Mr. Lonsdale notices it in the Silurian system.

C. numismalis (*Madrepora porpita*, Linn.) may be taken as an example. (Goldfuss, tab. 14, fig. 4, a, b.)

Fungia.—Animal gelatinous or membranous, generally simple, depressed, orbicular, or oval; mouth superior, transverse in a large disc, which is covered by many thick cirriform tentacula; the disc is solidified internally by a calcareous solid polypidom, of a simple figure

Fungia patellaris.
a, upper face; *b*, lower face.

(seldom complex), ornamented above by a star of radiating aculeated lamellæ, and below by simple rugose rays.

There are about nine recent (mostly from Indian Seas), and as many fossil species. De Blainville arranges them in three groups: simple and circular; simple and compressed; complex and oblong.

The animal, according to Quoy and Gaimard, is very like that of *Caryophyllia*; it covers the upper face, and returns over the lower, so that the whole polypidom is internal. M. Stutchbury has described the growth of this coral in the 'Linnæan Transactions.'

F. patellaris (Ellis and Soland., t. 28, figs. 1-4) may be taken as an example.

Montlivaltia (fossil).—Animal unknown; solidified by a calcareous polypidom of sub-conical or pyriform figure (fixed); transversely wrinkled below; enlarged, excavated, and lamellato-radiate above. From the Oolite of Caen. Goldfuss refers it to *Anthophyllum* of Schweigger; and De Blainville says it is closely allied to *Cyclolites*.

M. caryophyllata (Lamx., 'Zooph.' t. 79, figs. 8-10) is an example.

Polyphyllia.—Animals numerous, confluent, with a rather prominent mouth, lobed at the margin; numerous tentacula, not round the mouth, but scattered on the surface of a fleshy part, which entirely envelops and incloses a calcareous solid polypidom, which is a free oval elongated plate; above rather convex, and covered with lamellar ridges, which are denticulated, prominent, very slender, and transverse, but without stelliform disposition; below rather concave, and roughened by close-set tubercles.

The whole mass is free on the sea-bed.

Fungia talpa of Lamarck ('Actinologie,' pl. 52, fig. 1) belongs to this genus.

Anthophyllum.—Animal unknown, containing a calcareous polypidom of a conical or pyriform figure, fixed in the lower part, enlarged, flattened, excavated, and multilamellous in the upper part. This genus includes fossil species from ancient rocks, and appears imperfectly distinguished from *Turbinolia* unless the species of that genus were all free, which is at least doubtful.

A. Guettardi, Defr., is an example.

Ehrenberg unites in one genus *Monomyces*, the *Anthophylla*, *Montlivaltiæ*, and the two first groups of *Fungia*.

Turbinolia.—Animal simple, conical, ribbed externally with larger and smaller ribs; terminated above by a mouth begirt with numerous tentacula, and solidified by a calcareous polypidom which is free, conical, furrowed externally, attenuated to one extremity, enlarged at the other, and ending in a large shallow radiated cell.

Most of the species are fossil: they occur in rocks of all ages, particular species belonging to each; but if the genus is not very obscurely characterised, the use of the term is not very accurate. According to De Blainville, the recent *T. amicorum* has twenty-four ribs; but this number is exceeded vastly in some of the fossil species referred to the genus; and in others there are fewer than twenty-four.

Diploctenium of Goldfuss is a compressed *Turbinolia*, according to De Blainville.

T. amicorum, Bl., from the South Seas, may be taken as an example.

T. borealis and *T. milletiana* are found in British seas.

Turbinolopsis (fossil).—Animal unknown, solidified by a calcareous polypidom, of a simple turbinated figure, and free. This polypidom is lacunose, furnished above with radiating lamellæ, united at short equal intervals, and marked externally by longitudinal flexuous striæ, inclosing between their united edges vertical lines of pores or cells.

M. Lamouroux describes this genus. It has been since adopted by Mr. Lonsdale for specimens which occur plentifully in strata below Old Red-Sandstone. ('Silurian System,' by Murchison.) De Blainville appears to think it should be reunited with *Turbinolia*, but he had not examined the specimens noticed by Lamouroux.

T. ochracea. Lamouroux. 'Gen des Polyp.,' t. 82.

Caryophyllia.—Animals actiniform, subcylindrical, provided with a simple or double crown of short thick perforated tentacula, which project from the surface of stars or cylindriconical cells; cells furnished with radiating lamellæ internally complete, externally striated, and aggregated into a solid conical polypidom, fixed at the base. The species are grouped according to the simple or fasciculated character of the mass. There are both recent and fossil examples of each group.

Caryophyllia Cyathus.

Lamarck is the author of this genus, distinguishing it from *Turbinolia* and *Oculina*. He has been followed by nearly all zoologists; but Goldfuss has reunited *Caryophyllia* and *Oculina* into his genus *Lithodendron*.

C. Cyathus (Ellis and Sol., t. 28, f. 7) is an example. It has occurred in the British seas.

Ehrenberg divides this genus, and forms the following new ones:—

Desmophyllum. Example, *C. dianthus*.
Cyathina. Example, *C. Cyathus*.
Cladocera. Example, *C. calycularis*.

Sarcinula.—Animals unknown, contained in cells at the end of long cylindrical tubes; cells lamelliferous, stelliform; tubes striated externally, parallel to the axis, united by a cellular transverse mass into a solid calcareous polypidom, whose upper and under surfaces are plane and parallel.

This genus, established by Lamarck, includes both recent and fossil species. It seems to bear the same relation to *Caryophyllia* that certain tubular *Astrææ* bear to the ordinary forms of that genus. There is no sufficient reason for the conjecture of De Blainville, that Lithostrotion of Llwyd should be referred to this genus: it has more resemblance to the following group, with which indeed De Blainville has joined it.

Columnaria (fossil).—Animals unknown, contained in shallow multi-radiate stelliform cells, at the ends of prismatic tubes; tubes aggregated, contiguous, more or less parallel, forming by their union a solid thick calcareous polypidom.

This is a genus of Goldfuss, established on fossils of the Transition Strata.

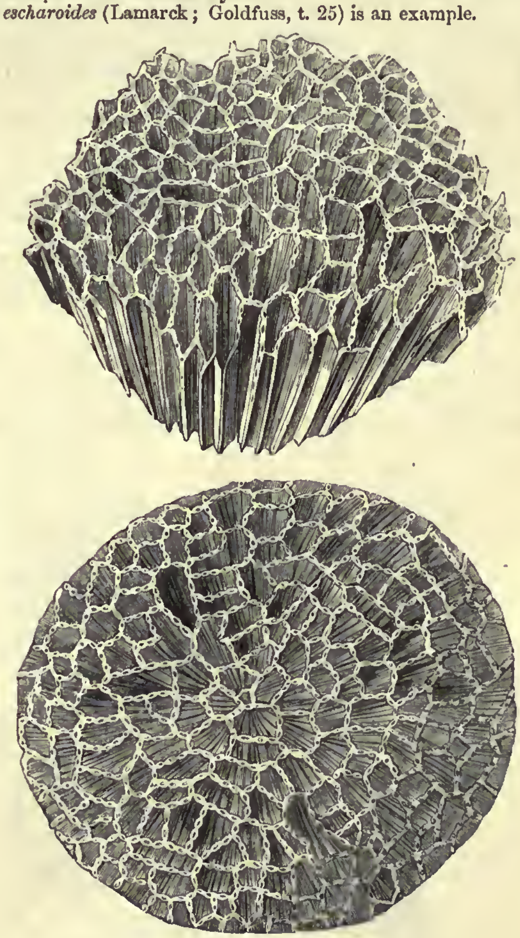
Stylina (fossil).—Animals entirely unknown, contained in radiated cells at the end of long cylindrical vertical tubes; tubes furnished internally with distinct lamellæ, which radiate from a solid more or less prominent axis, and are united by a cellular mass so as to form a stony polypidom, more or less extended, thick, and echinated above.

A genus of Lamarck (originally named *Fascicularia* by him), which includes perhaps only one species. The prominent axis occurs however in several madreporic fossils not usually referred to this genus—as certain *Cyathophylla* of Goldfuss. *Sarcinula conoidea* of this author is ranked by De Blainville as a *Stylina*.

Catenipora (fossil).—Animals unknown, contained in tubular cells; cells terminal, often oval, furnished with radiating plates, and united laterally into a calcareous polypidom, which may be described as of a conical figure, fixed, composed of vertical anastomosed lamellæ.

Tubipora catenulata of old writers is the type of this Lamarckian genus, which, with some surprise, we found to be, as De Blainville states, really a lamelliferous coral. He draws this inference from examining a fine specimen, at Bonn, of *C. escharoides*, which he considers the only species. It is peculiar to the Transition Rocks, though not perhaps to the Silurian System.

C. escharoides (Lamarck; Goldfuss, t. 25) is an example.



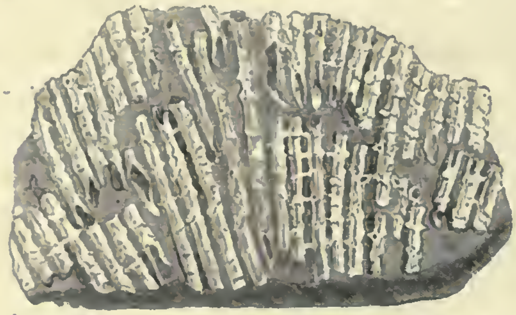
Catenipora escharoides.

Fischer's genus *Halysites* is identical with *Catenipora*.

Syringopora (fossil).—Animals unknown, contained in long subflexuous tubular vertical cells; opening of the cells round, terminal; numerous small horizontal tubuli branch off from the cells, and unite by anastomosis the whole ramified mass into one polypidom.

Goldfuss is tho author of this genus, the species of which were, by older writers, always ranked as *Tubiporæ*. In our own examinations of *Syringopora*, from the Carboniferous Limestone (*S. ramulosa* (?), Goldfuss), we have had reason to think the interior of the tubes had formerly been radiated; but the traces of the lamellæ are never clear, or even certain. Tho species belong to Silurian and Carboniferous Rocks chiefly, perhaps not exclusively.

S. verticellata (Goldfuss, t. 25, f. 6; *S. geniculata*, Phillips, 'Geol. of Yorkshire,' ii. t. 2, f. 1) may be taken as an example.



Syringopora geniculata.

Dendrophyllia.—Animals actiniform, furnished with a great number of bifid tentacula, in the midst of which is a polygonal mouth; the cells containing the animals are rather deep, and radiated by numerous prominent lamellæ; the polypidom which these compose is widely attached, arborescent, striated externally, lacunose internally, and truncate at the extremities. Tho species are both recent and fossil.

D. ramea (Sol. and Ellis, t. 38) is an example.

Lobophyllia.—Animals actiniform, furnished with many cylindrical tentacula; cells conical (sometimes elongated or sinuous), with a subcircular opening, laciniato-lamelliferous, terminating the few branches of the polypidom, which is fixed, of a turbinated shape, externally striated, and internally lacunose.

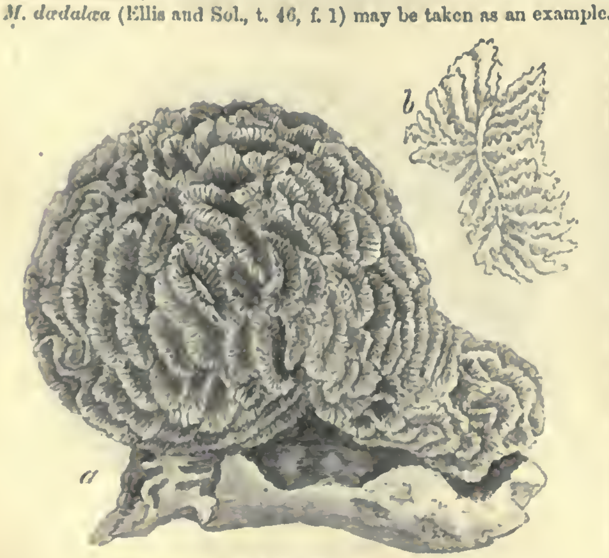
The species were included in Lamarck's genus *Caryophyllia*; the fossil species are chiefly from the Oolitic Formation.

L. Carduus (*Caryophyllia Carduus*, Lamarck) is an example.

Meandrina.—Animals more or less confluent, in one surface, in long sinuous series, having each a distinct mouth and lateral series of very short tentacula, contained in shallow cells, which are not really separate, but form by their lateral union sinuous valleys; these valleys are furnished on each side of the mesial line with transverse subparallel lamellæ, ending against ridges which separate the valleys; the whole calcareous polypidom is fixed, simple, turbiniform when young, and globular when old.

This genus, established by Lamarck, is universally adopted by zoophytologists. The recent species belong to the Indian or South Atlantic seas. The fossil species are few, and chiefly belong to the Oolitic Formation.

M. dædalæa (Ellis and Sol., t. 46, f. 1) may be taken as an example.



Meandrina dædalæa.
a, entire figure reduced; *b*, portion, natural size.

Dictyophyllia (fossil).—Animals unknown, contained in polygonal rather irregular cells of a considerable size; cells separated by partitions denticulated on both sides; the calcareous polypidom which results is fixed, deeply reticulated on the surface, and encrusts other bodies. The base of the cells is finely tuberculated.

The best marked species is *D. reticulata*, which is found in the chalk of Maastricht. Goldfuss, t. 21, fig. 3.

Agaricia.—Animals wholly unknown, contained in cells, which often appear incomplete or confused, and sublamellar internally: they constitute by their union a stony polypidom, fixed, formed of flattened foliaceous irregular expansions, stelliferous on one side only.

The recent species are not numerous. We receive them from the Indian Ocean and the South Sea. Goldfuss refers some fossils to this genus.

A. cucullata (Ellis and Sol., t. 42, f. 1, 2) is an example.

Tridacophyllia.—Animals actiniform, confluent, very depressed, enlarged, and attenuated to a finely crenulated edge; mouth central, a little tuberculous, but without tentacula; cells deep, irregular, foliaceous in the borders, lamellato-radiate, and denticulate within, externally and irregularly striated; the polypiferous mass thus formed is calcareous, foliaceous, not porous, striated, turbinated and fixed at the narrow part.

Lamarck included the principal species (*T. Lactuca*) in his genus *Pavonia*; another he named *Explanaria aspera*.

T. Lactuca (Ellis and Sol., t. 54) is an example.

Monticularia.—Animals unknown, contained in cells imperfectly circumscribed, sometimes even confused or confluent: the lamellæ of these cells are very prominent, very distinct, rather numerous, and diverge from a tubercle; the union of the cells is marginal and in one surface; the polypidom is calcareous, very lacunose and polymorphous: sometimes it encrusts other bodies, is agglomerated into a heap, or spreads in sinuous expansions, striated externally.

This genus of Lamarck is supposed to be identical with *Hydnopora* of Fischer. The recent species are from the Indian seas. Mr. Lonsdale refers a fossil species of the Silurian system to this genus.

M. exesa (Sol. and Ellis, t. 49, f. 3) may be taken as an example.

Pavonia.—Animals without tentacula; the cells which contained them confluent, conical, small, rather oblique, furnished with many very close lamellæ disposed irregularly, though sometimes in series; the polypidom thus composed is solid, fixed, running into various agglomerations and expansions, with sharp edges.

The recent species are from the East and West Indian seas. The few fossil species are from Transition and Oolitic Formations.

P. boletiformis (Ellis and Sol., t. 32, f. 3, 4) is an example.

Pavonia boletiformis.

The following genera, namely, *Astræa, Echinastræa, Branchastræa,* and *Oculina*, are grouped by De Blainville under tho sub-sectional title of *Madrastræa*:—

Astræa.—Animals short, more or less cylindrical; mouth rounded, placed in the midst of a disc covered with few and rather short tentacula; cells shallow, lamellæ radiating, and forming by their union a fixed polymorphous polypidom, which often encrusts other bodies, or is agglomerated on itself. This great genus is divided into the following sections.

Section A. *Astræoides* of Quoi and Gaimard.—Stars round and often disjoined.

A. calycularis (*Caryophillia calycularis* of Lamarck), from the Mediterranean, is an example.

Section B. Meandriniform *Astrææ.*—Stars distinct, unequal, oblong, more or less diffluent, forming encrusting or agglomerated masses.

A. Uva may be taken as an example.

Section C. *Gemmastræa.*—Stars circular, very distant, prominent, and forming encrusting masses.

These are chiefly fossil.

A. Lucasiana, Defr., from the Oolite of Besançon, is an example.

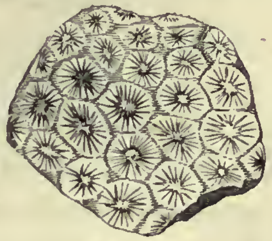
Section D. *Tubastræa.*—Cells tubular, vertical, more or less distant, with a round opening, the edges being hardly prominent, and radiated by a moderate number (12 to 24) of complete lamellæ. This section includes many recent and fossil species.

A. faveolata (Ellis and Sol., t. 53) may be taken as an example.

The animal is described by Quoy and Gaimard.

Section E. — Cells roundish, approximate, sometimes irregular, rather shallow; the lamellæ very distinct, cutting, complete, extended over the rounded interstices; mass encrusting or agglomerated.

A. Ananas (Ellis and Sol., t. 47) is an example.



Astræa Ananas.

Section F. *Siderastræa.*—Cells superficial or shallow, indefined, with numerous very fine lamellæ, radiating from an excavated centre, and continued to meet or even to join those of neighbouring cells.

A. siderea (Ellis and Sol., t. 49) may be taken as an example.

The fossil species are numerous, especially in the later Secondary and Tertiary Rocks.

De Blainville makes several groups of them according to the manner of their growth.

Section G. *Dipsastræa.*—Of a globular figure; cells profound, infundibuliform, sub-polygonal, contiguous, with common partitions, which are elevated, sulcated, and echinulated on the edges.

A. dipsacea (Lamarck; *Madrepora favosa*, Ellis and Sol., t. 50) is an example.

There are fossil species in the Secondary and Tertiary Strata.

Section H. *Montastræa.*—In thick masses composed of tubular cells, which acquire a polygonal figure from juxta-position; their edges not prominent; the cavity not deep, furnished with numerous lamellæ united to a solid prominent axis. The known species are fossil.

Section I. *Favastræa.*—In a thick mass composed of large polygonal excavated cells, pluriradiate, depressed in the centre, and hollowed towards the margin. (*Acervularia* of Schweigger; *Cyathophyllum* of Goldfuss.)

Goldfuss's generic name is much employed for fossils of the Silurian Rocks.

Recent, *Astræa magnifica*; Indian Sea: Fossil, *A. Baltica*, De Bl. (*A. Ananas*, Linn.) are examples.

Mr. Lonsdale has proposed a new genus, allied to *Cyathophyllum*; and from its vesicular internal structure calls it *Cystiphyllum*. From the Silurian Rocks.

Section K. *Strombastræa.*—In corticiform masses composed of infundibuliform polygonal radiato-lamelliferous cells, which are proliferous, or succeed one another vertically. Goldfuss calls the group *Strombodes*. Its distinctness is doubted by De Blainville.

Strombodes pentagonus, Goldfuss, fossil, in the North American limestone, may be taken as an example.

Section L. *Cellastræa.*—The species of this group differ from the *Dipsastræa* principally by the fineness of their radiating lamellæ, and by a peculiar cellular structure. The fossil species are found in Tertiary Strata.

A. incerta (Sol. and Ellis t. 47, 3) is an example.

In concluding his examination of the great genus *Astræa* (which includes several other genera adopted by Goldfuss, Schweigger, &c.), De Blainville acknowledges the probable imperfection of the arrangement above given, and notices the transitions which it presents to the generic groups of *Caryophyllia, Pavonia, Oculina*, &c. Perhaps until the relation of the lamelliferous cells to their contained polypi is known from a very general investigation of recent types, zoologists will do wisely not to propose new genera from ill-understood specimens of ancient corals.

Echinastræa.—Animals unknown, contained in raised cells which are strongly radiated, rather irregular, echinulated, and occupy only the upper surface of the coral. The mass is either fixed or free, expanded into a lobate or reflexed plate, internally echinated, striated, but not porous externally.

Part of *Explanaria*, Lamarck, is included in this new group, as well as *Echinophora* of that author.

E. ringens (Lamarck) may be taken as an example.

Branchastræa.—Animals unknown; the cells which contained them are of a cylindrical figure, channeled internally, prominent, radiating from the general mass, and united into a ramose, cylindrical, solid coral. Only one species, *B. limbata* (Goldfuss, t. 8, f. 7); from the Jura Limestone, Suabia.

Oculina.—Animals unknown, contained in regular, round, radiated cells, more or less prominent, and scattered on the surface of a solid, compact, arborescent, fixed polypidom.

Lamarck established the genus; Schweigger has united it to *Astræa*, and Goldfuss to *Caryophyllia*.

O. axillaris (Ellis and Sol., t. 13, f. 5) is an example.

O. prolifera has been taken in Zetland. [POLYPIFERA.]

Oculina axillaris.

MADREPORÆA, the second section of the Stony *Zoantharia* of De Blainville, and placed by him after *Madrephylliœa*. [MADREPHYLLIŒA.]

The corals of this section are generally arborescent, with small partially lamelliferous cells, and constantly porous in the interstices and walls of the cells. This last is the most important character. The Lamarckian genus *Madrepora* included many of the genera of De Blainville.

Dentipora.—Animals unknown; cells deep, circular, mammillated, furnished with 10 dentiform lamellæ prominent towards the margins, scattered in the polypidom, which is compact, expanded, its parts anastomosing together, and echinulated with strong interstitial tubercles.

The species are ranked with *Oculina* by Ehrenberg and earlier authors.

D. virginea (Ellis and Sol., t. 36) may be taken as an example.

Dentipora virginea.

a, magnified; *b*, section of the lamelliferous cell.

Astræopora.—Animals unknown (probably provided with a single crown of 12 tentacula): the cells which contained them are prominent, mamillary, internally sulcated, and irregularly scattered on the surface of the polypidom, which is extremely porous and echinulated, enlarged into thin expansions. *Astræa myriophthalma* of Lamarck belongs to this genus.

Sideropora.—Animals unknown; cells deep, immersed, circular or sub-hexagonal, with six deep notches at the border, and a prominent central axis, irregularly dispersed on the arborescent, palmated, finely granulated, but not porous polypidom. Several of Lamarck's *Porites* are placed in this group. *S. digitata* is an example.

Stylopora.—Animals unknown; cells with few lobes at the circumference, internally striated, with a pistilliform axis, irregularly aggregated into an arborescent or subpalmated fixed polyparium, whose interstices are porous and echinulated.

This group of Schweigger is not considered as really generic.

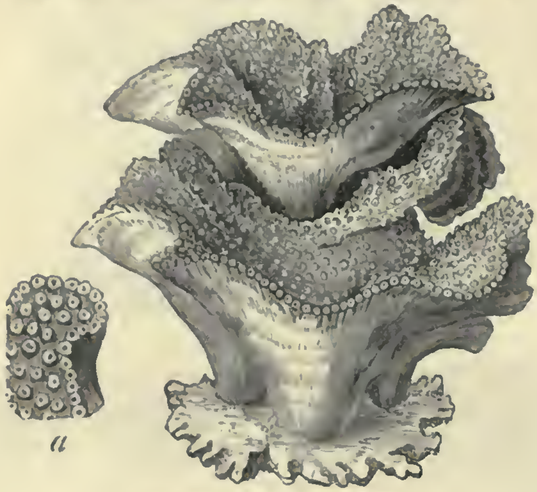
Coscinopora.—Animals unknown; cells infundibuliform, quincuncial, forming the openings of capillary tubes laterally adherent into an attached polymorphous polypidom.

This group, established by Goldfuss, is ranked by that author near to *Retepora.* There is apparently no evidence that it should be placed among the *Madreporæa.*

C. infundibuliformis (Goldfuss, pl. 9 and pl. 30, f. 10) is an example.

Gemmipora.—Animals without tentacula; cells deep, cylindrical, channelled, and almost lamelliferous within, prominent in a mammillary form on the surface of a fixed, porous, arborescent, or laminiform polypidom. Several of Lamarck's *Explanariæ* come into this group.

G. mesenterina (Ellis and Sol., t. 43) may be taken as an example.



Gemmipora mesenterina, diminished.
a, portion, natural size.

Montipora.—Animals actiniform, short, provided with small tentacula to the number of twelve, placed in a single series; cells very small, rounded, impressed, regular, with few internal grooves. Polypidom incrusting or agglomerated, very porous, much echinulated, and marked by mammillary prominences on the free surface. Some of Lamarck's *Porites* are included in this genus.

Porites verrucosa, Lamarck, an Australasian genus, is an example.

Madrepora.—Animals actiniform, rather short, with twelve simple

Madrepora abrotanoides, diminished.
a, termination of one of the branches, natural size.

tentacula; cells deep, prominent, scarcely stelliferous, irregularly scattered on the surface, and accumulated towards the terminations of the polypidom, which is very porous, arborescent or frondescent, and fixed.

This restricted genus includes several recent species, and a few fossils.

M. abrotanoides, Lamarck; *M. muricata*, Linn. (Ellis and Sol., t. 57), is an example.

Palmipora.—Animals unknown; cells very small, unequal, completely immersed, obsoletely radiated, scattered; polypidom fixed, cellular within, very finely porous and reticulated externally, expanded in a palmate or digitated form.

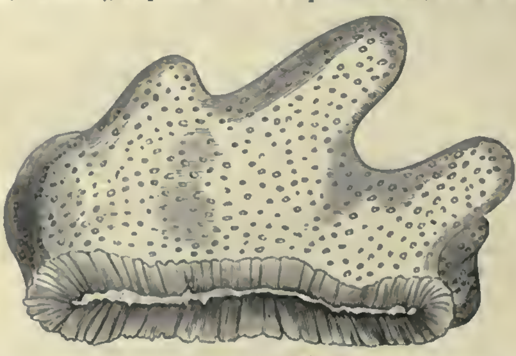
The genus includes *Millepora alcicornis* of Linnæus and others like it.

M. alcicornis, Linn., may be taken as an example.

Millepora alcicornis.

Heliopora.—Animals short and cylindrical, with a crown of 15 or 16 broad and short tentacula; cells cylindrical, vertical, or subdivergent, immersed, internally crenulated by partial lamellæ; polypidom largely porous in the interval of the cells.

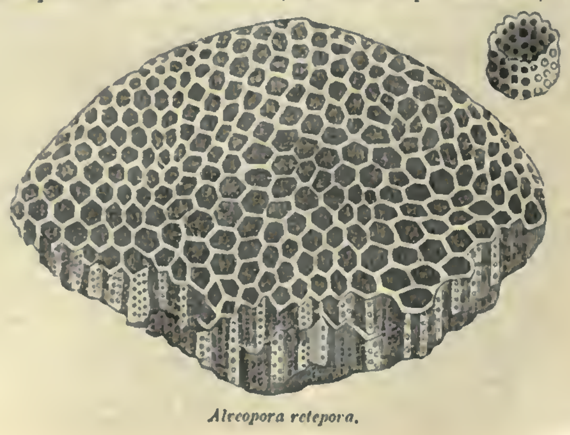
H. cærulea (*Madrepora cærulea*, Ellis and Sol., t. 12, f. 4; *Pocillopora cærulea*, Lamarck), a species from the equatorial seas, is an example.



Heliopora cærulea.

A fossil species in the Transition Limestone (*Astræa porosa*, Gold.), usually ranked in this genus, is put in *Porites* by Ehrenberg and Lonsdale. (Murchison's 'Silurian Region.')

Alveopora.—Animals actiniform, with 12 simple tentacula; cells



Alveopora retepora.

deep, polygonal, irregular, unequal, internally tuberculiferous, with perforated or reticulated parietes, echinulated on the terminal edges; polypidom porous, cellular.

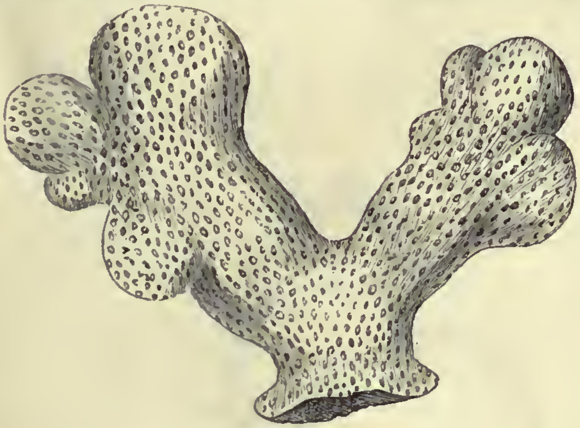
A. retepora; Madrepora retepora, Linn. (Ellis and Sol., t. 64, f. 3-5), may be taken as an example.

Goniopora.—Animals actiniform, elongated, cylindrical, with a crown of more than 12 simple tentacula; cells polygonal, internally sulcated, echinulated on the edges; polypidom extremely porous.

One recent species (*G. pedunculata* of Quoy and Gaimard).

Porites.—Animals urceolate, with 12 very short tentacula; cells polygonal, unequal, imperfectly defined, incompletely radiated by filamentous pointed rays, with echinulated intervals; polypidom diversiform, porous, and echinated. This is a genus of Lamarck, but somewhat contracted by De Blainville.

P. clavaria, Lamarck (Ellis and Sol., t. 47, f. 1), is an example.



Porites clavaria.

Seriatopora.—Animals without tentacula (?); cells immersed, ciliated on the edges, but not internally lamelliferous, ranged in longitudinal series on the cylindrical branches of a porous finely ramified polypidom. This is a genus of Lamarck modified. It includes only a few species, much like the type, *Madrepora seriata*, Linn.: figured in Ellis and Sol., t. 31, f. 1-2. Ehrenberg ranks them with Millepores.

Pocillopora.—Animals without tentacula (?); cells small, shallow, subpolygonal, echinulated on the edges, and sometimes rather lamelliferous within; towards the terminations of the branching polypidom the cells are contiguous and adherent, but separated by granular interstices near the base of attachment. The polypidom is not porous.

Lamarck established the genus, which is generally adopted. Ehrenberg doubts if there be any tentacula.

P. damicornis, Lamarck, recently found in the Indian Sea may be taken as an example. *P. interstincta* has been found in the British seas. [POLYPIFERA.]

MADREPORITE (*Anthraconite; Columnar Carbonate of Lime*)—a Mineral occurring in roundish masses, the structure of which is columnar and diverging. Fracture indistinctly lamellar. Hardness 3·0; yields easily to the knife. Colour grayish-black. Lustre vitreous. Opaque, or only translucent on the edges. Specific gravity 2·7. It is found in Norway at Stavern, in transition rocks; at Gyphytta in alum slate; in Greenland, and in Salzburg.

The following analysis is by Klaproth:—

Carbonate of Lime	83·00
Carbonate of Magnesia	10·30
Carbonate of Iron	1·25
Silica	4·50
Carbon	0·50
	99·55

MÆNU'RA, or MENU'RA, Dr. Shaw's and Dr. Latham's name for a singular genus of Birds, whose place in the system has occasioned some difference of opinion among ornithologists.

In 'An Account of the English Colony of New South Wales, from its first settlement in January, 1788, to August, 1801, &c., to which are added some particulars of New Zealand, compiled by permission from the manuscripts of Lieutenant-Governor King; and an Account of a Voyage by Captain Flinders and Mr. Bass, &c., abstracted from the Journal of Mr. Bass, by Lieutenant Collins of the Royal Marines,' &c. (4to. 2 vols., 1802, London), it appears that in January, 1798, in consequence of the determination of certain Irishmen to go out for the discovery of a settlement for themselves, the governor, after ineffectually trying corporal punishment, determined, with a view of checking the spirit of emigration, to convince these Irish by their own experience of the danger and difficulties which attended it, and accordingly he caused four of the strongest and hardiest among them to be chosen by themselves, and properly prepared for a journey of discovery. They were to be accompanied by three men, upon whom the governor knew he could depend, and who were to lead them back when fatigued and exhausted with their journey over the worst and most dangerous part of the country. A conspiracy to murder the guides was discovered, and counteracted by the addition of four soldiers to the guides, and on the 14th they set off from Paramatta. On the 24th the soldiers returned with three of the deputies, who, having gained the foot of the first mountains, were so completely sick of the journey, and of the prospect before them, that they requested to return with the soldiers, whose mission here terminated. The three persons who had been sent out with the Irishmen returned on the 9th of February. "On arranging their courses and distances on paper, they appeared to have travelled in a direction south-west three-fourths west about 140 miles from Paramatta. They brought in with them one of the birds which they had named pheasants, but which, on examination, appeared to be a variety of the Bird of Paradise. The size of this curious and handsome bird was that of a common hen; the colour a reddish-black, the bill long, the legs black and very strong. The tail, about two feet in length, was formed of several feathers, two of which were the principal, having the interior sides scalloped alternately of a deeper or lighter reddish-brown inclining to orange, shading gently into a white or silver colour next the stem, crossing each other, and at the very extremity terminating in a broad black round finishing. The difference of colour in the scallops did not proceed from any precise change in the colour itself, but from the texture of the feather, which was alternately thicker and thinner. The fibres of the outer side of the stem were narrow, and of a lead colour. Two other feathers of equal length, and of a bluish or lead colour, lay within those; very narrow, and having fibres only on one side of the stem. Many other feathers of the same length lay within those again, which were of a pale grayish colour, and of the most delicate texture, resembling more the skeleton of a feather than a perfect one." Lieutenant Collins then gives a figure of the bird "from the pencil of a capital artist," which seems to have been handed down from author to author, and is indeed upon the whole correct, with the name of *Mænura superba*.

M. Temminck arranged the form under his order of Insectivorous Birds (Insectivores), among the Thrushes, giving it a position between *Cinclus* and *Pitta*.

Cuvier does not differ much in his views from M. Temminck; for he places it among his great group of Passereaux (Cuvier's second order), and it stands in the 'Règne Animal' in the following relative position: *Oriolus, Gymnops, Mænura, Motacilla.*

M. Vieillot differs almost entirely from both Temminck and Cuvier; for, though he includes it in his second order, which corresponds with the *Insessores* of Mr. Vigors, the *Lyriferi* stand in M. Vieillot's 'Analyse' at the extremity of that order, and near the groups of *Columba* and *Penelope*.

Illiger, in his 'Prodromus,' arranged it among the *Rasores*.

Before we proceed to a consideration of the views of more modern authors, it is right to put the reader in possession of Cuvier's description, with his reasons for classing *Mænura* as he did. He says that the size of the bird (a little less than that of a common pheasant) has caused it to be referred to the Gallinaceous Birds, but that it belongs evidently to the Passerine order from its feet, whose toes (excepting the first articulation of the external and middle toe) are separated, while the form approaches the Thrushes (Merles) in the structure of the bill, which is triangular at its base, elongated, and a little compressed, and notched towards its point; the membranous nostrils are large and partially covered with feathers as in the Jays. *Mænura*, he adds, is to be distinguished by the great tail of the male, which is very remarkable for the three sorts of feathers that compose it. The twelve ordinary feathers are very long, with loose and very distant barbs; two more in the middle are furnished on one side only with close-set barbs, and two external ones are curved in the form of an S, or like the branches of a lyre, whose internal barbs, which are large and close-set, represent a broad riband, while the external ones are very short and do not become enlarged till towards the end of the feathers. The female has only twelve feathers of the ordinary structure.

Mr. Vigors ('Linn. Trans.,' vol. xiv.), who alludes to the position assigned to the bird by the authors above mentioned, places it at the extreme of his third order (*Rasores*), among his family of *Cracidæ*. [CRACIDÆ.]

M. Lesson speaks of the position of *Mænura* as far from being fixed, and though he follows Cuvier in placing it among the Passereaux, he observes that some authors think that it would stand better at the side of *Megapodius*, in the Gallinaceous order. After quoting the words of Cuvier given above, he says, "The *Mænura* has then been arranged sometimes among the gallinaceous birds under the name of Lyre-Pheasant, or Pheasant of the Woods, and sometimes at the end of the Calaos [HORNBILL], and the Hoazins [CRACIDÆ], as M. Vieillot classed it, while, scientifically speaking, it is near the Thrushes that *Mænura* ought to take its place, though it departs distinctly from them in the form of the body."

Mr. Swainson ('Classification of Birds,' vol ii. 1837) alludes to the place assigned to *Mænura* and *Megapodius* by Mr. Vigors, and says that they certainly accord more with that family than with any other group of the *Gallinaceæ*. Mr. Swainson observes that both these genera have the feet uncommonly large, and that both seem to represent the scansorial genus *Orthonyx*, a bird indeed scarcely larger than a sparrow, but agreeing in the very remarkable scansorial character of having the three fore toes of nearly the same size. "If," continues Mr. Swainson, "the *Cracidæ*, as we believe, is the scansorial family of the *Rasores*, this singular analogy is precisely what we should expect in two groups representing the same tribes." In the synopsis at the end of the volume Mr. Swainson cancels the term *Cracidæ*, and substitutes in its place the family *Megapodinæ* (*Megapodidæ?*), remarking, that as he has every reason to believe, from an attentive study of this family, that *Crax* is an aberrant genus, he has thought it better to correct his former error, and to name the whole from that group which is one of the chief types; and he makes *Mænura* the first genus of his 'Family *Megapodinæ*, Greatfoots,' with the following generic character:—Bill moderate, depressed at the base, straight; the tip obsoletely notched. Nostrils naked and placed near the middle of the bill. Feet very large, strong, and robust; nearly all the anterior toes equal; the claws enormous for the size of the bird, obtuse, and slightly curved. Wings short. Tail very long, lyre-shaped; the feathers singularly developed. The typical or conirostral form of the whole family.

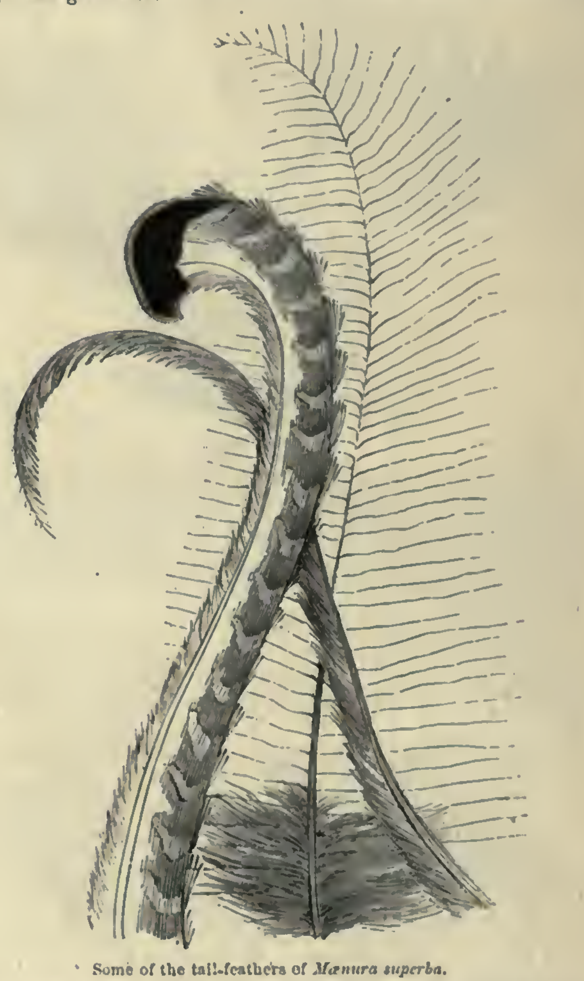
M. superba (*M. Lyra*, or *lyrata*, *M. Novæ Hollandiæ*, Shaw, Lath., *M. Paradisea*, Vieill.) is the only species known.

Lyre-Tail (*Mænura superba*), male.

Lieutenant Collins, in the work above quoted, gives, towards the end of his second volume, "a more minute and ornithological description (with which he had been 'favoured') than that stated above." The second description is as follows. "The bill of this bird, which has been named the *M. superba*, is straight, having the nostrils in the centre of the beak. The base of the upper mandible is furnished with hairs like feathers turning down; the upper mandible is at the base, somewhat like that of the pigeon. The eye is a dark hazel, with a bare space around it. The throat and chin are of a dark rufous colour; the rest, with the body, of a dusky gray. The feathers on the rump are longer than those of the body, and more divided. The colour of the wings, which are concave, is dark rufous. The legs and claws are large in proportion to the bird, particularly the claws. The outward toe is connected with the middle one as far as the first joint. The tail is long, and composed of three different sorts of feathers, of which the upper side is of a dark gray, with ferruginous spots. The first two lower feathers, which are a little curved in two directions, are beneath of a pearly colour, enriched with several crescent-shaped spaces, of a rich rufous and black colour. The laminæ are unwebbed, turned round toward the extremity, and ornamented with a black bar, the breadth of an inch, and fringed at the end. The shaft of the second, which is likewise long, is fringed with long hair-like filaments; and the third, which is also long and curved, is plumed on the inner side only, except at the extremity, where there are a few separated filaments of a dark gray colour.

"The female *M. superba* differs very little from the male, except in the tail, which is composed of twelve feathers, a little curved and plumed, having the upper side dark rufous and gray, and the under of a pearly colour."

The more modern descriptions of the tail of the female state it to be simply brown, and composed of long uniform feathers, which are straight and graduated.



Some of the tail-feathers of *Mænura superba*.

Notwithstanding the sombre hues of this extraordinary bird, the magnificence and peculiar structure of the beautiful tail of the male, which imitates the form of an ancient Grecian lyre, give it a superb appearance.

New South Wales, principally in the forests of *Eucalyptus* and *Casuarina* which cover the Blue Mountains, and in their rocky and retired avenues, is the habitat of this bird.

Lieutenant Collins says that "the following particulars relating to these birds were observed by persons resident in the country, and who were eye-witnesses of what is here told. They frequent retired and inaccessible parts of the interior; have been seen to run remarkably fast, but their tails are so cumbrous that they cannot fly in a direct line. They sing for two hours in the morning, beginning from the time when they quit the valley, until they attain the summit of the hill, where they scrape together a small hillock with their tail spread over them, imitating successively the note of every bird known in the country. They then return to the valley." If dependence could be placed upon this account as far as relates to the singing, it would assist the views of those who would place *Mænura* near the Thrushes; among the gallinaceous birds, singing, in the common acceptation of the word as applied to birds, is not known. But this sort of statements, taken as they mostly are from the relation of those who are not very careful as to the truth of their communications, if they can only surprise and please their auditors, must be received with many grains of allowance. The singing is not corroborated by subsequent observers.

Mr. Caley informed Mr. Vigors, that from the observations he was enabled to make on these birds during his stay in Australia, it was his opinion that they were gallinaceous. Mr. Caley generally found them in flocks, and for the most part on the ground. M. Lesson states that they come forth in the evening and the morning, remaining quiet during the day on the trees whereon they perch. He says that they are becoming more and more rare, and that he only saw two skins during the whole of his stay at New South Wales. Mr. Swainson informs us that chief-justice Field, of Gibraltar, who was long a resident in Australia, assured him (Mr. S.) that *Mœnura* in all its habits was a gallinaceous bird, living on the ground in small societies, and being very fond of rolling in the dust.

Mr. Bennett, in his 'Wanderings in New South Wales,' &c., remarks that this Native Wood-Pheasant, or Lyre-Bird of the colonists, the Béleck-Béleck and Balangara of the aboriginal tribes, is abundant about the mountain ranges in all parts of the colony. The tail-feathers are detached entire from the bird, and are sold in the shops at Sydney in pairs. Mr. Bennett observes that the price was formerly low; but now that the bird, from continued destruction, has become rare, their tails fetch from 20*s.* to 30*s.* the pair. About the ranges however of the Tumat country, where they have been seldom destroyed, they are more frequently seen.

The same author states that it has its young in December, the season when all the wild animals in the colony are produced, and can be then procured with facility. "It is," says Mr. Bennett in continuation, "a bird of heavy flight, but swift of foot. On catching a glimpse of the sportsman it runs with rapidity, aided by the wings in getting over logs of wood, rocks, or any obstruction to its progress; it seldom flies into trees, except to roost, and then rises only from branch to branch: they build in old hollow trunks of trees which are lying upon the ground, or in the holes of rocks; the nest is formed merely of dried grass or dried leaves scraped together. The female lays from twelve to sixteen eggs of a white colour, with a few scattered blue spots. The young are difficult to catch, as they run with rapidity, concealing themselves among the rocks and bushes. The Lyre-Pheasant, on descending from high trees on which it perches, has been seen to fly some distance. It is more often observed during the early hours of the morning, and in the evenings, than during the heat of the day. Like all the gallinaceous tribe, it scratches about the ground and roots of trees to pick up seeds, insects, &c. The aborigines decorate their greasy locks, in addition to the emu feathers, with the splendid tail-feathers of this bird, when they can procure them."

Mr. Bennett laments the rapid disappearance of the races of animals found in a new country, and which are pursued, whether useful or dangerous, even to extermination. He states that in the settled parts of the colony the harmless kangaroos and emus are rarely seen, when they might easily be domesticated about the habitations. "The same remark," he adds, "applies to the Lyre-Pheasant. Why are they not domesticated, before, by extermination, they are lost to us for ever?"

MÆRA, Dr. Leach's name for a genus of Amphipodous *Crustacea*. *M. grossimana*, Leach (*Cancer Gammarus grossimanus*, Montagu) 'Linn. Trans.,' ix. tab. 4, fig. 5, is very common on the English coasts, where it is found under stones and rocks at low water.

MAGI'LUS, De Montfort's name for a genus of Testaceous *Mollusca*, the form of whose shell varies very much according to its different stages of growth and the circumstances in which it is placed.

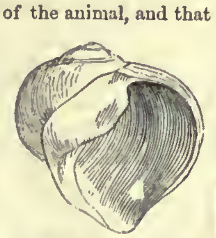
The genus was placed by Lamarck among his *Annelida*, in the family *Serpulacea*, containing the genera *Spirorbis*, *Serpula*, *Vermilia*, *Galeolaria*, besides that under consideration.

M. De Blainville arranged it among the *Mollusca* (family *Cricostomata*), between *Siliquaria* and *Valvata*, observing at the same time that Guettard clearly saw the relation of the form to *Vermetus*.

Cuvier, in his last edition of the 'Règne Animal,' gives it a position between *Vermetus* and *Siliquaria*, in his seventh order of Gastropods (*Tubulibranchiata*).

M. Rang remarks that, when he was seeking the animal in India, he was struck, like M. De Blainville, with the analogy which the genus presents not only to *Vermetus*, but also to many other genera of *Pectinibranchiata*. This analogy, M. Rang further observes, is especially remarkable when a young individual whose shell has not yet become tubular is examined.

M. Rang states that he saw some fragments of the animal, and that it is certainly a Gastropod. In his description however he notes the animal as unknown. Dr. Rüppell states that it is furnished with an operculum.



Shell of *Magilus* (young).

Shell.—Young: Fragile, with an epidermis, pyriform, ventricose, with a short spire of from three to four turns; aperture longer than it is wide, oblong, without any notch anteriorly, where the lip nevertheless forms an angle. Dr. Rüppell thinks that M. Rang, when he wrote the above description, had before him the young of *Leptoconchus*. Adult: The last whorl abandoning altogether the spiral form to produce an elongated tube, which is irregularly sinuous, or irregularly contorted, conical, compressed laterally, especially on the side of the base of the shell, carinated beneath, and free; aperture elliptical.

Shell of *Magilus* (old).

When in this state the shell presents all the characters of a regularly spiral univalve. The animal establishes itself in the excavations of Madrepores (*Astrææ*, &c.), and as the coral increases around it the *Magilus* is obliged, in order to have its aperture on a level with the surrounding surface, or near it, to construct a tube, which is more or less eccentric according to circumstances, the growth of the coral determining the length of the tube. As this tube goes on increasing the animal abandons the spiral for the tubular part of the shell, and in this operation it leaves behind no septa, or partitions, but secretes a compact calcareous matter which reaches to the very summit of the spiral part, and is deposited from time to time as the tube is lengthened; so that in an old specimen the posterior part of the shell presents a solid and almost crystalline mass: indeed the fracture of this mass is radiated and saccharoid. One species only, *Magilus antiquus*, is known. The colour is white, more or less pure. [LEPTOCONCHUS.]

MAGNESIA, the Oxide of the metal Magnesium. Magnesia, as well as several of its salts, occur as minerals. The sulphate and nitrates of magnesia are soluble, and have a bitter taste. The other native salts are insoluble. The specific gravity of all the salts is below 3.

Shephardite, also called *Brucite*, is a hydrate of magnesia. It occurs rarely, in hexagonal prisms, generally in laminar masses, and fibrous. Its primary form is a rhomboid. Colour white, greenish-white. Streak white. Lustre pearly. Transparent, translucent. Hardness 1·0 to 1·5. Specific gravity 2·33 to 2·63. It is found at Hoboken, in New Jersey, North America, and in the island of Unst, Shetland. Bruce, after whom it has been named, gives as its composition—

Magnesia	70
Water	30
	100

Nemalite is a name given to a fibrous form which contains some iron and carbonic acid. It occurs with the first form in North America.

Sulphate of Magnesia is the well-known Epsom Salts. It is often found in solution in mineral springs, also in sea-water. In some places it has been found crystallised. At Helderberg it occurs as an efflorescence, and it is called Hair-Salt. [EPSOMITE.]

Magnesite, Carbonate of Magnesia, occurs in acicular crystals, massive, and in powder. Its colour is usually white, occasionally grayish and yellowish. The massive varieties are found amorphous, reniform, nodular, and stalactitic. Fracture splintery, or flat conchoidal. Its hardness exceeds that of calc-spar. It is dull, nearly opaque. Specific gravity 2·8. It is found in several parts of Europe, as Styria, Moravia, Spain, and Silesia, in India, and at Hoboken, in New Jersey, North America. Its analysis by Rammelsberg gives—

Carbonic Acid	52·214
Magnesia	47·786
	100

Hydromagnesite is a name given to an earthy white pulverulent hydrous carbonate of magnesia found at Hoboken, New Jersey, North America.

Borate of Magnesia, Boracite, is a common form of magnesian mineral. [BORON.]

Nitrate of Magnesia occurs in white deliquescent efflorescences, associated with nitrate of lime, in limestone caverns. It is used in the manufacture of saltpetre.

Polyhalite, a brick-red saline mineral, consists of the sulphates of lime, potash, and magnesia, with 6 per cent. of water.

Magnesite is a phosphate of magnesia, from Salzberg, in Germany.

Rhodizite resembles Boracite. It occurs with the red tourmaline of Siberia.

Magnesian Alum occurs massive. Its structure is fibrous, also compact. Colour and streak snow-white. Lustre shining. It is found at Cape Verd, in Southern Africa, where it covers the floor of a grotto to the depth of six inches. Its analysis by Stromeyer gives—

Sulphate of Alumina	38·398
Sulphate of Magnesia	10·820
Sulphate of Manganese	4·597
Chloride of Potassium	0·205
Water	45·739
	99·759

Magnesian Pharmacolite occurs massive. Cleavage foliated in one direction. Colour dirty white, or honey-yellow. Hardness 5 to 6. Brittle. Lustre waxy. Specific gravity 2·52. Found at Längbanshyttan in Wermeland. Its analysis by Kühn gives—

Arsenic Acid	58.52
Lime	23·22
Magnesia	15·68
Protoxide of Manganese	2·13
Iron	a trace.
Loss by Ignition	0·30
	99·85

The silicates of magnesia are an exceedingly numerous group of minerals. They enter into the following:—*Talc, Chlorite, Serpentine, Nephrite, Meerschaum, Schiller Spar, Pyroxene, Hornblende, Chrysolite, Chondrodite.*

MAGNESIAN LIMESTONE, or Permian System, is the name given to the rocks which immediately underlie those of the Triassic or Upper or New Red-Sandstone series of England. In Russia a large group of deposits of this date exists, and is marked by distinct peculiarities. The abundance of carbonate of magnesia is characteristic of part of the series—hence its name. The Magnesian Limestone rock is seen to greatest perfection in England between the rivers Tyne and Tees, between the rivers Wharf and Dun, and between this last river and Nottingham. We mention these parts of the great line of magnesian limestone in the north of England for the purpose of pointing out some interesting differences in the composition and other characters of the rock. It is in the middle part of the course here indicated, from north to south, that the stratification of the rock is most developed. Between the Dun and Wharf, and for some space north and south of these rivers, this limestone occurs in fact in two rocks separated from each other by beds of red and bluish clay, with gypsum (indistinguishable from some of the upper or Keuper marls of the Red-Sandstone Formation); but in the northern and southern parts this difference does not obtain. Of the two limestones thus separated the upper one has but a limited extent (Smith's 'Geological Map of Yorkshire'); the lower one is almost uninterrupted from beyond the Tyne nearly to the Trent. The upper rock is about 12 yards thick; the lower one reaches 50 yards, or perhaps in some cases 100 yards: the upper one contains almost no magnesia, and lime burnt from it is extensively employed in agriculture; the lower one is very often composed of atomic aggregations of carbonate of lime and carbonate of magnesia, and, both as stone and when burnt to lime, is more useful in building. Its mode of aggregation varies extremely. In many situations (Thorp Arch, in Yorkshire) it is a soft powdery stone, traversed nevertheless by veins of calcareous spar; about Tadcaster, and generally between the Nid and the Dun, it is a firm though hardly compact rock, often traversed by sparry veins and full of irregular crystallised cavities. The crystals are generally carbonate of lime, sometimes mixed with oxide of iron. In a few cases sulphate of barytes appears in the form of veins dividing this rock, as at Huddleston, near Ferrybridge, &c. Still less commonly thin veins of carbonate of copper (sometimes apparently epigene, on sulphuret) line the joints of the rock about Newton Kyme, near Tadcaster, and in other places.

Some of the best building-stone of this description is dug in the quarries of Huddleston, Broadsworth, and Warmsworth, and it is generally really or nearly an atomic combination of carbonate of lime and carbonate of magnesia, a fact determined by the late Dr. Henry of Manchester.

A further state of arrangement of the materials of this rock is noticed in several localities between the Aire and the Dun, where the rocks assume locally and for limited areas the oolitic texture; and, finally, as one of the most valuable building-stones in the range of the magnesian limestone, may be signalised the white limestone of Roche Abbey, which in that noble ruin has stood the ravages of time better than almost any freestone of the north of England.

Farther south the grain of the rock changes; it becomes continually more and more crystalline, and from Bolsover to Nottingham the magnesian limestone may be described, with little inaccuracy, as a real dolomite, partially debased by small admixtures of sand. The small rhomboidal crystals of this rock are very evident in specimens which we collected many years ago at Mansfield Woodhouse and near Nottingham. The stone used for building the present Houses of Parliament consists of the magnesian limestone from this district.

A crystalline structure of the magnesian limestone rock is however not confined to the southern portion of its range, though there it is manifested in connection with very useful qualities in architecture. In the county of Durham we find it exhibited in the purely calcareous rocks of Hawthorn Hive, near Easington, in the romantic, contorted, and broken cliffs and pinnacles of Marsden, and in the singular coralloidal quarries of Building Hill. At Marsden it is curious to notice in near contrast, in the cliff, the flexible laminated limestone, and in the detached pinnacles an equally laminated rock traversed by complete planes of crystalline structure. What does this teach? obviously, the important fact, that, since its deposition in laminæ, the sedimentary mass of carbonate of lime has been subject to a new molecular arrangement, which, predominating over the original structure, has readjusted the particles and generated a new structure. In the same vicinity are brecciated rocks, which seem to require the hypothesis of reaggregation of fragmented portions of previously-indurated magnesian limestone beds. Thus various are the aspects of the mineral aggregation of the magnesian limestone of England. These diversities belong almost exclusively to the lower rock, for the upper laminated non-magnesian portion is usually of a uniform close texture, except in the lower beds, which are somewhat cellular (and of little value to the lime-burner) at Knottingley.

It should be added, that the general colour of the magnesian limestone (lower portion) is white, yellow, rich pale-brown, or reddish, while the upper rock is commonly of a gray, smoky, or purplish hue. This rock is usually interstratified with thin clay partings, the lower one very rarely.

The specific gravity of magnesian limestone is usually greater than that of common carbonate of lime. This however may be overlooked in the usual incomplete mode of trying such experiments, unless the observer makes the easy correction due to the absorption of water by many of these stones. Tried in powder (for example, by Leslie's process), the magnesian limestones of England betray by their weight their affinity to the dolomitic rocks of the Alps and the Eifel, though the introduction of the magnesia is probably not at all due to the same cause in the two cases. [DOLOMITE.]

Professor Sedgwick, in his admirable memoir in the 'Geological Transactions,' on the Magnesian Limestone, has pointed out clearly the most common organic fossils of this rock. We shall only observe here, that in respect of fishes (*Mollusca* and *Zoophyta*) this rock shows an extreme analogy with the Carboniferous System. Its place, by mineral analogies, may be rightly fixed in the Pœcilitic System; but by the affinities of organic existence it will be classed with the more ancient rocks. Let any one, for example, contrast its marine fossils, whether derived from Durham, Yorkshire, or the Thuringerwald, with those of the Muschelkalk; the former are seen to be analogous to forms common in the Mountain Limestone, the latter to those of the Lias. In neither case is the resemblance perfect; the species are not identical, but the result above announced is unequivocal, and must soon be felt in geological classification.

The following is a list of the fossils in this formation as given in Tennant's 'List of British Fossils':—

Polyparia.

Tubuliclidia spinifera.
Fenestella anceps.
F. flustracea.
F. ramosa.
F. virgulacea.

Crinoidea.

Encrinus ramosus.

Brachiopoda.

Terebratula elongata.
T. sufflata.
T. Schlotheimii.
Atrypa pectinifera.
Spirifer undulatus.
S. multiplicatus.
S. cristatus.
Productus horridus.
P. Morrisianus.
P. spiniferus.
Lingula Mytiloides.

Dimyaria.

Allorisma elegans.
Schizodus obscurus.
S. parallelus.
S. truncatus.
S. rotundatus.
S. parvus.
S. undatus.
S. pusillus.
S. minimus.
Nucula vinti.
Arca tumida.
Mytilus acuminatus.
M. septiferus.
Modiola costata.

Monomyaria.

Avicula speluncularia.
A. keratophaga.
A. antiqua.
A. inflata.
A. Binneyi.
A. discors.
A. Gervillia.
Pecten pusillus.
Ostrea pusilla.

Gasteropoda.
Natica minima..
Pleurotomaria carinata.
P. nodulosa.
Turbo Mancuniensis.
T. minutus.
Macrocheilus symmetricus.
Loxonema rugifera.
L. Urii.
Rissoa pusilla.
R. Leighii.
R. minutissima.
R. Gibsoni.
R. obtusa.

Pisces.
Palæoniscus comtus.
P. elegans.
P. glaphyrus.
P. longissimus.
P. macrophthalmus.
Platysomus macrurus.
P. parvus.
P. striatus.
Acrolepis Sedgwicki.
Pygopterus mandibularis.
Cœlacanthus granulatus.

Reptilia.
Palæosaurus Cylindrodon.
P. Platyodon.
Thecodontosaurus antiquus.

The Magnesian Limestone assumes a variety of forms simulating those arising from organic causes. Amongst these are the round masses which are found on the coast of Durham. At a distance these masses look like cannou balls, and the rock ir which they occur has obtained the name of Cannon-Ball Limestone. In many parts the rock has a pisiform or oolitic appearance, from being composed of small round bodies. These little masses, when submitted to the microscope, afford no evidence of having been deposited from organic causes. They are evidently concretionary, and have probably been slowly deposited from a solution of the magnesia and lime of which they are composed.

"In the quarries of Askern and Campsall, round or oval projections are seen, which vary from a pin's head to several feet in circumference. The layers of which they are composed are continuous with those of the limestone, and seem to be formed by some foreign substance serving as a nucleus upou which the limestone is deposited layer after layer; in some cases, the nucleus may be formed by the escape of carbonic acid or other gas, for I have frequently observed that the protuberance is hollow within.

"There is another class of bodies which have a conoidal form, the base being always uppermost; their size ranges from that of a pea to that of a large pear; they are not continuous with the layers of the limestone, but lie in distinct cavities, from which they may be removed almost entire, by a blow of the hammer. The cavities in which these bodies are fonnd have probably been at first made by the rotatory action given by running water to a small stone, or other substance, whilst the limestone was forming, a fresh deposit having afterwards taken place from the water: cavities of this kind may be frequently seen in streams running over loose sand, or other matter.

"Another striking feature in the physical character of the magnesian limestone is, the existence, in some places, of an immense number of cavities, which are frequently lined with beautiful crystals of carbonate of lime; some of these cavities are very small, as in the oolitic limestones; they are to be seen at Smeaton several feet square: the greater proportion of them contain crystals, and vary in size from a marble to an orange. Some geologists imagine that these cavities have been formed by the deposition of the rock upon gelatinous animal bodies, which, being gradually removed by decomposition, have left their mould or cast behind; others suppose that they have originated from the escape of gaseous matter, which, whilst the rock was hardening, was incapable of rising to the surface. By the subsequent passing of water, charged with carbonic acid, through these cavities, many of them would become enlarged by the dissolving power of this gas over the limestone.

"The productions called Stalactites and Stalagmites are often found in the dislocated and over-hanging portions of Magnesian Limestone; the former are long, depending like icicles; the latter are flat, and thinly extended over the surface of the rock. At Askern many beautiful specimens of stalagmites have been taken from the quarry." (Lankester, 'History of Askern.')

The Magnesian Limestone series may be traced in the north of France and in Burgundy, but is most fully developed at Mansfield in the Thuringian Forest, in the district of the Harz, aud in Franconia. Throughout the south of France it appears to have no representative, and is most likely altogether absent. When most perfectly expanded, the whole series is divisible into two groups, the lower one for the most part argillaceous, and the upper calcareous, and the series then rests immediately upon the conglomerates of the Rothe-todte-liegende.

The upper or calcareous portion in Germany is called Zechstein, and is chiefly a compact limestone, but the highest beds are marly consisting of, 1st, a grayish, bluish, or greenish clay, called Letten, often containing rolled fragments of dolomite and crystals of gypsum. This reposes on a fetid limestone called Stinkstein, which is a compact or granulated rock of a blackish-brown or greenish colour, and extremely bituminous, giving out an offensive odour when struck or rubbed. The lower bed of the Zechstein is called Rauwacké, and consists of a hard but cellular magnesian limestone, abounding in long, irregular, and narrow cavities, which are most numerous where the bed attains a considerable thickness, but are almost obliterated in the thinner and more compact portions. The whole thickness of the Zechstein is rarely more than 20 or 30 yards.

Of the schistose beds, which form the base of the Magnesian Limestone series, the lowest is sandy, and forms a kind of transition from the underlying sandstones. It is of no great thickness, and is succeeded by a bituminous band, remarkable for great uniformity both of mineral character and fossil contents, beiug traceable over a considerable district in Germany, and forming an excellent geological horizon for an extent of at least 250 miles. According to M. D'Aubuisson one-tenth part of the mass of this bed consists of bitumen and carbon; and although not more than a foot iu thickness it contains so considerable a quantity of iron and argentiferous copper pyrites as to be worth working as au ore, whence it has received the name of Kupfer Schiefer, or Copper-Slate.

The lowest bed of the magnesian limestone group is called, from its lithological character and relative geological position, the Lower New Red-Sandstone; but it might very fairly be associated with the upper coal-measures, for it contains numerous remains of extinct vegetables uot to be distinguished from species fonnd throughout the carboniferous system. It differs somewhat however from the coal-grits in mineral composition, being more discolonred with oxide of iron, besides being chiefly made up of conglomerate, iu which quartz and decomposed granite abound. This conglomerate, although iu its lower portion exceedingly coarse, passes upwards into a fine-grained sandstone, and so by finer sands mixed with marl shows a gradual transition to the upper and marly beds. Beds of freestoue are sometimes but rarely fonnd alternating with the fine sands and clays of this division; and the mass is altogether very irregular both in thickness and extent, appearing to have presented an uneven surface at the commencement of the deposit of the more recent magnesian limestones, aud in some places to have undergone considerable degradation before those beds were superimposed. The irregularity thus described as affecting the lower strata must have been owing, in all probability, to subterranean movements disturbing the bed of the ocean during the period of their deposition. The marls associated with the fossiliferous bands in the county of Durham are also sometimes bituminous, and traces of bitumen occur in thin bedded compact limestones of the same geological date.

The lower new red-sandstoue, or Rothe-todte-liegende, as observed in Germany, is perfectly similar in almost all respects to the contemporaneous beds in our own country, being made up of coarse conglomerates alternating with marls and shaly beds, the conglomerates being generally composed of fragments of the neighbouring crystalline rocks, cemented by a fine ferruginous and sometimes argillaceous sandstone. In France this deposit is exhibited wrapping round the old rocks which form the central axis of the Vosges. It consists of a coarse incoherent sandstone, generally of a red but sometimes of a bluish-gray colour, alternating with shaly and micaceous marls, the whole formation being extremely variable both in its mineral character and in the extent of its development. It passes insensibly into the upper beds called the 'Grés des Vosges,' or Vosges Sandstone, there being no intermediate bed of magnesian limestone.

The Permian system of Russia exactly corresponds to the magnesian limestone and lower new red-sandstone of our own country; but it has been judged advisable to give a distinct name to the continental group, and the district in which the rocks are most perfectly exhibited being included in the ancient kingdom of Permia, that name has been selected for reasons similar to those which induced Sir R. Murchison on a former occasion to apply the term Silurian Formation to a group typically exhibited in the region of the ancient Siluri. The Permian district extends for about 700 miles from north to south along the western or European flanks of the Ural chain, and for nearly 400 miles between those mountains and the river Volga. The strata within this area are described as lying in an enormous trough of carboniferous limestone, and though occasionally thrown into anticlinal axes of some length, are often traceable for great distances without any break or interruption of the sequence. The Permian rocks of Russia consist of a great number of distinct strata of very varied lithological character. They are composed for the most part of white limestones with gypsum and rock-salt, of red and green gritstones with shales and occasionally copper-ore, and of magnesian limestones, marlstones, conglomerates, &c. The whole series is fossiliferous, and contains the remains of extinct animals and vegetables, greatly resembling those of the carboniferous period. In the Russian beds also there have been discovered reptilian remains like those of the Bristol magnesian conglomerate, and fish identical with the species from Durham and from Mansfeld in the Thuringian forest.

(Sedgwick, in *Geological Transactions;* Smith, *Geological Map of Yorkshire*, &c.; notices of contemporaneous deposits in the midland and southern counties of England occur in Murchison's *Silurian System;* Conybeare and Phillips, *Geology of England and Wales*, &c.; Ansted, *Elementary Course of Geology*.)

MAGNESITE. [Magnesia.]

MAGNET, NATIVE. [Iron.]

MAGNO'LIA, a genus of Plants named in honour of Pierre Magnol, who was professor of medicine and prefect of the botanic garden of Montpellier. He was born in 1638, and died in 1715. He gave an account of the plants growing wild about Montpellier, in a work entitled 'Botanicum Monspeliense; seu Plantarum circa Monspelium nascentium Index,' 8vo., 1686. This work, illustrated with plates, as well as one published in 1689 with the title 'Prodromus Historiæ Generalis Plantarum in quo Plantæ per Familias disponuntur,' was arranged according to a natural system of his own. In another work embracing the plants growing in the Montpellier Garden, entitled 'Hortus Regius Monspeliensis,' he has arranged the plants according to the system of Tournefort.

The genus *Magnolia* is the type of the natural order *Magnoliaceæ*. It has a calyx of 3 deciduous sepals that resemble petals; the corolla is composed of 6 to 9 petals; the stamens and pistils numerous; the carpels are disposed compactly in spikes, opening by the external angle, 1-2-seeded, permanent; the seeds baccate, somewhat cordate, pendulous, hanging out beyond the carpels by a very long umbilical white thread. The species of *Magnolia* are trees or shrubs, with alternate, stipulate, deciduous, or evergreen simple leaves, and large terminal solitary odoriferous flowers. They are all natives of North America and Asia.

M. grandiflora, Great-Flowered Magnolia, or Laurel-Bay, is an evergreen tree, reaching sometimes a height of 70 feet. It has oval-oblong coriaceous leaves with the upper surface shining and the under surface rusty; the flowers erect, with from 9 to 12 petals expanding. This plant is one of the tallest and handsomest trees of North America. It has large pale-green shining leaves nearly 10 inches long, with large white flowers. It has been cultivated in England for the last century, and in this country attains a height of from 20 to 30 feet. Several varieties of this species have been named and described. Amongst the most constant and best known varieties are—1, *M. g. obovata*; 2, *M. g. Exoniensis*; 3, *M. g. angustifolia*; and 4, *M. g. præcox*. The first is known in the Carolinas by the name of the Big Laurel; the second is the Exmouth Magnolia; the third and fourth are varieties which have been produced in France.

In the cultivation of this species a deep sandy loam, dry at bottom, and supplied with vegetable mould, suits all the varieties. In planting it against a wall, almost any aspect may be chosen except a north-east. This plant may be propagated by stools, which should be laid down in autumn, and require two years before they are fitted for separation. They are then potted, and kept in pits or under glass during the winter. It may be also propagated by seeds from America.

M. glauca, deciduous Swamp Magnolia, is an almost deciduous plant, with obtuse elliptical leaves, glaucous on the under surface; the flowers from 9-12-petalled, contracted; the petals ovate, concave. This species is a tree rising from 15 to 20 feet in height. It is a native of North America, in low moist swampy ground at a little distance from the sea, from Massachusetts to Florida and Louisiana. This plant is also cultivated, and a number of varieties have been described. The bark has a bitter and aromatic odour resembling sassafras. On this account it has been used in America as a substitute for other aromatic bitter barks as Cascarilla, Canella, &c., and, it is said, with great success. Although not much used in Europe, very favourable reports of its efficacy in chronic rheumatism, ague, and remittent fever have been given. All the species of *Magnolia* possess more or less the properties which are most evident in *M. glauca*. When used, a tincture made from the bark, seeds, or cones is equally efficacious. It is said that when the tincture is made from the leaves and cones whilst green, it is more efficacious. In America this tree is known by the names White Laurel, Swamp Laurel, Swamp Sassafras, Sweet Bay, and Beaver-Tree. The last name is given to it on account of the fondness of the beaver for it. The flowers are of a cream colour and have a sweet scent, which Kalm says may be smelt at a distance of three miles. The flowers are followed by red berries, which give the tree a handsome appearance. The berries are steeped in brandy and used as a domestic medicine for various complaints.

M. umbrella is a deciduous tree with lanceolate spreading leaves, the adult ones smooth, the younger ones pubescent underneath; the petals 9-12, exterior ones pendent. It is a native of North America, in the Carolinas, Georgia, Virginia, and New York. The leaves are one to two feet long, placed at the ends of the branches in a circular manner, somewhat in the form of an umbrella, from which circumstance it has been called the Umbrella-Tree. The wood is soft and spongy, and on the mountains of Virginia is called Elmwood.

M. acuminata, a deciduous tree with oval acuminate leaves, the under surface pubescent, the flowers with from 6 to 9 petals. It is a native of North America, from Pennsylvania to the Carolinas. The flowers are large, 3 or 4 inches in diameter, of a yellowish colour, mixed with faint blue or pea-green, but not remarkable for their beauty. The fruit is about 3 inches long, and resembles a small cucumber, whence in America it is called Cucumber-Tree. A tincture is made of the fruit, and is used in cases of rheumatism. Several varieties of this plant have been described. It is often used in the London nurseries as a stock on which to engraft the other species.

There are several other species of this magnificent genus found in the forests of North America, all of which are valued in Great Britain for ornamental culture. The best known of these are *M. cordata*, the Heart-Leaved Cucumber-Tree, with yellow flowers streaked with red, and having a disagreeable odour; and *M. auriculata*, Indian Physic, or Long-Leaved Cucumber-Tree, having white flowers and a bitter bark, which is used as a medicine by the Indians.

M. Yulan, or *M. conspicua*, a deciduous tree with obovate abruptly acuminated leaves, the younger ones pubescent, expanding after the flowers; the flowers erect, 6-9-petalled; the styles erect. This plant attains a height of 30 or 40 feet in its native country, but reaches only 8 or 10 feet in our gardens. It grows in China, where it has been cultivated since the year 627. Its native name is Yulan. It is a very showy tree, having white flowers sometimes suffused with purple, which give out a most delicious perfume. It blossoms in this country from February to April, and is distinguished from the other species by the flowers appearing before the leaves. It is not quite so hardy as the American species; still, unless the weather is unpropitious, it will put forth an abundance of blossoms during the dreary months of February and March.

M. purpurea, the Purple-Flowered Magnolia, is a deciduous shrub, with obovate-acute reticulately-veined leaves, almost smooth; the flowers erect, of 3 sepals and 6 obovate petals; the styles very short. This plant is a native of Japan, and seldom attains a greater height than 10 feet. The bark when bruised has an aromatic odour. The flowers are more or less purple without, and always white within. It is a very ornamental species and worthy of cultivation. The best situation for it is against a wall, when its branches will reach from 15 to 20 feet.

In their cultivation the hardy kinds may be treated in the same way as *M. grandiflora*. The Chinese kinds are often inarched or budded on *M. obovata*. When the plants are replanted after layering or propagation by seed, neither the roots nor leaves ought to be cut off, otherwise they will not succeed so well.

(Don, *Dichlamydeous Plants*; Louden, *Encycl. of Trees and Shrubs.*)

MAGNOLIA'CEÆ, *Magnoliads*, an important natural order of albuminous polypetalous Exogenous Plants, consisting of bushes and trees, inhabiting the temperate parts of both the Old and New World. They have the numerous disjoined carpels and hypogynous stamens of *Ranunculaceæ*, to which they are closely allied; they differ not only in their arborescent habit, but in the young leaves being enveloped in stipules, either horn-like and convolute, or bivalved, which are thrown off as the leaves unfold. The flowers are usually large and sweet-scented, and the leaves are firm, broad, and large, in consequence of which many of the species are objects of cultivation in all civilised countries. In England, where they are exotics, they are among the most highly-valued of ornamental plants, and every species which can bear the climate, or which will thrive in conservatories, has been collected with great care, whenever opportunities have offered, so that few now remain to be imported. Among the most

A branch of *Talauma pumila*.

1, a head of ripe fruit with the seeds hanging down by their cords; 2, a vertical section of a seed, showing the minute embryo lying in copious albumen.

ornamental of the hardy kinds are the *Magnolia grandiflora* of Carolina; *M. glauca*, of which there are many varieties; *M. macrophylla*, the flowers of which are among the largest in the vegetable kingdom; and the Tulip-Tree, *Liriodendron tulipifera*, a large tree with singular truncate leaves. In Bengal the air is often perfumed with the fragrance of the Tsjampac, a species of *Michelia;* while in China and the Malayan Archipelago others are equally well known for their ornamental characters. Nor are the plants of this order less useful than beautiful. It is probable that they are all valuable for the febrifugal qualities of their bark. *M. glauca* is among the best bitter and aromatic species known in medicine, and the Tulip-Tree affords to the North American settler a substitute scarcely inferior to it.

The genera *Talauma* and *Magnolia* have the very singular property of dropping their seeds out of the back of the seed-vessels when ripe, allowing them to hang down, each suspended by a long extensible elastic cord, composed of delicate spiral vessels.

In consequence of the seeds of *Magnoliaceæ* containing an abundance of oil which often becomes rancid soon after they are gathered, it is difficult to transport them to a considerable distance in a living state. The best method of succeeding in that object is to pack the seeds in earth as soon as they are ripe, pressing them close and securing them in a box. Under such circumstances they will preserve their vitality for several months.

There are 11 genera and 65 species of this family.

MAGONIA, a genus of Plants belonging to the natural order *Sapindaceæ*. The flowers are polygamous; the male flowers have a 5-parted unequal reflexed calyx; petals 5, linear, and unequal; disc unequal between the petals and stamens, on one side long and double, in the other short, simple, and rugose; stamens 8, diclinate. Hermaphrodite flowers as in the male, but stamens much smaller and not diclinate; ovary 3-celled, many-seeded; styles curved; stigma 3-lobed; capsule large, woody, 3-valved, loculicidal; seeds large, flattened, surrounded with a wing; hilum in the edge. The species are trees with a corky bark; leaves alternate, abruptly pinnate, without stipules; flowers panicled.

M. pubescens is a small tree common in the western deserts of the province of Minas Geraes in Brazil. It has downy branches; leaflets 8, ovate or oblong, sessile, deeply emarginated and downy; the flowers in a terminal sessile or stalked panicle from 9 to 16 inches long; calyx downy, yellowish-green; petals linear, obtuse above, in the middle smooth and dark purple, at the edges and point downy and green; fruit a large, woody, globose, 3-cornered, somewhat depressed capsule, with 3 valves, 3 cells, and many seeds. The ashes of this plant are extremely alkaline. The bark is used for subduing the swellings produced in the skins of horses by the stings of insects. The leaves of this species and *M. glabrata* are poisonous to fishes.

(Lindley, *Flora Medica.*)

MAGPIE. [CORVIDÆ.]

MAIA. [MAIIDÆ.]

MAIADÆ. [MAIIDÆ.]

MAIANTHEMUM, a genus of Plants belonging to the natural order *Asparagaceæ*. It has a 4-parted perianth; the segments horizontally patent or reflexed, deciduous; stamens 4; style 1; stigma blunt; berry 2-celled; cells 1-seeded.

M. bifolium has a stem with two alternate, stalked, triangular, cordate leaves; the stem is from 6 to 8 inches high; root filiform; leaves very deeply cordate; raceme terminal, resembling a spike; flowers small; segments reflexed; berry yellow with brown spots. It is found in woods in the north of England.

MAID, a Fish. [RAIIDÆ.]

MAIDEN HAIR, the common name of the *Adiantum Capillus Veneris*, a fern found wild in many parts of Europe, on damp shaded rocks. It is the Adianton (Ἀδίαντον) of the Greeks, and has probably gained its trivial name from its having formed a part of the preparations used by the ladies for stiffening their hair. (Dioscorides, l. iv. c. 136.) [ADIANTUM.]

MAIGRE. [SCIÆNIDÆ.]

MAIIDÆ, or MAIADÆ, a tribe of *Crustacea*, the second of the family of *Oxyrhynchi*, according to the system of M. Milne-Edwards. It is composed of Brachyurous Crustaceans, whose carapace, nearly always very spiny, is, with some exceptions, much longer than it is wide. Rostrum generally formed of two elongated horns. First joint of the internal antennæ but little developed; that of the external antennæ, on the contrary, very large, and soldered with the neighbouring parts so as to be confluent with them; its external border always constituting a considerable portion of the lower wall of the orbit, and its anterior extremity united to the front before the level of the internal canthus of the eyes. The moveable stem of the antennæ always of considerable length. The epistome generally considerably wider than it is long, whilst the buccal frame is longer than it is wide. The third joint of the external jaw-feet is as wide as it is long, more or less dilated on the external side, and truncated or notched at its anterior and internal angle, by which it is articulated with the fourth joint, which is very small. The anterior feet of the female are in general hardly larger or longer than the others, and sometimes they are even shorter. The same conformation obtains in some of the males; but in general the first pair of feet in these last are longer and much larger than the second pair, and their length sometimes is equal to twice that of the carapace; they are directed obliquely forwards and outwards; the hand is never triangular, and the immoveable finger of the claw is not inclined downwards, so as to form a decided angle with the lower edge of the hand. The succeeding feet are generally of moderate length; those of the second pair are most commonly once and a half the length of the post-frontal portion of the carapace, but they are never twice as long as that portion; those of the third pair are hardly ever more than once and a quarter as long as the post-frontal portion of the carapace, and the other feet shorten in succession. The abdomen is ordinarily composed of seven distinct joints in both sexes; but sometimes this number varies in the different species of the same genus. (Milne-Edwards.)

The genera and species of this family are numerous. We shall describe the principal genera:—

Libinia (Leach).—This genus has the greatest relation to *Doclea* and *Pisa*, between which genera it establishes, in the opinion of M. Milne-Edwards, a nearly insensible passage. The general form of the body in *Libinia* approximates closely to that of *Doclea*.

Carapace very convex above, in general nearly circular, with its orbito-frontal portion placed sensibly above the level of its lateral borders, which are prolonged towards the mouth rather than towards the external canthus of the eyes. Sometimes the carapace is elongated a little, and bears a considerable resemblance to that of some of the *Pisæ*. Rostrum small, narrow, and notched in the middle: the front, measured between the orbits, is much narrower than the anterior extremity of the buccal frame; the anterior angle of the superior orbital border is projecting, but never reaches beyond the basilary joint of the external antennæ; the orbits are nearly circular, and directed very obliquely forwards and outwards; their external angle is formed by a large compressed tooth, which is separated from the rest of the wall of this cavity by two fissures; one superior and very narrow, the other inferior and more or less open. The stomachal region of the carapace is but little developed, but the branchial regions highly so; and their lateral border, which is armed with spines and very much curved, is directed towards the anterior angle of the mouth. The eyes are small and very short; the basilary joint of the external antennæ is short, but very much developed, and always wide in front, a disposition which occurs in *Pisa*, whilst the contrary is to be remarked in *Doclea;* the second joint of these antennæ is stout, short, cylindrical, and inserted on the sides of the rostrum at a distance nearly equal from the orbit and the antennary fosset; the third joint is rather smaller than the second, and the fourth is very slender and very short. The epistome is very small, and the whole of the antennary region is not more than half the length of the buccal frame. The external jaw-feet and the sternal plastron have the same form as in *Pisa*. The anterior feet are much longer than in *Doclea*, but less developed than in *Pisa;* they are always nearly of the same size as those of the second pair, and in general are much shorter even in the males; the hand is very nearly cylindrical, and has little convexity; the pincers are rounded or trenchant, and finely dentilated, and touch nearly throughout their length, a disposition which is rare in the *Pisæ*. The remaining feet much resemble those of the *Pisæ*, except that their last joint is longer, and never armed below with horny spines, as in them; the length of the feet diminishes progressively, and those of the second pair are not more than about once and a half as long as the post-frontal portion of the carapace; they are in general much shorter, and this character suffices to distinguish the *Libiniæ* from the *Docleæ*. The abdomen is composed of 7 joints in each of the sexes.

The species of this genus are found in the seas of America, as far as is known.

M. Milne-Edwards divides the genus into two sections: the first consisting of species which have the anterior and external angle of the basilary joint of the external antennæ obtuse, and not prolonged beyond the level of the internal one, and the slit of the inferior orbital border very narrow; the second consisting of species which have the anterior and external angle of the basilary joint of the external antennæ spiniform, and prolonged much beyond the level of the internal angle, and the slit of the inferior orbital border very wide.

Libinia spinosa belongs to the second section. The body is entirely covered with a short and brownish down, and it is about four inches (French) in length.

It is found on the coasts of Brazil.

Herbstia (Milne-Edwards).—Intermediate between the *Libiniæ*, the *Pisæ*, and the triangular *Mithraces*.

The carapace is more triangular than in *Libinia;* the stomachal region nearly as much developed as the branchial regions. Rostrum small, hardly longer than it is wide, and formed of two flattened horns, which are pointed and divergent, and the base of which occupies all the width of the front. Orbits oval-shaped, and directed obliquely forwards, outwards, and upwards; their superior border with two small fissures, which terminate anteriorly in a small spine, less projecting than that situated below, and belonging to the basilary joint of the external antennæ; their inferior border is complete, and presents only a small fissure. Eyes large and retractile. Disposition of the antennary region, the jaw-feet, the sternal plastron, and the feet, essentially the same as in *Pisa*. The tarsi of the last four feet present small horny spines placed irregularly.

H. condyliata is the only species known. It has the body covered

Libinia spinosa.

a, under side of head in detail; *b*, abdomen of female.

with a thin and fine down, is about two inches in length, and of a reddish colour.

It inhabits the Mediterranean.

Herbstia condyliata.

Pisa (Leach).—The carapace is gradually narrowed anteriorly for about three-fourths, and its latero-anterior borders prolonged obliquely in a nearly straight line up to a small distance from its posterior border; the surface very convex; the regions in general sufficiently distinct, and the stomachal region in particular very much developed; the front wider than the buccal frame, and armed with four horns directed forwards, the two external of which occupy the anterior extremity of the superior orbital border, and the two middle of which form the rostrum, which is always at least once and a half as long as it is wide; eyes carried on very short peduncles, and bent backwards in the orbits, which are of an oval shape, and directed outwards and downwards; the upper border of these cavities with two slits, separated from each other by a triangular tooth, and their external angle situated rather below than above the lateral border of the carapace, which is there terminated; the orbital border interrupted below by a large notch; the internal antennæ without any peculiarity; the basilary joint of the external antennæ much longer than it is wide, only slightly narrowed forwards, and exceeding the level of the internal canthus of the eyes, but completely hidden above by the spiniform prolongation of the superior orbital border; the second joint of the antennæ slender and cylindrical, and inserted at a distance nearly equal from the antennary fosset and the orbit, a little without the level of the external border of the rostrum, so as to show itself between this prolongation and the lateral horns of the front; the third joint small and cylindrical, and the fourth rather long; antennary region nearly of the size of the buccal frame, and the epistome large and nearly square; the second joint of the external jaw-feet prolonged from the internal side much beyond the level of its external angle; and the third joint much longer than it is wide, strongly dilated outwards, and deeply notched at its anterior and internal angle; sternal plastron longer than it is wide. In the female the anterior feet are in general nearly of the same length as those of the second pair; but in the male they are remarkably longer and stouter; the hand is convex, and the fingers trenchant, and finely dentilated on their terminal moiety; the remaining feet are cylindrical, and of moderate length; those of the second pair are not much longer than the post-frontal portion of the carapace; the length of the other feet diminish successively, and, in nearly all the species, their last joint is furnished below with small horny points, which are placed very regularly on one or two longitudinal lines, like the teeth of a comb; abdomen composed of seven distinct joints.

The whole of the body of the *Pisæ* is ordinarily covered with hairs, which are recurved at the end, and catch up foreign bodies which they touch; it is not rare therefore to see these crustaceans covered with sea-weeds and sponges. This disguise most probably answers the double purpose of enabling them to surprise their prey and of protecting them from their enemies.

Nearly all the species live in the European Seas at considerable depths, and are often dredged up by the fishermen. After spring-tides they are frequently found hidden under stones at low-water. They are not used as food.

The species are divided into two sections, depending on the absence or presence of spiniform teeth on the upper border of the third or third and fourth joints of the last four pairs of feet, &c. The first of these sections is separated into two subdivisions, dependent principally upon the rounded or triangular form of the posterior portion of the carapace.

P. tetraodon, the Four-Horned Spider Crab, is two or three inches in length, and has the body entirely covered with a kind of down and some crooked hairs; it is of a brownish colour; the lateral margin with four spines, the posterior part of the carapace rounded without spines; a small tubercle near the posterior margin. This species is very common on the English and French coasts. They are found concealed under the long hanging *Fuci* which clothe the rocks at some distance from the shore. Like all the slow-moving *Crustacea* they are frequently covered with *Fuci*. Their movements are exceedingly slow and measured, but they seize their prey easily and hold it firmly.

Four-Horned Spider-Crab (*Pisa tetraodon*).

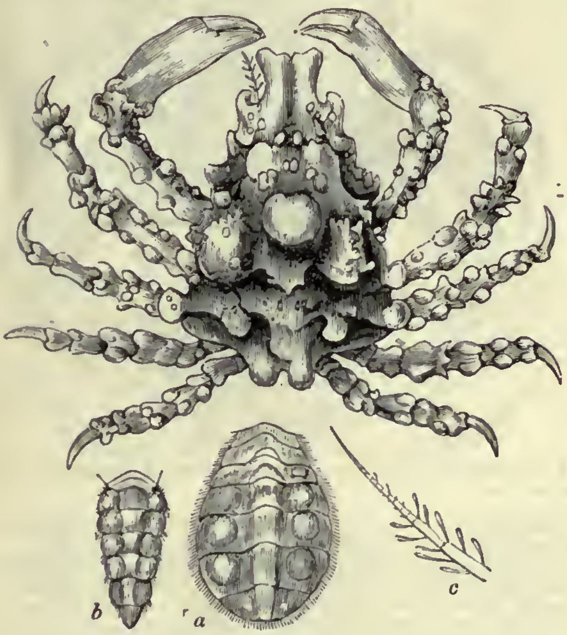
a, male; *b*, female; *c*, abdomen of female; *d*, abdomen of male; *e*, antenna; *f*, pedipalp.

P. Gibbsii is also a British species. It has no spines on the lateral margin. It is found on the southern coasts of Devon and Cornwall.

Lissa (Leach).—Very much resembling *Pisa*, and perhaps ought not to have been separated from it. The distinguishing characters of *Lissa* consist in the disposition of the rostrum, which is formed of two lamellose horns, truncated anteriorly, and wider anteriorly than they are at their base, and in the absence of spines on the tarsi.

L. chiragra is the only species known: its length is about two inches, and the colour an intense red; the feet are furnished with some hairs, but the trunk is unarmed.

It is found in the Mediterranean, and is said to have been taken on the coast of Cornwall by Mr. Swainson, but it is not mentioned in Bell's 'British Crustacea.'



Lissa chiragra.
a, abdomen of female; *b*, abdomen of male; *c*, antenna.

M. Milne-Edwards remarks that *L. fissirostris* of Mr. Say seems to bear much analogy to *Hyas araneus;* but Milne-Edwards cannot be certain that it belongs to the same genus from the author's description.

Hyas (Leach)—Approaching very nearly to *Pisa*, and especially to *Herbstia*, but easily distinguished by the form of the first joint of the external antennæ, which, instead of being cylindrical, as in nearly all the Oxyrhynchs, is flattened and enlarged on the external side. Carapace rather large, especially anteriorly; rostrum, which is formed of triangular horns that are flattened and convergent, moderate, and leaving the insertion of the moveable stem of the external antennæ completely visible; front large; orbits directed a little forwards; edges not spiny, and with a single fissure above; external edge of the basilary joint of the antennæ straight, and separated from the external portion of the orbit by a very large notch; the third joint of the external jaw-feet a little dilated outwards; feet disposed as in *Pisa*, except that the four last pairs are longer, and have no spines on the inferior surface of the tarsus.

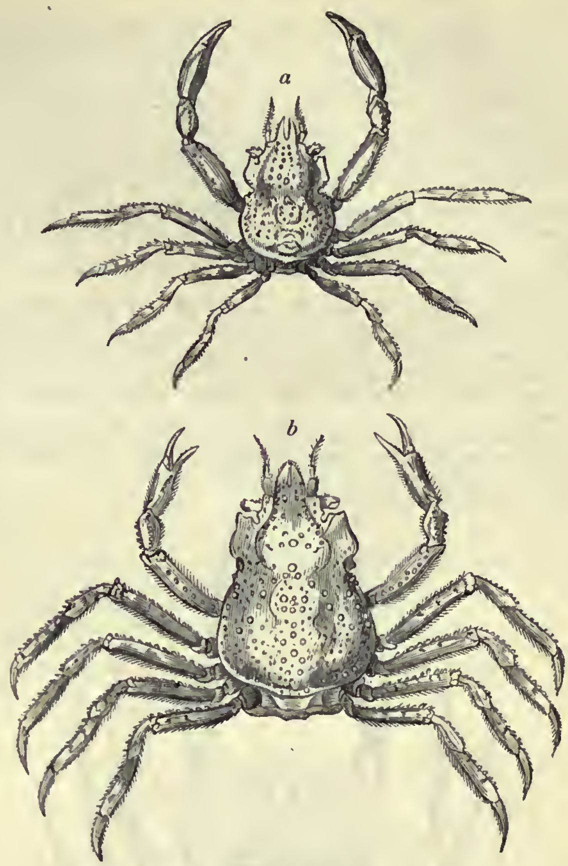
H. coarctata (Leach). The carapace of this species is strongly contracted beneath the external orbital angles. Length about two inches. Colour yellowish.

It has been taken in the English Channel.

H. araneus has the carapace not contracted behind the post-orbital hastiform process. This is also a British species, and, with the exception of *Maia Squinado*, is the largest of the family found in the British Fauna.

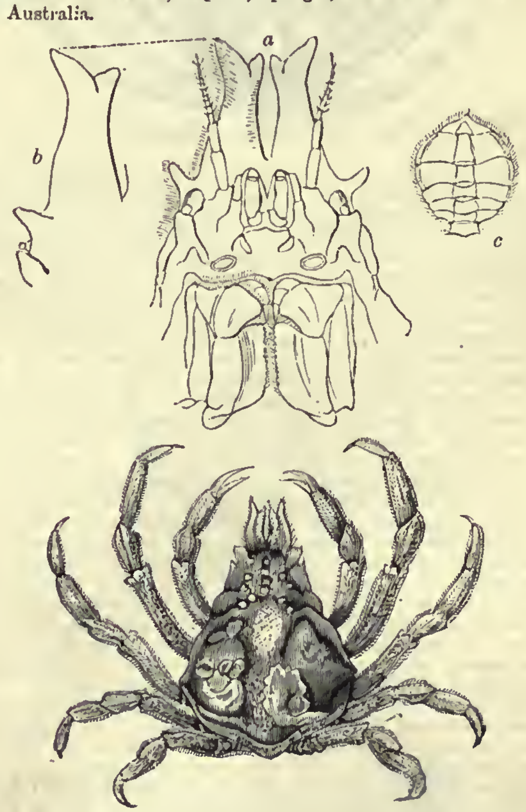
Naxia (Milne-Edwards)—Establishing, in the opinion of M. Milne-Edwards, the passage between the genera *Lissa* and *Chorinus* of Leach. General form of the body as in *Pisa* and *Lissa*, and the disposition of the rostrum very analogous with that which is proper to *Lissa*. *Naxia* is however distinguished from the preceding genera by the disposition of the antennæ and orbits. Carapace nearly pear-shaped; rostrum much resembling that of *Lissa*; orbits very small, nearly circular, deep, and marked with a fissure above and below, but without any hiatus at their inferior border; basilary joint of the external antennæ wide, but narrow forwards, very much advanced, and completely hidden by the rostrum and the anterior angle of the superior orbital border; the moveable stem of these appendages inserted under the rostrum, near the antennary fosset, and not beyond the edge of the external border of that prolongation, as in *Pisa*. Epistome very large.

N. serpulifera (*Pisa serpulifera*, Milne-Edwards). Length about 4 inches. Body covered with a brownish down, and the carapace often



Hyas coarctata.
a, male; b, female.

encrusted with *Flustræ*, *Serpulæ*, Sponges, and the like. It is brought from Australia.



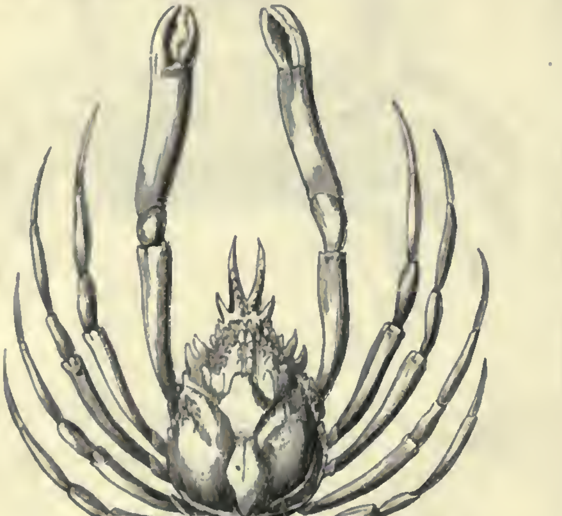
Naxia serpulifera, one-third natural size.
a, under side of the head in detail; *b*, one of the protruding points, with the eye in profile; *c*, abdomen of the female.

Chorinus (Leach).—Carapace longer and narrower than it is in nearly all of the *Maiidæ;* but in general form not differing much from *Pisa*. Rostrum formed of two great pointed horizontal horns. Eyes retractile, and the orbits directed outwards and downwards; but the lower wall of these cavities is very incomplete; basilary joint of the external antennæ narrow, their moveable stem inserted under the rostrum, and in great part concealed by it. Epistome, jaw-feet, sternal plastron, and abdomen, disposed nearly as in *Pisa*; anterior feet longest, especially in the males, and the claw strongly curved inwards, dentilated and pointed, but a little hollowed out into a sort of gutter; the succeeding feet are cylindrical; those of the last three pairs of moderate length, but the second pair are very long: in the male they are in general once and a half or even twice as long as those of the third pair.

M. Milne-Edwards divides the species of this genus into two sections: the first consisting of those which have the superior orbital border scarcely marked, and formed by three spines, the anterior one very large, and the two posterior rudimentary; the second consisting of those species which have the superior border lamellose and advanced.

C. Heros is the only species of the first section. Length from two to three inches, or rather more. Rostrum, sides of the carapace, and four last pair of feet, hairy. Colour yellowish-red.

It is taken in the seas of the Antilles.



Chorinus Heros, reduced one-half.

Mithrax (Leach).—Carapace always a little convex above, and a good deal narrowed forwards; disposition of the different regions as in the other Oxyrhynchs; rostrum bifid, generally very short, and separated from the internal canthus of the eyes by a rather considerable space; orbits nearly always armed with two or three spines at their superior border, one at their external angle, and one or two at their inferior border; latero-anterior borders of the carapace spiny, or at least toothed; internal antennæ bent a little obliquely outwards, and the frontal portion of the partition which separates them armed with a recurved spine; basilary joint of the external antennæ large, and nearly always armed forwards with two strong spines; the second joint of these appendages is, on the contrary, narrow and cylindrical, and inserted on the sides of the rostrum, nearer the antennary fosset than the orbit; third joint nearly as large and as long as the second; the terminal and articulated stem rather short. External jaw-feet presenting nothing remarkable; sternal plastron nearly circular; anterior feet generally in the male longer and stouter than that of the second pair, the hand or claw always stout and convex, the pincers distant at their base, enlarged at the end, deeply hollowed into a spoon-shape, and terminated by a semicircular trenchant edge; feet of the second pair about once and a quarter as long as the post-frontal portion of the carapace; the succeeding feet gradually shortened; the tarsi short, hooked, and often armed with some points at their inferior surface. Abdomen generally formed of seven joints in both sexes; but sometimes only four are to be perceived in young females, the second, third, fourth, and fifth segments being soldered.

M. Milne-Edwards remarks that *Mithrax* establishes some connection between the family of the Oxyrhynchs and that of the Cyclometopes.

The species are found in the seas of America for the most part, where some of the species attain to a considerable size.

M. Milne-Edwards divides the genus into two sections: the first consisting of those species which have the superior edge of the orbit armed with strong spines; the second, of those which have the superior border of the orbit unarmed. The first of these sections is further subdivided into two sub-genera, the first sub-genus consisting of those triangular species whose last four feet are not spiny; and the second sub-genus, of those transversal species whose last four feet are armed with spines. The second section contains the third sub-genus, consisting of the depressed species.

M. dichotomus is about two inches in length. Colour, yellowish. It is found on the coasts of the Balearic Islands.

Mithrax dichotomus.

a, under part of the head; *b*, abdomen of the male; *c*, termination of one of the posterior feet.

Paramithrax (Milne-Edwards)—Establishing, in the opinion of M. Milne-Edwards, the passage between *Mithrax* and *Maia*.

General form of the carapace very closely approaching that of the triangular *Mithraces*. Rostrum formed of two stout horns, and considerably less wide than the front, which, in its turn, has nearly as much extent as the buccal frame. Orbits oval-shaped, their upper border arched forwards as in the *Maiæ*, and with three strong spines posteriorly separated by two notches more or less deep; their inferior border widely notched or incomplete. Eyes retractile, with slender peduncles, which are rather long and recurved, as in the *Maiæ*. The antennary region and antennary pits resembling those of the *Maiæ*. Basilary joint of the external antennæ large and armed with spines, one of which (the external) advances in general beyond the border of the front, and separates the orbit from the insertion of the moveable stem, which is not covered by the front. External jaw-feet and sternum nearly as in the *Maiæ*. Anterior feet of moderate strength, and terminated by pointed and rounded claws, which are not dentilated as in *Pisa*, nor hollowed into a spoon-shape as in *Mithrax*. The succeeding feet are cylindrical, very little or not at all spiny, and of variable length, according to the species; there are no small horny points at the lower end of the last joint, as in most of the *Mithraces*.

The species are Australasian.

M. Milne-Edwards divides *Paramithrax* into two sections:—the first consisting of those species which have the orbits very incomplete below, and whose eyes do not reach to the external angle of the cavities; the second, of those whose orbits have only one notch below, and whose eyes, when turned back, touch the external orbital angle. *P. Peronii* is an example of the first section, and *P. Gaimardii* of the second.

Maia (Lamarck).—This genus was established by the author of the 'Animaux sans Vertèbres,' for the reception of the genera *Inachus* and *Parthenope* of Fabricius, or, in other words, for all the *Oxyrhynchi* properly so called. More modern authors have cut the Lamarckian genus down to the group formed by the small number of species which may be arranged in close approximation to *M. Squinado*.

Carapace about a fourth longer than it is wide, and much narrowed anteriorly; its upper surface is rough, with multitudinous tubercles and spines, and the regions are not strongly marked on it; rostrum horizontal, and formed of two divergent horns; the latero-anterior border of the carapace armed with strong spines; orbits of an oval shape, rather deep, and with their superior border, which is elevated and rounded anteriorly, divided behind by two fissures. Internal antennæ exhibiting nothing remarkable, but the portion of the front which separates their fossets or pits is prolonged into a strong curved spine, which is directed downwards. First joint of the external antennæ very large, and constituting more than half of the inferior floor of the orbit, which it only exceeds anteriorly a very little; its extremity is armed with two stout spines, and carries the succeeding joint at its superior and external border, so that the moveable stem of these appendages springs in the internal canthus of the eyes. Epistome wider than it is long; buccal frame the same. Second joint of the external jaw-feet prolonged a good deal, from the internal side. Sternal plastron nearly circular, and its median suture, although sufficiently long, only occupying the last thoracic ring. First pair of feet not a great deal shorter than the others, slender, nearly cylindrical, and terminated by a claw, the fingers of which, nearly styliform, are never hollowed into a spoon-shape nor dilated towards the extremity, and present few or no dentilations. Length of the second pair hardly exceeding once and a half the width of the carapace; the succeeding feet gradually shorter; their terminating joint is styliform, and presents neither spines nor dentilations on its inferior border. Abdomen consisting of seven distinct joints in both sexes.

The species are found in the seas of Europe.

M. Squinado, the Corwich, or Spinous Spider-Crab. Body covered with hooked hairs; length four or five inches; colour reddish.

It is a native of the British Channel, the oceanic coasts of Europe, and the Mediterranean.

Corwich, or Spinous Spider-Crab (*Maia Squinado*), reduced.

b, female (young); *c*, abdomen of female; *d*, abdomen of male; *e*, antenna; *f*, pedipalp.

This species is often dredged up, and the fishermen sometimes eat it, but its flesh is not much esteemed. It was considered by the ancients to be endued with reason, and was by them represented suspended from the neck of Diana of the Ephesians, as an emblem of wisdom. It is also figured on ancient coins and medals. We take from Bell's 'British Crustacea' the following interesting communication from Mr. R. L. Couch, on the habits and reproduction of this species:—

"This is the most abundant of all the crabs found on our coast, but it does not make its appearance so early in the season as the Common Crab, the Lobster, or indeed any other; it is rarely found earlier than May, but from that time till the end of the fishery in August and September these crabs make their appearance in vast numbers, to the great vexation of the fishermen; for it is found that from the time these begin to enter the pots the more valuable kinds considerably decrease in number, and this is supposed to arise from their restless activity. No sooner are they in the crab-pot than they are continually in motion, scrambling from one part to another, and in this way frighten the Crab and Lobster, and prevent them from entering. In the spring and early part of the summer they lie concealed beneath the sand in deep water. About May they leave their places of concealment, but never come into shallow water, as does the Common Crab; the latter is often found in crevices of rock, or beneath stones left by the receding tide, but this is never the case with the Corwich. They shed their spawn about August or September, at some short distance from the shore, probably in the sands. In this too they differ from the Common Crab, for even when the spawn is quite mature for 'casting' they enter the pots as readily as at any other time; whilst, on the other hand, it is a very rare occurrence to catch the Common Crab with spawn, unless it be with a dredge-net. It would seem either that they grow very fast or that the young differ considerably in their habits from the larger ones; for whilst it is very common to find specimens measuring nine or ten inches in the length of the carapace, it is very rare indeed to get one less than three inches; and a fisherman tells me that after many years fishing he caught one about the size of a half-crown, which was the smallest he ever saw. The ova, when quite ready for shedding, are about the size of a very small mustard-seed, and of a reddish-brown colour, besprinkled with small dark spots.

"After keeping them suspended in sea-water for twenty-four hours some of the ova dropped from their attachments, and soon after the young escaped, and this evidently by their own exertions, as distinct motions were easily observable under the microscope while they were yet inclosed. When they first escape they are, as it were, rolled on themselves, the caudal extremity being bent on the body; but this is soon changed for a different position.

"I could detect no spine on the anterior part of the carapace, which was quite smooth, but marked with dots. The eyes are sessile and large; the claws, particularly towards the extremity, covered with minute hairs."

Micippa (Leach).—Post-frontal portion of the carapace nearly quadrilateral, slightly convex, rounded backwards, and hardly narrowed anteriorly; its fronto-orbital border is straight and very wide, and its lateral borders are armed with spines. Rostrum lamellar, and directed vertically downwards so as to form a straight angle with the axis of the body and the epistome. Orbits placed above and on the sides of the rostrum; at their superior border a deep slit; ocular peduncles retractile, rather long, narrowed in the middle, and prolonged to the extremity of the cornea. The stem of the internal antennæ in bending back remains vertical, instead of becoming horizontal, as in nearly all the other brachyurous crustaceans. The basilary joint of the external antennæ very large, and wider in front than it is behind; the second joint of these appendages is inserted against the edge of the rostrum, at a considerable distance from the orbit. The third joint of the external jaw-feet is extremely dilated on the external side, and very deeply notched at the point where it articulates with the succeeding piece. Sternal plastron nearly circular. Feet cylindrical and of moderate length, there being little difference in size and length between the first and succeeding pairs. Abdomen consisting of seven distinct joints in both sexes.

The species occur on the coasts of the Indian Ocean.

M. Philyra. Length about 2 inches; colour yellowish. It is found in the Indian Ocean and on the coasts of the Isle of France.

Micippa Philyra.

Criocarcinus (Guérin).—The principal characters of this extraordinary genus are found in the disposition of the orbits and of the eyes. The orbitary cavities have nearly the form of a long and truncated tube directed outwards; but they do not sheath the eyes as in *Pericera*, for the ophthalmic ring advances nearly to their extremity, and the ocular peduncle, which is long, slender, and, like that of *Maia*, is inserted so as to be completely exposed, and to be capable of reflection backwards, and of applying itself throughout its length against the external border of the basilary joint of the external antennæ, a position in which it is concealed under the post-orbital spines of the carapace.

C. superciliosus (*Cancer superciliosus* Herbst). Length 18 lines.

Criocarcinus superciliosus.

Paramicippa (Milne-Edwards).—Approaching nearly to *Micippa.* Carapace nearly as wide as it is long; rostrum bent back below, and the latero-anterior borders armed with teeth. Disposition of the external antennæ nearly the same as in *Micippa*, except that the second joint, which is placed on the same level as the upper part of the front, is flattened, enlarged, very short, and triangular or heart-shaped. The disposition of the eyes is very different, for they cannot be reflected backwards, and there is no post-foraminal orbitary cavity; their peduncle shoots much beyond the edges of the orbit, and presents the same disposition as in the *Criocarcini*, except that they are immoveable. Form of the external jaw-feet the same as in *Pisa;* but the epistome is extremely short. The feet are short, those of the second pair hardly longer than the post-frontal portion of the carapace; the succeeding feet are gradually shortened. The abdomen of the female is composed of seven joints.

The only certain locality of the species stated by M. Milne-Edwards is the Red Sea.

P. tuberculosa. There are some hairs on the feet, and even on the carapace. Colour brownish.

Its locality is unknown.

Pericera (Latreille)—Bearing much resemblance to *Pisa*, but differing from that genus in many characters, and especially in the disposition of the orbits. Carapace very much elongated, and more or less triangular, a little convex and unequal above. Rostrum horizontal, and formed by two great conical horns. Front very wide, and occupying nearly twice as much space as the base of the rostrum. Orbits circular, very small, and extremely deep, directed outwards, and entirely filled by the ocular peduncles, which are inclosed therein as in a sheath, scarcely proceed beyond it, and cannot be reflected forwards or backwards; their upper border is very much produced, and presents a fissure. The basilary joint of the external antennæ is very large, and presents nearly the same dispositions as in *Micippa*, for it is much wider in front than it is behind, and terminates by a very extensive transversal border, which is soldered to the front or the sides of the rostrum. The position of the moveable stem of the external antennæ varies a little; sometimes it is inserted under the rostrum, sometimes a little outside the lateral border of that prolongation, but always very near the antennary fosset, and very distant from the orbit. Disposition of the external jaw-feet, as well as that of the sternal plastron, the feet, and the abdomen, nearly the same as in *Pisa.*

The species are found in the seas of the Antilles, as far as is yet known.

M. Milne-Edwards divides the genus into two sections. The first, consisting of those species in which the anterior angles of the superior orbitary border are prolonged into a strong spine, which much exceeds the basilary joint of the external antennæ; the second, of those species which have the terminal tooth of the basilary joint of the external antennæ going much beyond the anterior angle of the superior orbital border.

P. cornuta, M. Milne-Edwards (*Cornejo cornuto*, Parra; *Cancer cornudo*, Herbst; *Maia Taurus*, Lam.), Horned Crab of Hughes, who describes the whole animal as "covered with brownish plushy hairs." Length from 3 to 4 inches.

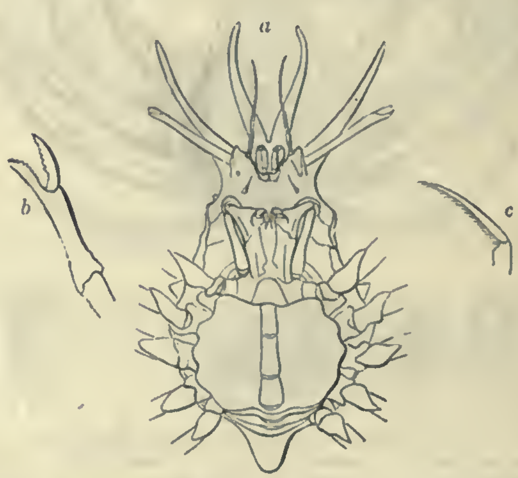
It is a native of the seas of Barbadoes and the Antilles.

Pericera cornuta (reduced one-fourth).

Stenocinops (Latreille)—Approaching *Pericera*, the principal difference being in the disposition of the eyes. Carapace narrow, very unequal, and furnished posteriorly with a large triangular prolongation, which covers the insertion of the abdomen; rostrum formed of two styliform and divergent horns; upper border of the orbit armed with a horn analogous to that of the rostrum, but directed more obliquely. Ocular stems delicate, immoveable, and very projecting; internal antennæ presenting nothing remarkable; first joint of the external antennæ much longer than it is wide, the second slender, and inserted under the rostrum a little in front of the level of the eyes. Epistome nearly square, and the third joint of the external jaw-feet dilated towards the external and anterior angle. Feet slender and cylindrical: in the female those of the first pair are hardly stouter than the others, and are much smaller than those of the second pair. Abdomen of the female composed of five joints only, the three rings which precede the last being soldered together. Neither Herbst, Latreille, M. Guérin, nor M. Milne-Edwards appears to have examined a male.

S. cervicornis, Latr. (*Cancer cervicornis*, Herbst), is the only species known. Length from about two to three inches.

It is a native of Mauritius.



Stenocinops cervicornis.

a, under side in detail; *b*, termination of one of the first pair of feet; *c*, termination of one of the succeeding feet.

Menæthius (Milne-Enwards)—With much of the habit of *Pisa*, and establishing the passage between that genus and *Halimus.* Carapace about once and a half as long as it is wide, very much narrowed anteriorly, and of the form of a triangle rounded at its base; rostrum formed by a large pointed process, which is placed on the median line of the body, and occupies about a third of the total length of the carapace; the anterior angles of the orbits surmounted by a large pointed and horizontal tooth directed forwards; the borders of these cavities without fissures, and exactly surrounding the base of the ocular peduncle, which is short and but little moveable. The disposition of the external antennæ, of the external jaw-feet, and of the thoracic feet, the same as in *Pisa*, except that there exists on the lower surface of the tarsi two rows of horny points. The abdomen of the male composed of seven distinct joints; that of the female of five only, of which the penultimate is formed by the soldering of three rings.

M. Monoceros. Length about 10 lines. Rostrum fringed with hairs. Colour brownish.

It is found in the Red Sea and the Indian Ocean.

Halimus (Latreille).—M. Milne-Edwards looks upon this genus as establishing the passage between the Eurypods, the *Pisæ*, the *Menæthii*, and the next genus.

Carapace, including the rostrum, about once and a half as long as it is wide, and convex above; rostrum advanced, and formed of two divergent horns; superior orbitary border projecting, and the latero-anterior borders of the carapace nearly always straight, and armed with strong spines; eyes not retractile, and exceeding considerably the edges of the orbit, which is prolonged backwards, with a groove which represents the post-foraminary portion; first joint of the external antennæ very long, straight, and nearly of the same width at its extremity as at its base, the insertion of the moveable stem of these appendages not covered by the rostrum. The epistome very large, and nearly square; third joint of the jaw-feet strongly dilated outwardly; pterygostomian regions very small; anterior feet slender, and of moderate length in the male as well as in the female; the succeeding feet long, slender, and compressed, their penultimate joint enlarged below, and truncated like a subcheliform claw. Abdomen of the male composed of seven segments; that of the adult female of five segments.

The species are found in the Indian Ocean.

H. Aries. Length about an inch.

Halimus Aries.

a, head in detail; *b*, eye; *c*, pedipalp.

Acanthonyx (Latreille).—Carapace nearly as elongated as in *Halimus*, but less convex, and much less spiny; rostrum horizontal, and formed of two flattened and divergent horns; orbits circular, and occupied entirely by the base of the ocular peduncle, which passes beyond them remarkably. Disposition of the antennæ, of the epistome, and of the jaw-feet nearly the same as in *Halimus*. Feet short and stout; those of the last four pair very much compressed; fifth joint enlarged below, notched near the end with a hairy tooth, against which the finger is bent back in manner of a claw; those of the second pair show this structure most clearly.

The form is widely spread. Species are recorded from the Mediterranean, from the Antilles, and from the Cape of Good Hope.

A. lunulatus. Length about 8 lines; body smooth, with some fasciculi of hairs on the front; colour deep green. It inhabits the coasts of Provence and the Bay of Naples, where it is found in crevices of the rocks overhung with *Algæ*.

Acanthonyx lunulatus.

a, head in detail; *b*, eye; *c*. termination of foot of second pair; *d*, antenna.

Epialtus (Milne-Edwards)—Establishing in some respects, according to the opinion of M. Milne-Edwards, the passage between *Doclea* and *Acanthonyx*, but much more nearly approximated to the latter. Carapace between circular and hexagonal, scarcely longer than it is wide, regularly convex and smooth above; rostrum narrow, triangular, and little or not at all divided; latero-anterior borders of the carapace very short, and forming with the lateral borders a very open angle; eyes very short, and not projecting much beyond the orbit, which is circular and with entire borders: but the eyes nevertheless appear susceptible of being recurved a little backwards; antennary region very small; moveable stem of the external antennæ inserted under the rostrum, at a considerable distance in front of the orbit, and the basilary joint of these appendages nearly triangular, and very narrow at its extremity. It would seem to form the whole of the lower orbitary wall. The second joint of these antennæ is a little enlarged, and nearly twice as long as the third; epistome small and square; external jaw feet large, and their third joint nearly square, not sensibly enlarged externally, and only a little notched at its anterior and internal angle, where it joins to the succeeding articulation; the sternal plastron nearly circular; anterior feet rather strong, and the claws slightly spoon-shaped; the succeeding feet cylindrical, and on their penultimate joint a small setiferous tubercle more or less projecting; their last joint is furnished below with two rows of small spines, and has but little flexibility: the tubercle is only well apparent in the posterior feet; the second pair are much longer than the others: segments of the abdomen varying from six to seven in the male.

The species are found on the coasts of Chili, as far as is yet known.

E. tuberculatus. Length 3 or 4 four lines; colour brownish-yellow. It is a native of Chili.

Epialtus tuberculatus.

Leucippa (Milne-Edwards).—M. Milne-Edwards sees in *Leucippa* much analogy to *Acanthonyx*, and he is of opinion that the former establishes in some points a passage between the Maians and the Parthenopians. Carapace resembling that of *Eurynome*, save that instead of being unequal and beset with spines as in them, its surface is perfectly smooth; its length exceeds its width only a little, its anterior portion is nearly triangular, and its latero-anterior borders are projecting and trenchant; rostrum horizontal, projecting, very wide, and formed of two lamellar horns; orbits incomplete, so that the eye cannot be hid therein completely; the superior border of these cavities is straight, and goes to rejoin the base of the first tooth from the latero-anterior border of the carapace, so as to form a triangular notch; the external edge of the basilary joint of the external antennæ constitutes the internal portion of their inferior wall or partition: but backwards and below they are limited by nothing, and it may be said that there is no post-foraminary portion of the orbit; the eyes are small, and carried on a very short peduncle: when they are folded backwards they only reach a little beyond the transversal line, and they are applied on the angle of the latero-anterior border of the carapace; the first joint of the external antennæ is straight throughout its length; the second and the third are completely hidden under the rostrum, and this last is nearly twice as long as that which precedes it; epistome not very much developed; external jaw feet with their third joint very much dilated outwards, and slightly truncated at its anterior and internal angle; feet short, compressed, and surmounted nearly throughout their length by a trenchant crest; abdomen of the female composed of seven segments, and covering the whole of the sternal plastron: that of the male unknown.

This form, as far as is known, belongs to the Pacific Ocean.

L. pentagona, the only species, is about four lines in length; colour pale-gray (female).

Leucippa pentagona.

a, under view of the head, magnified.

(Milne-Edwards, *Histoire Naturelle des Crustacées*, &c.; Bell, *British Stalk-Eyed Crustacea.*)

MA'LABATHRUM, a name which occurs frequently among the writings of the ancients, and which was applied to a leaf imported from India, whence it was likewise called φύλλον Ἰνδικόν, and also simply Folium. It was employed by them both as a medicine and as a perfume. From it there was prepared both an oil and a wine by maceration of the leaves in these menstrua. Many fabulous statements accompany the earliest accounts, as that of Dioscorides, by whom it is stated that by some they are thought to be the leaves of the Indian Nand; that they are moreover found floating on Indian marshes, and that they grow without roots (lib. i., c. 11), and that (lib. ii. c. 10) it is by feeding on them that the animal affording the Onychia, or Unguis Odoratus of the ancients, becomes aromatic. In the works of the Arabs Saduj is given as the synonyme of *Malabathrum*; and Saduj, both in Persian works and in India, is applied to Tej-Pat, or the leaf of the Tej, which is a species of *Cinnamomum*, *C. albiflorum*, growing in the dense forests of the valleys of the Himalaya, which extend from Rungpore to the Deyra Doon in 30° N. lat. Dr. Hamilton found the same name applied to a very nearly allied species, the

C. Tamala. Both species most probably yield the leaves which were so highly esteemed in ancient times, and are still as extensively employed in eastern countries, and may be found in every Indian bazaar under the names of Tuj, or Tej-Pat, or by the Arabic name of Saduj-Hindee. They are analogous in all respects to bay-leaves produced by the *Laurus nobilis*, and are in fact the bay-leaves of India. The name *Malabathrum* no doubt is derived from Tamala-putra, or Tamala-leaf, as was first indicated by Garcias: "Appellant autem Indi folium *Tamalapatra* quam vocem Græci et Latini imitantes corrupte *Malabathrum* nuncuparunt." These are brought from the interior of almost inaccessible forests, and necessarily stripped from the branches for the facility of carriage; hence most probably originated the fables with which their early accounts are accompanied.

MALACANTHUS. [LABRIDÆ.]

MALACHITE. [COPPER.]

MALACHIUM, a genus of Plants belonging to the natural order *Caryophyllaceæ.* It has 5 sepals; 5 bifid or entire petals; 10 stamens and 5 styles; the capsules opening with 5 bifid valves.

M. aquaticum, Water Chickweed, has a decumbent stem, angular, ascending, and covered with glandular hairs; cordate-ovate leaves, acuminate, sessile, the lowest one stalked; flowers scattered, solitary, in the forks of the stem; petals bipartite, rather exceeding the calyx; capsule exceeding the calyx. It is usually found in wet places in Great Britain.

(Babington, *Manual of British Botany.*)

MALACOLITE, or MALAKOLITH, a Mineral belonging to the Pyroxene series. [AUGITE.]

MALACO'LOGY. The science of Molluscous or Soft-Bodied Animals (Μαλακὸς and λόγος) includes the knowledge of such animals, whether protected by shells or entirely naked, and their distribution into classes, sub-classes, families, genera, and species. In this more extended and philosophical view of the subject, the science of Conchology may now be considered as merged; and the more modern classifications are based upon the anatomy of the soft parts and the habits of the animals, as well as upon the structure of the shells in those molluscous forms which have that protection. [CONCHOLOGY.]

The shell-collector of former days looked upon his drawers, if they were rich in rare species or varieties, as containing an assemblage of gems; and indeed the enormous prices given for fine and scarce shells, joined with the surpassing beauty of the objects themselves, almost justified the view which the possessor took of his cabinet of treasures. They were to him really "Les Delices des Yeux et de l'Esprit;" and the energetic zeal with which he collected and the sacrifices that he made to procure a fine and perfect Many-Ribbed Harp, a Gloria Maris, or Cedo Nulli, among the cones; an Aurora, or Orange-Cowry, a *Voluta aulica*, or *Voluta Junonia*, &c., were only comparable to the extravagances of those visited by the tulip mania when it was at its height. But though they were the delight of his eyes, they were, in nine cases out of ten, little more to the owner of them: they were mere trinkets on which he looked dotingly without knowing, and scarcely wishing to know, the organisation of the animal whose skeleton only was before him. This innocent trifling came at last to be viewed in its true light by some collectors worthy of better employment, who put off childish things, and went deeper into the subject. Lister, Adanson, Linnæus, Poli, Cuvier, Lamarck, De Blainville, and others, gave dignity to this department of zoology, and gradually raised the science to its proper rank; whilst the comparatively imperishable nature of the covering of the testaceous mollusks became, in the hands of such men as William Smith and his followers, among the most valuable records by which the stratification of the earth's crust could be demonstrated, and its geological history deciphered. [GEOLOGY.]

We must first examine what animals are included under the general name of *Mollusca*, or, if M. De Blainville's term be adopted as being the more comprehensive, *Malacozoa*, or *Malacozoaria.*

The Μαλάκια of Aristotle, his Ὄστρεα, or Ὀστρακόδερμα, and his Μαλακόστρακα, are distinguished by him from the Fishes as not having, like the latter, blood; which must be understood as meaning that they were without red blood. The Μαλάκια are further described as having all the fleshy parts external and the solid or firm parts internal, and are thus distinguished from the Ὀστρακόδερμα, which are defined as having the fleshy parts internal and the solid parts external. The Μαλακόστρακα are described as also having the solid parts of their bodies external, and the soft and fleshy parts internal, but as being protected externally by a crust instead of a shell, and having ambulatory feet.

Thus the Μαλάκια and Ὀστρακόδερμα of Aristotle, who is followed by Ælian and the Greek naturalists generally, correspond with the Naked and Testaceous *Mollusca* of the moderns.

Pliny and the ancient Latin zoologists employ the same denominations as the Greeks, though they have translated them by the terms *Mollia* for the Naked, and *Testacea* for the Shell-protected Mollusca.

Upon the revival of letters, we find Belon, Rondelet, Gesner, and Aldrovandus adopting the denominations of the ancients, and Jonston, in his general compilation, continuing the same under the general terms of *Exanguia*, or *Exanguia aquatica;* and the more particular ones, as applicable to the animals immediately under consideration, of *Mollia*, or *Mollusca*, and *Testacea*, or *Conchylia.*

Our countryman John Ray, who has justly been called the Precursor of Linnæus, and whose systematic views on the subject of zoology are well worthy of the attention of the student, appears to have been the first who applied the term *Vermes*, or Worms, to all Invertebrate Animals (with the exception of Insects and Crustaceans), whose blood or circulating fluid is white, and who employed the term *Vermes* (*Mollusca*) and *Vermes* (*Testacea*) to denote the divisions of Aristotle.

Lister, in his 'Synopsis Methodica Conchyliorum,' cannot be considered as having done much as a systematist, and though that zoologist gave the anatomy of many molluscous animals, as had been done by Fabius Columna before him, and Willis, Swammerdam, and others after him, little appears to have been effected for a principle of classification resting on their external organisation or their form, and still less for one resting on their internal structure.

Linnæus, in his 'Natural Division' of Animals into three sections, depending on the structure of the heart and on the circulating fluid, makes his third section consist of those animals which have an unilocular heart without an auricle (inauritum), and a white and cold circulating fluid (sanie frigida, albida). This section he separates into two sub-divisions: the first (*Antennata*) consisting of the Insects (*Insecta*); the second consisting of the Worms (*Vermes*).

The following is his definition of his class *Vermes*:—Cor (heart) uniloculare, inauritum, sanie frigida. Spiracula (respiratory organs) obscura. Maxillæ (jaws) multifariæ, variæ variis. Penes (intromissive generative organs) varii Hermaphroditis Androgynis. Sensus (organs of sensation), tentacula. Caput nullum, vix Oculi, non Aures, Nares. Tegmenta (covering or integument) calcarea aut nulla, nisi spinæ. Fulcra (organs of support or motion). Nulli Pedes aut Pinnæ.

The class so defined—and the very definitions will show how very limited the knowledge of the structure of such animals was in the time of the writer—consists of the following orders in the 'Systema Naturæ':—1, *Intestina;* 2, *Mollusca;* 3, *Testacea;* 4, *Lithophyta;* 5, *Zoophyta.*

The order *Mollusca* consists of the following genera arranged in the subdivisions here given:—

MOLLUSCA.

α. Mouth above. Animal fixing itself by its base.
Actinia. Ascidia.

β. Mouth anterior. Body perforated with a small lateral foramen.
Limax. Aplysia. Doris. Tethis, or *Tethys.*

γ. Mouth anterior. Body surrounded anteriorly by tentacles.
Holothuria. Terebella.

δ. Mouth anterior. Body brachiated, or furnished with arms.
Triton. Sepia. Clio. Lernæa. Scyllæa.

ε. Mouth anterior. Body pedated.
Aphrodita. Nereis.

ζ. Mouth below, central.
Medusa. Asteria, or *Asterias. Echinus.*

In the above assemblage of animals we find a very heterogeneous arrangement; *Mollusca, Radiata*, and the genus *Lernæa* (which last belongs to *Crustacea*) [LERNÆADÆ], being there collected together.

The order *Testacea*, 'Testaceous simple Molluscs, covered with a calcareous shell,' consists of the following subdivisions and genera:—

TESTACEA.

* Multivalvia.

Chiton (Animal *Doris*). *Lepas* (Animal *Triton*). *Pholas* (Anima *Ascidia*).

** Bivalvia: CONCHÆ.

Mya (Animal *Ascidia*). *Solen* (Animal *Ascidia*). *Tellina* (Animal *Tethys*). *Cardium* (Animal *Tethys*). *Mactra* (Animal *Tethys.*) *Donax* (Animal *Tethys*). *Venus* (Animal *Tethys*). *Spondylus* (Animal *Tethys*). *Chama* (Animal *Tethys*). *Arca* (Animal *Tethys?*) *Ostrea* (Animal *Tethys*). *Anomia* (Animal Corpus Ligula, emarginata, ciliata, ciliis valvulæ superiori affixis. Brachiis 2, linearibus, corpore longioribus, conniventibus, porrectis, valvulæ alternis, utriuque ciliatis, ciliis affixis valvulis utrisque). *Mytilus* (Animal *Ascidia?*). *Pinna* (Animal *Limax*).

*** Univalvia Spira regulari: COCHLEÆ.

Argonauta (Animal *Sepia*). *Nautilus* (Animal—'Rumph. Mus.,' t. 17, f. D). *Conus* (Animal *Limax*). *Cypræa* (Animal *Limax*). *Bulla* (Animal *Limax*). *Voluta* (Animal *Limax*). *Buccinum* (Animal *Limax*). *Strombus* (Animal *Limax*). *Murex* (Animal *Limax*). *Trochus* (Animal *Limax*). *Turbo* (Animal *Limax*). *Helix* (Animal *Limax*). *Nerita* (Animal *Limax*). *Haliotis* (Animal *Limax*).

**** Univalvia absque Spira regulari.

Patella (Animal *Limax*). *Dentalium* (Animal *Terebella*). *Serpula* (Animal *Terebella*). *Teredo* (Animal *Terebella*). *Sabella* (Animal *Nereis*).

This arrangement makes each of the generic characters reside in the shell, which is treated as the habitation of the 'animal.' Any one who examined this method soon found that it was impossible to affix any definite idea to many of the inhabiting animals, and but a vague one to most. To the bulk of the Bivalves, or Conchæ, a *Tethys* is assigned as the animal; to the bulk of the Univalves with a regular spire, a *Limax* or Slug, which last is stated to be the animal of *Pinna* among the Bivalves; and yet the wonder is how Linnæus approached so nearly to a natural arrangement with the scanty materials—for scanty they were when compared with the information that we now possess—which formed the groundwork of his classification. Upon this system almost all scientific collections of shells were arranged till within these few years; and so bigoted were many of the followers of this great man, who would have been the first to remodel his arrangement as new light poured in upon him, that every attempt at adopting the views of Cuvier, Lamarck, and others, and even those of Bruguière, founded upon the structure of the animals, was for a long time resisted, and almost resented as a presumptuous attempt at 'genus-making.'

Daubenton had read to the Academy of Sciences at Paris a memoir on the systematic distribution of shells, in which, whilst he admitted that an acquaintance with these alone might suffice for arrangement, he remarked that a knowledge of the animals, or soft parts, was indispensable for forming a complete system of conchology and a natural distribution of these exuviæ. But though this indefatigable anatomist broached this opinion, he does not appear to have carried his plan into execution.

Guettard seems to have beeu the first who carried out the suggestion of Daubenton; for in 1756 he read a memoir inserted in the 'Transactions' of the same academy, and therein established upon sound principles the necessity, in forming a classification of shells, of having recourse to the animals, or soft parts which they inclose, and a part of which the shells are. He did more; for he well characterised, upon the principle advocated by him, several genera, especially among the Univalves, as they were then called. And although he acknowledges that his information with regard to the Bivalves was not sufficient to enable him to carry out his views in the same manner with regard to them, he observes that they must be susceptible of being characterised with reference to the animals, or soft parts, as well as the Bivalves. Guettard further pointed out the division of shells into Terrestrial, Fluviatile, and Marine, and paid particular attention to the presence or absence of the operculum. There can be little doubt that these observations determined D'Argenville to add to his second edition of 'Conchyliologie' (1757) a number of figures of the animals, or soft parts, under the name of Zoomorphoses: these, it is true, are many, if not all of them, very bad.

The principles of Guettard were in the same year (1757) more extensively applied by Adanson in his 'Histoire Naturelle du Sénégal—Coqnillages.' He distinguishes all the external parts of the animals and the shells. In the Univalve shells, as they were then called, or, as Adanson denominates them, the Limaçons, he points out the whorls (spires), the apex (sommet), the aperture, the operculum, &c.; and in the Bivalves, under the name of Conques, he treates of the valves, which he terms battans, and notices their equality or inequality—whether they shut close or gape at any point—the hinge, and the number and form of the teeth composing it, with the cavities which they form—the ligament, considering it as to form and situation—the muscles, or rather muscular impressions, with regard to their figure, size, and number; the nacre, &c. Out of the modifications of these parts of the bivalve shell he forms divisions as—five depending on the variations of the hinge; three depending upon the relative situations of the ligament externally, internally, &c.; three depending upon the modifications of muscular attachment, namely, 1st, Conques with one muscular attachment; 2nd, Conques with two muscular attachments; and, 3rd, Conques with three muscular attachments; and three depending upon the presence or absence of the nacre and its modifications.

In the animals, or soft parts, of the Limaçons, he directs his attention to five principal parts:—

1. The Tentacula, or tentacles, which he names horns (cornes), and which he considers with regard to their number and shape as furnishing specific character, according as they are absent, or as there are two or four, or according to their conical or cylindrical form, the absence or presence of convexity (renflement) at their origin, and their situation at the root, or at the extremity of the head.

2. The Eyes—their absence or presence; and in the latter case, their situation upon the head at the internal side of the root of the tentacles, behind the tentacles, towards their internal side, at the origin of the tentacles on their external side, above the root of the tentacles on their external side, at the middle of the tentacles on their external side, and at the summit of the tentacles.

3. The Mouth, as provided with two jaws without a proboscis, or with a proboscis without jaws.

4. The Trachea, or respiratory orifice, as formed by a simple hole situated on one of the sides of the animal, or by a long pipe which has its exit near the back.

5. The Foot, according as it is divided by a transverse furrow at its anterior part, or not.

The Conques are regarded by Adanson with reference to four principal parts, namely:—

1. The Mantle, which may be either divided all round into two lobes, or divided on one side only, or form a sac, open only at the two opposite extremities.

2. The Trachea, or tube, which may be either single, and in the form of an aperture, double in the form of apertures, double in the form of separate and distinct pipes, or double in the form of united pipes.

3. The Foot null, or not appearing externally, or appearing externally.

4. The Byssus, or Threads, which exist in some species, and do not exist in others.

The shells which he had observed at Senegal are figured and distributed generally in the following order, under two families:—

Family I.—Limaçons.

Section 1. Limaçons Univalves.

Genera:—*Cymbium*. *Bulinus* (*Physa* of the moderns). *Coretus* (*Planorbis* of Guettard). *Pedipes* (*Auricula* of Lamarck). *Cochlea* (*Bulimus* of Bruguière). *Lepas* (*Patella* of modern authors, and also embracing the Chitons). *Haliotis*. *Yetus* (*Voluta* of Lamarck, *Cymba* of Broderip). *Terebra*. *Porcellana* (*Marginella* and *Oliva* of authors). *Cypræa*. *Peribolus* (young of *Cypræa* and small *Marginellæ*).

Section 2. Limaçons Operculés.

Genera:—*Strombus* (*Conus* of the moderns). *Purpura* (including, with the true *Purpuræ*, *Dolium*, *Cassidaria*, *Murex*, *Strombus* of the moderns, some *Mitræ*, &c.). *Buccinum*. *Cerithium*. *Vermetus*. *Trochus*. *Turbo*. *Natica*. *Nerita*.

Family II.—Conques.

Section 1. Conques Bivalves.

Genera:—*Ostreum* (*Ostrea* of the moderns). *Jataronus* (*Spondylus* (?) of the moderns). *Perna* (including *Mytilus*, *Modiola*, *Avicula*, *Pinna*, and *Cardita*). *Chama* (including *Venus*, *Cytherea*, *Mactra*, *Cardita*, and some of *Solen*; but apparently none of the *Chamæ* of modern authors). *Tellina* (*Donax* of the moderns). *Pectunculus* (including *Cardium*, *Arca*, and some true *Pectunculi* of Lamarck). *Solen*.

Section 2. Conques Multivalves.

Genera:—*Pholas*. *Teredo*.

Such is the system of Adanson; and although it presents errors, which would very probably have been avoided by so good an observer if he had lived at a later period, when this branch of knowledge became better known, we must allow him the merit of being the first who practically applied the principle of classification based on the structure of the soft as well as the hard parts, or, in other words, on the organisation of the animal and shell.

Geoffroy, a physician of Paris, applied the same principle in his little 'Treatise on the Terrestrial and Fluviatile Shells' in the neighbourhood of that city. His genera of Univalves amount to five only, namely, *Ancylus*, *Cochlea*, *Buccinum*, *Planorbis*, and *Nerita*. His genera of Bivalves consist of two, *Chama* and *Mytilus*, in the first of which he places *Cyclas*, and in the second an *Anodon* and a *Uno*.

Müller, the Dane, presented zoologists with a system founded on the same principle, which, whilst it was more complete than that of Guettard, inasmuch as it extended to all conchiliferous animals, was less natural than that of Adanson, and altogether inferior to it, as far as Adanson's went; but it was much more elaborate, and demands a great share of praise. The author of the 'Zoologia Danica,' in his 'Vermium Terrestrium et Fluviatilium Historia,' adopts three primary divisions—Univalves, Bivalves, and Multivalves.

He divides the Univalves into three sections:—

1. Those Testaceous Univalves whose shell is pierced through and through; and in this section he places the *Echini* and *Dentalium*.

2. Those which have a very large aperture, consisting of *Akera* (*Bulla* of modern zoologists), *Argonauta*, *Bulla* (*Physa* of Draparnaud and others), *Buccinum* (*Limnæa* of the moderns), *Carychium*, *Vertigo*, *Turbo*, *Helix*, *Planorbis*, *Ancylus*, *Patella*, and *Haliotis*.

3. Operculated Testaceous Univalves, in which he places the genera *Tritonium* (*Buccinum* of Linnæus), *Trochus*, *Nerita*, *Valvata*, and *Serpula*.

The Bivalves are divided by the same author into two sections only: the first consisting of those which have a toothed hinge, including *Terebratula*, a new genus; the second, of those which have a toothless hinge, including two new genera, *Anomia* and *Pecten*, which he separates from the Oysters.

The Multivalves comprise the genera *Chiton*, *Lepas*, and *Pholas*.

There can be little doubt that it was to these authors (among whom we do not include Müller, whose works appeared subsequently, nor Geoffroy, whose treatise appeared nearly simultaneously) we owe the amended arrangement of Linnæus as it finally appeared in his last edition of the 'Systema Naturæ' (the 12th, 1767), and as we have given it above. In the earlier editions the term *Mollusca* does not seem to have occurred to him. The Naked Molluscs are distributed among the order Zoophytes, of his class *Vermes*, and the Testaceous Molluscs formed his third order of that class, *Testacea*. Among the first we find *Tethys*, under which he arranged the *Holothuriæ*; and *Limax* and *Sepia*, which he placed near the *Hydræ*. The second were not yet divided into Univalves and Bivalves. The genera *Patella* and *Cochlea* seem to have embraced all the Turbinated Univalves; and *Cypræa*, *Haliotis*, and *Nautilus* the Simple Univalves. All the Bivalves appear to be collected under the term *Concha*; and the *Ascidiæ*, under the name of *Microcosmus*, seem to have found a place under his *Testacea*.

It is in the tenth edition (1758) that we first trace considerable augmentations, which increased in the last that received the correction of the great Swedish naturalist's own hand, and which appeared in three volumes: the first part of the first volume being published in 1766; the second part of that volume, containing the *Insecta* and *Vermes*, in 1767; the second volume, containing the Plants ('Regnum Vegetabile'), in 1767; and the third, containing the Minerals ('Regnum Lapideum') in 1768. Adanson's work was published at Paris in 1757, ten years before the second part of the second volume of the last edition of the 'Systema Naturæ.' But Linnæus appears to have only profited by the labours of Guettard and Adanson to add to the genera of the orders *Mollusca* and *Testacea* of his *Vermes*, and to define them more closely. Geoffroy's publication appeared nearly at the same time with his own last edition. The object of Linnæus seems to have been to establish a nomenclature and form a system of chonchology resting on the modifications of structure in the shell alone; in fact an arbitrary system, which has now generally given way to systems founded upon more natural principles.

Pallas ('Miscellanea Zoologica,' 1766) seems to have been the first to point out the unsteady foundation on which the system of Linnæus rested. He shows that the subdivision of the Testaceous Molluscs, as adopted by Linnæus and his followers, resting on the shell only, without taking the animal into consideration, is far from natural; and in that spirit of prophecy which is now fulfilled, he remarks that it cannot be preserved.

Bruguière, nevertheless, weighing the great influence which the system of Linnæus had exercised on zoology in general, and the powerful aid which it afforded to the student of that science, clung, in his 'Dictionnaire des Vers,' to the method of the Swede in so many points that he may be said almost to have done little more than imitate him.

Bruguière admits the division of the two orders Molluscous Worms and Testaceous Worms. The first of these he subdivides into two sections, according to the presence or absence of tentacula, and consequently jumbles together a very heterogeneous mass of animals; for the same reason his second section is even more heterogeneous than the first. He however separates into a distinct order the *Echini* and Star-Fishes.

In the second order, or that of Testaceous Worms, though the Linnæan principle is kept in view, the genera are more multiplied and their characters better defined; and as Bruguière is one of those authors who has greatly contributed to the advancement of this branch of zoology, we shall give an outline of his system of conchology.

He, like Linnæus, divides the Testaceous Worms into three sections, according to the number of the valves.

In the first (Multivalves) he places the Chitons, *Balanus*, and *Anatifa* (*Lepas* of Linnæus), *Teredo*, *Fistulana*, *Pholas*, *Char* (a new and imaginary genus), *Anomia*, and *Crania*. We here have for the first time a separation of the Pedunculated and Sessile types of the Cirripeds (*Campylosomata* and *Acamptosomata*) pointed out under the generic appellations of *Anatifa* and *Balanus*, and the new genera *Fistulana* and *Crania*.

The Bivalves (second section) are divided into the regular and irregular.

Among the Regular Bivalves are three new genera, namely, *Acardo*, *Placuna*, and *Perna*.

The Irregular Bivalves contain the new genera *Trigonia*, *Pecten* (previously separated from the Oysters by Müller and Poli), *Tridacna*, *Cardita* (formed at the expense of *Chama*, Linn.), and *Terebratula*, containing a division of *Anomia*.

The Univalves are subdivided into the Unilocular, or those without any partitions, and the Multilocular, or those which are furnished with regular partions or septa.

The Unilocular Univalves without a regular spire contain *Patella* and *Fissurella*, divided for the first time, and, notwithstanding the observations of Pallas, *Dentalium*, *Serpula*, *Siliquaria*, and *Aspergillum*, among others; *Fissurella*, *Siliquaria*, and *Aspergillum*, being new.

The Unilocular Univalves with a regular spire present a less heterogeneous assemblage. We find among them *Voluta* reduced to a more uniform genus by withdrawing from it some of the widely different species which Linnæus had congregated under that name, and the following new genera: *Ovula* (or rather *Ovulum*), *Oliva*, *Purpura*, *Cassis*, *Terebra*, *Fusus*, *Cerithium*, *Bulimus*, *Planorbis*, and *Natica*.

The Multilocular Univalves not noticed by Linnæus, but pointed out by Breyn or Breynius of Danzig, in his 'Disertatio de Polythalamiis, nova Testaceorum Classe' (1732), comprise the genera *Camerina*, *Ammonites*, and *Orthoceras*, at the expense of the genus *Nautilus* of Linnæus.

Gmelin, whose edition of Linnæus appeared about the same time with the work of Bruguière, requires but little notice. Four or five new genera were added to the 'Systema Naturæ,' which received in this edition a great number of species, too many of them added carelessly and in a manner to create confusion, instead of dissipating it.

In 1791 Poli published the first volume of his splendid work, 'Testacea utriusque Siciliæ eorumque Historia et Anatome.' Of the care with which the details are wrought out, and the magnificence and accuracy with which they are illustrated, it is impossible to speak too highly. But while Poli avoids the errors of those who sought to establish a system of testaceous molluscs on the structure of the shell alone, he runs into the opposite extreme, and rests his arrangement on the soft parts of the animal only, without any reference to the hard part or shell. He divides the *Mollusca* into three orders:—1, Mollusca Brachiata (*Sepiæ*, &c., of Linnæus, and the Tritons and *Serpulæ* of the same author). 2, Mollusca Reptantia (Gastropods of the more modern authors). 3, Mollusca Subsilientia (Multivalves and Bivalves of the old school, and characterised as being provided with a long foot, as being fixed to rocks or free, and as always wanting a head and eyes).

Of these families the most natural are the Bivalves, and their arrangement is based upon the structure of important parts.

Little seems to have been done for the science from 1789 to 1798, a period which included the French revolution and its reign of terror; but in 1798 a new era commenced, and George Cuvier published his 'Tableau Elémentaire de l'Histoire Naturelle des Animaux.' This great man, clearly perceiving that Guettard, Adanson, Geoffroy, Müller, and Poli took a right view of the principles of classification when they proposed the organisation of the naimal as its basis, adopted that method, and united, as Pallas had done, under the name of *Mollusca* both the *Vermes* (*Mollusca*) and *Vermes* (*Testacea*) of Linnæus. Considering the absence or presence of a shell as a contingency of secondary importance, he divided the *Mollusca* into three sections,—the Cephalopodous *Mollusca*, the Gastropodous *Mollusca*, and the Acephalous *Mollusca*. Finally he arranged this 'Second Grand Division of the Animal Kingdom' in six classes, and gave the following method in his last edition of the 'Règne Animal' (1830).

Class I.—CEPHALOPODA.

1, *Sepia* of Linnæus, containing the following genera and subgenera: *Octopus*, *Polypus*, *Eledone*, *Argonauta*, *Bellerophon*, *Loligo*, *Loligopsis*, *Onychoteuthis*, *Sepiola*, *Sepioteuthis*, and the Cuttles properly so called, namely, *Sepia* of Lamarck. 2, *Nautilus* of Linnæus, containing *Spirula*, the *Nautili* properly so called (*Nautilus pompilius*, &c.), *Lituus*, *Hortolus*, and *Orthoceras*. 3, *Belemnites*, including *Actinocomax* (?)*. [CEPHALOPODA.] 4, *Ammonites*, including the *Ammonites* properly so called (*Simplegades* of De Montfort), *Planites* of De Haan, *Ceratites*, *Orbulites*, *Globites*, *Goniatites*, *Pelagus*, *Scaphites*, *Baculites* (*Tiranites*, *Rhabdites*, *Ichthyosarcolites*), *Hamites*, *Turrilites* (the last with M. Audouin's doubt). 5, *Camerina* (*Nummulites* of Lamarck), with their infinity of genera. [FORAMINIFERA.]

Class II.—PTEROPODA.

1, *Clio*. 2, *Cymbulia*. 3, *Pneumodermon*. 4, *Limacina*. 5, *Hyalæa*. 6, *Cleodora*, including *Creseis*, *Cuvieria*, *Psyche*, and *Eurybia*, of M. Rang, and perhaps *Triptera* of Quoy and Gaimard. 7, *Pyrgo* (fossil).

Class III.—GASTEROPODA.

Order 1. *Pulmonifera*.

Section 1. *Pulmonifera Terrestria*.

1, *Limax*, including *Limax* properly so called. *Arion*. *Vaginulus*. *Testacella* and *Parmacella*. 2, *Helix*, including *Helix* properly so called, *Vitrina* (*Helicolimax* of Férussac). *Bulimus*. *Pupa*. *Chondrus*, and *Succinea*. 3, *Clausilia*. 4, *Achatina* (including *Polyphemus* of De Montfort).

Section 2. *Pulmonifera Aquatica*.

1, *Onchidium*. 2, *Planorbis*. 3, *Limnæus*, or *Limnæa*. 4, *Physa*, near which Cuvier would place *Scarabus* of De Montfort. 5, *Auricula* (including *Carychium* of De Férussac). 7, *Melampus* (*Conovulus*, Lam.).

Order 2. *Nudibranchiata*.

1, *Doris*. 2, *Onchidoris*. 3, *Plocamoceros*. 4. *Polycera*. 5, *Tritonia*. 6, *Thethys*, or *Tethys*. 7, *Scyllæa*. 8, *Glaucus*. 9, *Laniogerus*. 10, *Eolidia*. 11, *Cavolina*. 12, *Flabellina*. 13, *Tergipes*. 14, *Busiris*. 15, *Placobranchus*.

Order 3. *Inferobranchiata*.

1, *Phyllidia*. 2, *Diphyllidia*.

Order 4. *Tectibranchiata*.

1, *Pleurobranchus*. 2, *Pleurobranchæa* (*Pleurobranchidium* of De Blainville). 3, *Aplysia*. 4, *Dolabella*. 5, *Notarchus*. 6, *Bursatella*. 7, *Akera*, including *Bullæa*, *Bulla*, and the *Akeræ* properly so called (*Doridium* of Meckel, and *Lobaria* of De Blainville). 8, *Gastropteron*. 9, *Umbrella*.

Order 5. *Heteropoda* (Lam.).

These were all comprised by Forskal under his genus *Pterotrachea*, and comprehended—

* In the text *Actinocomax* is included in the section appropriated to the genus *Belemnites*, though it is spoken of as a genus. In the 'Table Méthodique,' *Actinocomax* is printed as a genus, not a sub-genus.

1, *Carinaria.* 2, *Atlanta.* 3, *Firola.* 4, the Timoriennes of Quoy and Gaimard. 5, the Monophores of the same. *Phylliroe* of Péron is placed here, but with doubt.

Order 6. *Pectinibranchiata.*

Family of Trochoids.—1, *Trochus* (including *Tectus, Calcar, Rotella, Cantharidus, Infundibulum, Telescopium, Solarium,* and *Euomphalus*). 2, *Turbo,* including, as genera and sub-genera, *Turbo* properly so called (which comprises both *Turbo* and *Meleagris* of De Montfort), *Delphinula, Pleurotomaria, Turritella, Scalaria,* together with certain terrestrial and fresh-water sub-genera, namely, *Cyclostoma, Valvata,* and *Paludina;* and the following:—*Littorina, Monodon, Phasianella, Ampullaria* (including *Lanistes* of De Montfort), *Helicina, Melania, Rissoa, Melanopsis, Pirena, Acteon* (*Tornatella,* Lam.), *Pyramidella, Janthina, Nerita, Natica, Peloronta, Velates, Neritina,* and *Clithon.*

Family of Capuloids.—1, *Capulus* (*Pileopsis* of Lamarck). 2, *Hipponyx.* 3, *Crepidula.* 4. *Pileolus.* 5, *Navicella* (*Cimber* of De Montfort). 6, *Calyptræa.* 7, *Siphonaria.* 8, *Sigaretus.* 9. *Coriocella.* 10, *Cryptosoma.*

Family of Buccinoids.—1, *Conus.* 2, *Cypræa.* 3, *Ovula,* or rather *Ovulum,* including *Volva* (*Radius* ?) and *Calpurnus* of De Montfort. 4, *Terebellum.* 5, *Voluta,* including *Oliva, Volvaria,* the true *Volutæ* (subdivided by Broderip into *Cymba—Cymbium* of De Montfort—*Melo,* and *Voluta*), *Marginella, Columbella, Mitra,* and *Cancellaria.* 6, *Buccinum,* including *Buccinum* of Bruguière, *Nassa, Eburna, Ancillaria, Dolium* (the Tuns, and Partridge Tuns), *Harpa, Purpura, Unicornus* (*Monoceros,* Lam.), *Ricinula* (*Sistrum* of De Montfort), *Concholepas, Cassis, Cassidaria* (*Morio* of De Montf.), and *Terebra.* 7, *Cerithium* (including *Potamides*). 8, *Murex,* including *Murex,* Brug., which comprises the *Murices* properly so called (*Murex,* De Montf.), and *Brontes, Typhis, Chicoreus, Aquillus, Lotorium, Triton,* and *Trophon* of the same; *Ranella* (including *Apollon* of De Montf.); *Fusus* (including *Fusus* and *Latirus* of De Montf.); *Struthiolaria, Pleurotoma, Clavatula, Pyrula* (including *Fulgur* of De Montf.), and *Fasciolaria.* 9, *Strombus* (including *Strombus,* Lam., *Pteroceras, Rostellaria,* and *Hippochrenes*).

Order 7. *Tubulibranchiata.*

1, *Vermetus,* including *Vermilia.* 2, *Magilus.* 3. *Siliquaria.*

Order 8. *Scutibranchiata.*

1, *Haliotis,* including *Padollus* as a sub-genus, and *Stomatia.* 2, *Fissurella.* 3, *Emarginula* (*Palmarium* of De Montfort). 4, *Parmophorus* (*Scutus* of De Montfort).

Order 9. *Cyclobranchiata.*

1, *Patella.* 2, *Chiton.*

Class IV.—Acephala.

Order 1. *Acephala Testacea* (with four branchial feuillets, or leaflets.)

Family of Ostraceans.—1, *Arcado,* Brug., or *Ostracites,* La Peyrouse, including *Radiolites, Sphærulites, Calceola, Hippurites,* and *Batolites,* 2, *Ostrea,* Linn., including *Ostrea,* Brug., *Gryphæa, Pecten, Lima,* and *Pedum.* 3, *Hinnites.* 4, *Plagiostoma.* 5, *Pachytes.* 6, *Dianchora.* 7, *Padopsis.* 8, *Anomia.* 9, *Placuna.* 10, *Spondylus,* from which Lamarck has separated *Plicatula.* 11, *Malleus.* 12, *Vulsella.* 13, *Perna,* from which have been separated *Crenatula, Gervillia, Inoceramus, Catillus,* and *Pulvinites.* 14, *Etheria.* 15, *Avicula,* including *Margarita.* 16, *Pinna.* 17, *Arca,* Linn., including *Arca,* Lam., *Cucullæa, Pectunculus,* and *Nucula.* 18, *Trigonia.*

Family of Mytilaceans.—1, *Mytilus,* Linn., including *Modiola* and *Lithodomus.* 2, *Anodon,* including *Iridina, Dipsas,* &c. 3, *Unio,* including *Hyria* and *Castalia.* 4, *Cardita.* 5, *Cypricardia,* and the *Coralliophaga* of M. De Blainville, *Venericardia,* and *Crassatella* (*Paphia,* Roiss).

Family of Chamaceans.—1, *Chama,* Linn., including *Tridacna Hippopus, Chama* (Brug.), *Diceras,* and *Isocardia.*

Family of Cardiaceans.—1, *Cardium,* including *Hemicardium.* 2, *Donax,* 3, *Cyclas,* including *Cyrena, Cyprina,* and *Galathæa.* 4, *Corbis,* Cuv., *Fimbria,* Megerle. 5, *Tellina.* 6, *Loripes.* 7, *Lucina.* 8, *Ungulina.* 9, *Venus,* including *Astarte* (*Crassina,* Lam.), *Cytheræa, Capsa,* and *Petricola.* 10, *Corbula.* 11, *Mactra.*

Family of the Enfermés.—1, *Mya,* including *Lutraria, Anatina, Solemya, Glycymeris, Panopea,* and *Pandora.* 2, *Byssomya.* 3, *Hiatella.* 4. *Solen,* including *Sanguinolaria, Psammobia,* and *Psammothea.* 5, *Pholas.* 6, *Teredo.* 7, *Fistulana.* 8, *Gastrochæna.* 9, *Teredina.* 10, *Clavagella.* 11, *Aspergillum.*

Order 2. *Achephala* without shells.

1st Family (Simple).—1, *Biphora,* including *Thalia, Salpa,* and *Dagysa.* 2. *Ascidia,* including *Cynthia, Phallusia, Clavellina,* and *Boltenia.*

2, Family (Aggregate).—1, *Botryllus.* 2, *Pyrosoma.* 3, *Polyclinum.*

Class V.—Brachiopoda.

1, *Lingula.* 2, *Terebratula,* including *Spirifer* and *Thecidea.* 3, *Orbicula,* including *Discina* and *Crania.*

Class VI.—Cirrhopoda.

(*Lepas* and *Triton,* Linn.)

1, *Anatifa,* including *Pentalasmis, Pollicipes, Cineras, Otion,* and *Tetralasmis.* 2, *Balanus,* including *Acasta, Conia, Asema, Pyrgoma, Ochthosia, Creusia, Coronula, Tubicinella,* and *Diadema.*

Such is the method finally proposed by Cuvier; and, while perusing it, the reader should remember that he had the advantage of reference to almost every author of note who had written on the subject, down to the year 1830. Not that this at all detracts from the excellent use which he has made of the materials at his command, and the grand philosophical views which he took of this intricate department of zoology.

We must now go back to 1798, when Lamarck began his publications on the *Mollusca,* by a paper in which he separated the great genus *Sepia* into three genera; and in 1799 he gave to the world his 'Prodromus' of a new classification of shells, wherein he established several new genera. In this work he states his adhesion to the principles and views of Bruguière, whilst profiting by the observations of Cuvier as to the organisation of the animals, but remarks that he has been compelled to restrict still more the characters of the genera, and consequently to augment their number. In 1801, when he published his 'Animaux sans Vertèbres,' he seems to have been convinced of the justice of the views of Cuvier; and no longer confining his attention to the shells, he followed very nearly the example of that great zoologist, and rested his system upon the organisation of the soft parts, as well as on the form of the shell of the animal. The first vol. of the last edition, which received the corrections of Lamarck's own hand, was published in 1815, and the last vol. in 1822. The following is the arrangement left by him:—

Before we enter upon that part of the system which in strictness belongs to the subject before us, it will be necessary to give a succinct view of Lamarck's Annelids. This he divides into three orders:—

I. The Apod Annelids, containing the *Hirudinidæ,* or Leeches, and the *Lumbricidæ,* or Worms (Echiurées).

II. The Antennated Annelids, containing the *Aphroditidæ,* the *Nereididæ,* the *Euniciddiæ,* and the *Amphinomidæ.*

III. The Sedentary Annelids, containing the *Dorsalidæ,* which include *Arenicola* and *Siliquaria;* the *Maldanidæ,* which include *Clymene* and *Dentalium;* the *Amphitritidæ,* which comprise *Pectinaria, Sabellaria, Terebella,* and *Amphitrite;* and the *Serpulidæ* (*Spirorbis, Serpula, Vermilia, Galeolaria,* and *Magilus*).

The Annelids immediately precede Lamarck's—

Class X.—Cirrhipedes.

Order 1. Sessile Cirrhipedes.

Section 1. With a quadrivalve operculum.

Genera:—*Tubicinella. Coronula. Balanus. Acasta.*

Section 2. With a bivalve operculum.

Pyrgoma. Creusia.

Order 2. Pedunculated Cirrhipedes.

Section 1. Body completely enveloped by its tunic; shell composed of contiguous pieces, leaving a free issue to the animal when they are opened.

Anatifa. Pollicipes.

Section 2. Body completely enveloped by its tunic, which nevertheless has an anterior opening; shell formed of separate pieces, which have no need to open themselves for the issue of the arms of the animal.

Cineras. Otion.

Class XI.—Conchifera.

Order 1. *Conchifera Dimyaria.*

Two muscles of attachment at least; shell, internally, with two muscular impressions, which are separate and lateral.

(1) Shell regular, generally equivalve.

(*A*) Shell gaping, in general, at the lateral extremities, its valves being approximated.

(*) Crassipede Conchifers.—Mantle with its lobes united anteriorly, either entirely or partially; foot thick posterior: gape of the shell always remarkable, often considerable.

(1) Shell either contained in a tubular sheath, distinct from its valves, or entirely or partially incrusted in the wall of the sheath, or projecting externally.

Family *Tubicolidæ.*

Aspergillum. Clavagella. Fistulana. Septaria. Teredina. Teredo.

(2) Shell without a tubular sheath.

(*a*) Ligament external.

(†) Shell either furnished with accessory pieces, foreign from its valves, or gaping very much anteriorly.

Family *Pholadidæ.*

Pholas. Gastrochæna.

(††) Shell without accessory pieces, and gaping at the lateral extremities only.

Family *Solenidæ.*

Solen. Panopæa. Glycymeris.

(*b*) Ligament internal.

Family *Myidæ.*

Mya. Anatina.

(**) Tenuipede Conchifers.—Mantle with its lobes not united, or hardly united anteriorly; foot small, compressed; gaping of the shell often considerable.

(†) Ligament internal.

Family *Mactridæ.*

(1) Ligament internal only.

(*a*) Shell gaping on its sides.

Lutraria. Mactra.

(*b*) Shell not gaping at its sides.

Crassatella. Erycina.

(2) Ligament visible externally, or double, one part being internal, the other external.

Ungulina. Solemya. Amphidesma.

Family *Corbulidæ.*

Shell inequivalve. Ligament internal.

Corbula. Pandora.

(††) Ligament external only.

Family *Lithophagidæ.*

Boring shells without accessory pieces, without any particular sheath, and more or less gaping at their anterior side. Ligament of the valves internal.

Saxicava. Petricola. Venerupis.

Family *Nymphidæ.*

Two cardinal teeth at most in the same valve. Shell often gaping a little at the lateral extremities. Ligament external. Nymphs in general gaping outwards.

(1) Solen-like *Nymphidæ.*

Sanguinolaria. Psammobia. Psammotæa.

(2) Tellen-like *Nymphidæ.*

(*a*) Lateral teeth, one or two.

Tellina. Tellinides. Corbis. Lucina. Donax.

(*b*) No lateral teeth.

Capsa. Crassina.

(*B*) Shell closed at the lateral extremities, when the valves are closed.

(***) Lamellipede Conchifers.—Foot flattened, lamelliform, not posterior.

Family *Conchidæ.*

Three cardinal teeth at least in one valve, with as many or less in the other. Lateral teeth sometimes.

(1) Fluviatile *Conchidæ.*—Shell with lateral teeth, and covered with a false epidermis.

Cyclas. Cyrena. Galathea.

(2) Marine *Conchidæ.*—No lateral teeth in the greater number; rarely an epidermis, which covers the whole shell except the umbones.

Cyprina. Cytherea. Venus. Venericardia.

Family *Cardiidæ.*

Cardinal teeth irregular, either in their form or situation, and accompanied in general by one or two lateral teeth.

Cardium. Cardita. Cypricardia. Hiatella. Isocardia.

Family *Arcidæ.*

Cardinal teeth small, numerous, intrant, and disposed in each valve on a line which is either straight, or arched, or broken.

Cucullæa. Arca. Pectunculus. Nucula. Trigonia. Castalia.

Family *Naiidæ.*

Fluviatile shells, whose hinge is sometimes furnished with an irregular cardinal tooth which is simple or divided, and with a longitudinal tooth which is prolonged under the corselet; and sometimes is without any tooth at all, or is furnished along its length with irregular granular tubercles.

Muscular impression posterior and compound. Umbones with the epidermis peeled off, and frequently eroded.

Unio. Hyria. Anadonta (or rather *Anodon*). *Iridina.*

(****) Ambiguous Conchifers.

Family *Chamidæ.*

Shell irregular, inequivalve. A single cardinal tooth, which is oblique and subcrenate, inserted into a little pit in the opposite valve.

Muscular impressions two, distant, lateral. External ligament depressed.

Diceras. Chama. Etheria.

Order 2. *Conchifera Monomyaria.*

Only one muscle of attachment, which seems to traverse their body. Shell with an internal subcentral muscular impression.

(*) Ligament marginal, elongated on the border, sub-linear.

(*a*) Shell transverse, equivalve, with an elongated muscular impression bordering the upper limb.

Family *Tridacnidæ.*

Tridacna. Hippopus.

(*b*) Shell longitudinal or subtransverse, with a muscular impression contracted into an isolated space without bordering the limb.

(†) Ligament at the lateral border of the shell, and always entire.

Family *Mytilidæ.*

Hinge with a subinternal ligament, which is marginal, linear, very entire, occupying a great part of the anterior border. Shell rarely foliated.

Modiola. Mytilus. Pinna.

(††) Ligament at the lower border of the shell, or divided.

Family *Malleidæ.*

Ligament marginal, sublinear, either interrupted by crenulations or serial teeth, or altogether simple. Shell sub-inequivalve, foliated.

Crenatula. Perna. Malleus. Avicula. Meleagrina.

(**) Ligament not marginal, contracted into a short space under the umbones, and not forming a tendinous tube under the shell.

(*a*) Ligament internal or demi-internal. Shell regular, compact, not foliated.

Family *Pectinidæ.*

Pedum. Lima. Plagiostoma. Pecten. Plicatula. Spondylus. Podopsis.

(*b*) Ligament internal or demi-internal. Shell irregular, foliated, sometimes papyraceous.

Family *Ostreidæ.*

(1) Ligament demi-internal. Shell foliated, but nevertheless often acquiring great thickness.

Gryphæa. Ostrea. Vulsella.

(2) Ligament internal. Shell delicate, papyraceous.

Placuna. Anomia.

(***) Ligament either null or unknown, or represented by a tendinous cord which sustains the shell.

(*a*) Ligament and animal unknown. Shell very inequivalve.

Family *Rudistidæ.*

Sphærulites. Radiolites. Calceola. Birostrites. Discina. Crania.

(*b*) Shell adherent, either immediately or by a tendinous cord which sustains it, and serves as a ligament. Animal with two opposed arms, which are opposed, ciliated, and cirrhous.

Family *Brachiopodidæ.*

Conchifers having near the mouth two opposed elongated ciliated arms, rolled spirally when in repose. Mantle bilobated, the lobes separated anteriorly, enveloping or covering the body.

Shell bivalve, adhering to marine bodies, either immediately or by a tendinous cord.

Orbicula. Terebratula. Lingula.

Class XII.—Mollusca.

Order 1. *Pteropoda.*

No foot for creeping, nor arms for progress or seizing the prey. Two fins opposed and similar, proper for natation. Body free and floating.

Hyalæa. Clio. Cleodora. Limacina. Cymbulia. Pneumodermon.

Order 2. *Gasteropoda.*

Animals with a straight body, never spiral nor enveloped in a shell which can contain the entire animal; having under the belly a foot or muscular disc united to the body nearly throughout its length, and serving for creeping.

Some naked, others protected by a dorsal shell, not imbedded; and others, on the other hand, containing a shell more or less hidden in their mantle.

Section 1. *Hydrobranchiata.*

Branchiæ, whatever be their position, elevated either in a net-work, in laminæ, in a pectinated form, or in a ribbon-like shape. The animals of this section breathe water only.

(*a*) Branchiæ external, placed above the mantle, either on the back or on the sides, and being in no particular cavity.

Family *Tritonidæ.*

Glaucus. Eolis. Tritonia. Scyllæa. Tethys. Doris.

(*b*) Branchiæ placed under the border of the mantle, and disposed in a longitudinal series round the body, or on one side only; not being in any particular cavity.

Family *Phyllididæ.*

Phyllidia. Chitonellus. Chiton. Patella.

Family *Semiphyllididæ.*

Branchiæ placed under the border of the mantle, and disposed in a longitudinal series on the right side of the body only.

Pleurobranchus. Umbrella.

(c) Branchiæ placed in a particular cavity upon the back, situated anteriorly near the neck. Shell always external, and covering the soft parts.

Family *Calyptræidæ.*

Parmophorus. Emarginula. Fissurella. Pileopsis. Calyptræa. Crepidula. Ancylus (?).

(d) Branchiæ placed in a particular cavity towards the posterior part of the back, and covered either by the mantle or by an opercular escutcheon.

(†) No tentacula.

Family *Bullidæ.*

Akera. Bullæa. Bulla.

(††) With tentacula.

Family *Laplysidæ.*

Laplysia. Dolabella.

Section 2. *Pneumobranchiata.*

Branchiæ creeping, in the form of a vascular net-work, on the wall of a particular cavity, the aperture of which is a hole which the animal contracts or dilates at its pleasure. Animals of this sectiou breathe nothing but air.

Family *Limacidæ.*

Onchidium. Parmacella. Limax. Testacella. Vitrina.

Order 3. *Trachelipoda.*

Body spiral in its posterior part, this part being separated from the foot, and always enveloped in the shell. The foot free, flattened, attached to the lower base of the neck, or to the anterior part of the body, and serving for creeping. Shell spirivalve and sheathing (engainante).

Section I. (Phytiphagous.)

Trachelipods without a projecting siphon, and respiring in general by means of a hole. The greater part phytiphagous and furnished with jaws. Shell with the aperture entire, having at its base neither dorsal sub-ascending notch nor canal.

(*) Trachelipods respiring air only. Shell spirivalve, unarmed (mutique), not distinctly nacreous.

Family *Colimacidæ* (terrestrial).

(a) Four tentacles.

Helix. Carocolla. Anostoma. Helicina. Pupa. Clausilia. Bulimus. Achatina. Succinea.

(b) Two tentacles.

Auricula. Cyclostoma.

Family *Limnæidæ.*

Amphibious. Living in the water, but coming to the surface to breathe. Shell with a sharp edge to the lip.

Planorbis. Physa. Lymnæa, or rather *Limnæa.*

(**) Trachelipods breathing water only. Branchiæ projecting in form of filaments, lamiœ or tufts in the brauchial cavity. Shell often nacreous, and often also having protuberant parts on the surface.

(a) Shell fluviatile, operculated, the left border of which does not resemble a demi-partition.

(†) Shell with disunited borders.

Family *Melanidæ.*

Melania. Melanopsis. Pirena.

(††) Shell with united borders.

Family *Peristomidæ.*

Valvata. Paludina. Ampullaria.

(b) Shell fluviatile or marine, whose left border or lip resembles a demi-partition.

Family *Neritidæ.*

Navicella. Neritina (fluviatile). *Nerita. Natica* (marine).

(c) Shell marine, whose left lip does not resemble a demi-partition.

(†) Shell floating at the surface of the water.

Family *Janthinidæ.*

Janthina.

(††) Shell not floating, having the aperture very wide; no columella.

Family *Macrostomidæ.*

Sigaretus. Stomatella. Stomatia. Haliotis.

(†††) Aperture without any particular width; plaits on the columella.

Family *Plicacidæ.*

Tornatella. Pyramidella.

(††††) No plaits on the colnmella.

(a) Borders of the aperture united circularly.

Family *Scalaridæ.*

Vermetus. Scalaria. Delphinula.

(b) Borders of the aperture disunited.

Family *Turbinidæ.*

Solarium. Rotella. Trochus. Monodonta, or rather *Monodon. Turbo. Planaxis. Phasianella. Turritella.*

Section II. (Zoophagous.)

Trachelipods with a projecting siphon, and which only breathe the water which arrives at the branchiæ by means of this siphon. These feed on animal substances only, are marine, have no jaws, and are furnished with a retractile proboscis.

Shell spirivalve, sheathing the soft parts, with an aperture which is either canaliculated, or notched, or turned up at its base.

(a) Shell with a canal more or less long at the base of its aperture, and the right border of whose lip does not change with age.

Family *Canaliferidæ.*

Section 1. No constant bourrelet on the right lip of the species.

Cerithium. Pleurotoma. Turbinella. Cancellaria. Fasciolaria. Fusus. Pyrula.

Section 2. A constant bourrelet on the right lip in all the species.

(α) No bourrelet on the spire.

Struthiolaria.

(β) Bourrelets on the spire.

Ranella. Murex. Triton.

(b) Shell with a canal more or less long at the base of its aperture, and the right border of whose lip changes its form with age, and has a sinus inferiorly.

Pteridæ (Ailées, or Wing-Shells).

Rostellaria. Pterocera, or rather *Pteroceras. Strombus.*

(c) Shell with a short canal, ascending posteriorly, or with an oblique notch at the base of its aperture, this demi-canal being directed towards the back.

Family *Purpuridæ* (Purpurifères).

Section 1. An ascending canal, or recurved towards the back.

Cassidaria. Cassis.

Section 2. An oblique notch directed backwards.

Ricinula. Purpura. Monoceros. Concholepas. Harpa. Dolium. Buccinum. Eburna. Terebra.

(d) No canal at the base of the aperture, but a subdorsal notch and plaits on the columella.

Family *Columellidæ* (Columellaires).

Columella. Mitra. Voluta. Marginella. Volvaria.

(e) Shell without a canal, but having the base of its aperture notched or versant, and the whorls of the spire large, compressed, and enrolled in such a manner that tho last whorl nearly eutirely covers the others.

Family *Convolutidæ* (Enroulées).

Ovula, or rather *Ovulum. Cypræa. Terebellum. Ancillaria. Oliva. Conus.*

Order 4. *Cephalopoda.*

Mantle in form of a sac, containing the lower part of the body. Head projecting from the sac, surrounded by arms, which are not articulated, but furnished with suckers (ventouses), and which environ the mouth; two sessile eyes; two horny mandibles to the mouth; three hearts. Sexes separate.

1st Division.—Polythalamous Cephalopods.

Shell multilocular, enveloped completely or partially, and which is inclosed in the posterior part of the auimal, often with adherence.

(*) Shell multilocular, with simple chambers.

(1) Shell straight or nearly straight; no spiral.

Family *Orthoceratidæ.*

Belemnites. Orthoceras. Nodosaria. Hippurites. Conilites.

(2) Shell partially spiral; last whorl continued in a straight line.

Family *Lituolitidæ.*

Spirula. Spirolina. Lituola.

(3) Shell semi-discoid; spire eccentric.

Family *Cristacidæ.*

Renulina. Cristellaria. Orbiculina.

(4) Shell globulose, spheroidal, or oval, with enveloping whorls or partitions united en tunique.

Family *Spherulidæ.*

Miliola. Gyrogona. Melonia.

(5) Shell discoid, with a central spire, and partitions radiating from the centre to the circumference.

Family *Radiolididæ.*

Rotalia. Lenticulina. Placentula.

(6) Shell discoid, with a central spire, and partitions which do not extend from the centre to the oircumference.

Family *Nautilidæ.*

Discorbis. Siderolites. Polystomella. Vorticialis. Nummulites. Nautilus.

(**) Shell multilocular, with chambers pinked (decoupés at the edges).

Family *Ammonitidæ.*

Ammonites. Orbulites. Ammonoceras. Turrilites. Baculites.

2nd Division.—Monothalamous Cephalopods.

Shell unilocular, entirely external, and enveloping the animal.

Argonauta.

3rd Division.—Sepiary Cephalopods.

No shell, either internal or external. A solid free cretaceous or horny body, contained in the interior of the greater part of the animal.

Octopus. Loligopsis. Loligo. Sepia.

Order 5. *Heteropoda.*

Body free, elongated, swimming horizontally. Head distinct; two eyes. No arms surrounding the head. No feet under the belly or under the throat for creeping. One or more fins, without any regular order, and not disposed by pairs.

Carinaria. Pterotrachea. Phylliroë.

Such was Lamarck's arrangement, as he finally left it, after various modifications in the course of his publications, from the commencement of them to the second edition of his 'Animaux sans Vertèbres.' During that interval many authors had presented their views to the public, and we proceed to notice some of them.

In 1800 M. d'Audebard de Férussac (the father) produced a system of Conchology based on the consideration of the animal and its shell. He introduced some observations on the complete or incomplete state of what he calls the 'spiral cone' of the shell, and the point of attachment of the foot, under the neck or under the belly of the Gastropods. His views were limited to the Terrestrial and Fluviatile Molluscs, or Musculites, as he calls them, and subdivides them into orders almost as numerous as his genera, among which we find *Helicolimax*, forming the passage between the *Limaces* and the *Helices.*

The work of M. Bosc, in the supplements to Buffon (Det., 1802), may be considered as rather of a retrograde character, for it still clung to the system of Linnæus as amended by Bruguière; and, notwithstanding the progress already made, we find him adhering to the terms Molluscous Worms and Testaceous Worms, as designating the Naked and Testaceous *Mollusca.* His divisions were nearly those of Bruguière, though he adopted the new subdivisions which Cuvier and Lamarck had established, and appears to have been conscious of the value of those innovations. Bosc was an observer, and had studied many of the *Mollusca* in a living state. He established many new facts and some new genera.

In 1803 appeared the 'Prodromus' of the work of Draparnaud, which was not published till after his death in 1808, on the Terrestrial and Fluviatile *Mollusca* of France. This work is conceived and executed in a philosophical spirit, and with rational views of a natural system of classification. He abandoned the arbitrary method of Linnæus, and returned to the principle proposed by Réaumer (1711) in his 'Memoir on the Progressive Motions of Shells,' making his classification that of Cuvier.

The 'Natural History of Mollusca,' for Sonnini's edition of Buffon, was hardly commenced by Denys de Montfort, and almost entirely executed by M. De Roissy. The classification is carried out on the principles of Cuvier, but the author differs from Cuvier on some points, as, for instance, in thinking that the section of the Anodons ought not immediately to follow that of the Oysters, and that the aperture which Cuvier regarded as anterior in *Biphora* was really posterior—an opinion in which he is supported by Messrs. Bosc, Péron, De Blainville, Chamisso, and Kuhl. In this work the analogy of the Polythalamous or Chambered Shells is pointed out. M. De Roissy appears to have perceived the passage from the Univalve to the Bivalve Molluscs by means of the *Patellæ*, and he seems to have been the first who placed *Aspergillum* near to *Fistulana*, a position which it still holds.

M. Duméril, in 1806, published, in his 'Zoologie Analytique,' a classification of *Mollusca* nearly similar to that of Cuvier. M. Duméril divides the *Mollusca* into five orders:—*Cephalopoda, Pteropoda, Gasteropoda, Acephala*, and *Brachiopoda.* The principal novelties in this publication were a division of the *Gasteropoda*, according to their organs of respiration, into three families—*Dermobranchiata, Siphonobranchiata*, and *Adelobranchiata*—which correspond nearly to the three divisions established on the structure of the shell; and a separation of the *Brachiopoda* as a distinct order.

In 1808 Denys de Montfort published his 'Univalves Cloisonnées,' and in 1810 the second volume of his 'Conchyliologie Systematique,' containing the 'Univalves non Cloisonnées.' His genera are very numerous, and not many of them are retained at present by zoologists, though they are for the most part neatly defined. His method is only carried out with regard to the Univalves; but his primary division rests upon the number of valves, and is separated into Univalves, Multivalves, and Bivalves, as in the systems of the older conchologists. He differs however in restricting the term Multivalves to shells made up of several united pieces, without any solution of continuity; whilst he applies the term Dissivalves to shells made up of many pieces, but not coherent nor adherent to each other, as *Teredo, Fistulana, Balanus*, &c.

Oken, in 1810, read to the Society of Göttingen a paper upon the knowledge of *Mollusca* apart from their shells and upon a natural classification established upon this basis; and carried out this principle in his 'Manual of Nat. Hist.,' published at Jena in 1816. Our limits will not allow us to do more than call the reader's attention to this work, which he will find well worthy of perusal, though it does not contain any new principle of arrangement, and there is somewhat too much of change of name about his genera, of which there are but few really new. Nor can we do more than hint at the work of M. Rafinesque (Palermo, 1814). About the year 1816 much light was thrown on the Aggregated *Mollusca* by Lesueur, Desmarest, and above all by the great Savigny, and in 1817 M. De Blainville first made known the principles of his system, which he afterwards carried out to its completion. The systems of Goldfuss and Ranzani appeared in the same year, 1820, the first at Nuremberg and the second at Bologna; the first may be regarded as a compilation of the labours of those malacologists who had embraced the natural system; and the basis of the second, as far as the Cirrhipeds are concerned, rests on the structure of the shell and its operculum without regard to the animal, and, as far as relates to the Acephalous Molluscs, does little more than give new denominations to the four sections of that division.

M. De Férussac (the son) divided (1819) the *Mollusca* into two grand sections, the Cephalous and the Acephalous.

Cephalous *Mollusca.*

These are divided into three classes—Cephalopods, Pteropods, and Gastropods.

The first class, Cephalopods, contained the two orders, Decapods and Octopods, as in the arrangement of Dr. Leach. This class in the system of De Férussac embraces all the naked Cephalopods and all the animals with multilocular shells; but was subsequently considerably modified in a joint-work with M. D'Orbigny.

The second class, Pteropods, which originally consisted of the families *Hyalææ, Limacinæ*, the Clios, the Pneumoderms, and the Phyllirhoes, also underwent considerable changes in a subsequent and joint-work with M. Rang.

The third class, Gastropods, are divided into the following orders and sub-orders:—1, Nudibranchians (Anthrobranchians and Polybranchians). 2, Inferobranchians (Phillidians and Semi-Phillidians). 3, Tectibranchians. 4, Pulmonians without an operculum (Geophilians, Gehydrophylians, and Hygrophilians). 5, Operculated Pulmonians. 6, Pectinibranchians (Pomastomes, Hemipomastomes, Apomastomes, and Adeloderms). 7, Scutibranchians, Ormiers (Haliotis, &c.), Calyptracians, Heteropods. 8, Cyclobranchians (Chismobranchians and Polyplaxiphores).

Acephalous *Mollusca.*

These are divided into four classes—Cirripedes, Brachiopods, Lamellibranchians, and Tuniciers.

The first, Cirripedes, is divided into the orders—Sessile Cirripedes and Pedunculated Cirripedes.

The second, Brachiopods, contains the three families *Lingulidæ, Terebratulidæ*, and *Cranidæ.*

The third, Lamellibranchians, comprehends five orders—the Ostraceans, Mytilaceans, Benetiers (*Tridacna* and *Hippopus*), the Cardiaceans, and the Enfermés (*Myidæ, Solenidæ, Pholidæ*, and *Tubicolidæ*).

The fourth, Tuniciers, consists of the two orders Tethid Ascidians (*Tethidæ* and the Pyrosomes) and Thalid Ascidians (*Biphora*, &c.).

In England Dr. Leach had been active in introducing a natural system, as appears from his published papers, descriptions, and works. He had it in contemplation to publish a general history of English *Mollusca*; but the most distressing of maladies deprived zoology of one of its most zealous cultivators, and the work has never appeared.

Dr. J. E. Gray published in the 'London Medical Repository' (1821), his system, which divides the *Mollusca* (taken in the largest sense of the word) into seven classes.

The first, *Antliobrachiophora* (Cephalopods), consists of three orders—*Anostcophora, Sepiæphora*, and *Nautilophora.*

The second, *Gasteropodophora*, is divided into three sub-classes—*Pneumobranchia, Cryptobranchia*, and *Gymnobranchia.*

The first of these Sub-classes contains two orders—*Adelopneumona* and *Phaneropneumona.* The second embraces nine orders—the *Ctenobranchia*, which are divided into six sections by the application of a new principle, namely, the form of the operculum: the *Trachelobranchia*; the *Monopleurobranchia*; the *Notobranchia*; the *Chismatobranchia*; the *Dicranobranchia*; the *Cyclobranchia*; the *Polyplacophora*; and the *Dipleurobranchia.* The third class consists of two orders—*Pygobranchia* and *Polybranchia.*

Dr. Gray's third class, *Gasteropterophora*, corresponds with the *Heteropoda* of Lamarck, and is similar to M. De Blainville's order *Nucleobranchiata.*

The fourth class, *Stomatopterophora*, corresponding with the *Pteropoda*, contains two orders, *Pterobranchia* and *Dactyliobranchia.*

The fifth class, *Saccophora* (Tuniciers of Lamarck), consists of three orders—*Holobranchia*, *Tomobranchia*, and *Diphyllobranchia*.

The sixth, *Conchophora*, consists of orders depending on the number of muscular impressions, and denominated from the form of the foot, as *Cladopoda*, *Leptopoda*, *Phyllopoda*, *Pogonopoda*, and *Micropoda*.

The seventh, *Spirobrachiophora*, corresponds with the *Brachiopoda*.

M. De Blainville, who in 1814 had published his first sketch of a methodical arrangement of the *Malacozoa*, as he designates the animals on which we are treating, still further developed that method in 1817 in his 'Prodromus' of a general classification of the animal kingdom. The organ upon which that arrangement is based is the organ of respiration, and it was finally perfected in the method which appeared in his 'Manuel de Malacologie' (1825). We here give an outline of it.

Type.—MALACOZOA.

Class I.—*Cephalophora.*

Order 1. *Cryptodibranchiata.*

Family 1. *Octocera*, containing the genus *Octopus*, which includes *Eledone* (Leach) and *Ocythoe* (Rafinesque).

Family 2. *Decacera*, including the genus *Loligo* (*Sepiola* and *Cranchia*, Leach. *Onychotenthis*, Lichtenst., the Sagittated Calamaries, *Pteroteuthis*, *Sepioteuthis*), and the genera *Sepia*, *Beloptera*.

Order 2. *Cellulacea.*

Family 1. *Spherulacea*, consisting of the genus *Miliola*, including Pollontes of De Montfort; *Melonia*, including *Borelis* of De Montfort; *Saracenaria*; and *Textularia*.

Family 2. *Planulacea*, comprising *Renulina*, including *Frondicularia* of Defrance; and *Peneroplis*, including *Planularia* of Defrance.

Family 3. *Nummulacea*, containing *Nummulites*, including *Lycophris* of De Montf.; *Helicites*, including *Rotalites* and *Egeon* of De Montf.; *Siderolites*, including *Tinoporus* and *Siderolithes* of De Montf.; *Orbiculina*, including *Flotes*, *Helenis*, and *Archaias* of the same; *Placentula*, including *Eponides* and *Florilus* of the same; and *Vorticialis*, including *Themeon*, *Sporilus*, and *Andromedes* of the same.

Order 3. *Polythalamacea.*

Family 1. *Orthoccrata.* Genera *a.* (with simple chambers or partitions), *Belemnites*, including *Callirhöe*, *Hibolithes*, *Porodragus*, *Cetocis*, *Acamas*, and *Paclites* of De Montf.; *Conularia*; *Conilites*, including *Achelois*, *Amimonus*, and *Thalamus* of the same; *Orthoceras*, including *Nodosaria* (Lam.), *Reophax*, and *Molossus* of De Montf.; *b.* (with sinuous chambers), *Baculites*, including *Tiranites* of the same.

Family 2. *Lituacea.* Genera *a.* (with simple chambers), *Ichthyosarcolithes*; *Lituola*; *Spirula*, including *Hortolus* and *Lituites* of De Montf., and *Spirolina* of Lam. *b.* (with sinuous chambers), *Hamites* and *Ammonoceratita.*

Family 3. *Cristacea.* Genera, *Crepidulina*, including *Astacolus*, *Cancris*, and *Periples* of De Montf.; *Oreas*; and *Linthuris*.

Family 4. *Ammonacea.* Genera *Discorbites*; *Scaphites*; *Ammonites*; and *Simplegas*, including *Ammonites*, *Planulites*, and *Amaltheus* of De Montf.

Family 5. *Nautilacea.* Genera, *Orbulites*, including *Aganides* and *Pelagus* of De Montf.; *Nautilus*, including *Angulithes*, *Oceanus*, and *Bisiphytes* of the same; *Polystomella*, including *Geophonus*, *Pelorus*, *Elphidium*, *Phonemus*, *Chrysolus*, and *Melonis* of the same; *Lenticulina*, including *Patrocles*, *Nonion*, *Macrodites*, *Robulus*, *Lampas*, *Pharamum*, *Antenor*, *Clisiphontes*, *Rhinocurus*, *Herion*, and *Spincterules* of the same.

Family 6. *Turbinacea.* Genera, *Cibicides*; *Rotalites*, including *Storilus*, *Cidarollus*, and *Cortalus* of De Montf.

Family 7. *Turriculacea.* Genus, *Turrilites.*

Class II.—*Paracephalophora.*

Sub-Class I.—*Paracephalophora Dioica* (Aquatic, but capable of living for some time out of water).

Section 1. Organs of respiration, and shell non-symmetrical, and almost constantly turned spirally from left to right.

Order 1.—*Siphonobranchiata.*

Family 1. *Siphonostomata* (*Murex*, Linn.). Genera (no persistent bourrelet on the right lip), *Pleurotoma*, including *Clavatula*, Lam.; *Rostellaria*, including *Hippochrenes* of De Montf.; *Fusus*, including *Latirus* of De Montf.; *Pyrula*, including *Fulgur* of De Montf., and *Melongena*, and *Rapana* of Schum.; *Fasciolaria*; *Turbinella*, including *Polygonum* of Schum.; *Triton*, including *Lotorium*, *Aquillus*, and *Persona* of De Montf., and *Struthiolaria* of Lam.; *Ranella*, including *Buffo* and *Apollon* of De Montf.; *Murex*, including *Brontes*, *Chicoreus*, *Typhis*, and *Phos* of the same.

Family 2. *Entomostomata* (*Buccinum*, Linn.). Genera, *a.* (Turriculated Entomostomes), *Cerithium*, including *Vertagus* of Schum.; *Triphora*, or *Tristoma*, of Deshayes; *Nériné* of Defrance, *Potamides* of Brongniart, *Pyrazus* of De Montf., and *Pirena* of Lam.; *Melanopsis*; *Planaxis*; *Subula.* *b.* (Turbinaceous Entomostomes, or those whose spire is moderately elongated and rarely subturriculated), *Terebra*; *Eburna*; *Buccinum*, including *Alectrion* and *Cyclops* of De Montf., and *Nassa* of Lam. *c.* (Ampullaceous Entomostomes, or those whose shell is in general globulous), *Harpa*; *Dolium*, including *Perdix* of De Montf.; *Cassidaria*, including *Oniscia* of Sowerby; *Cassis*; *Ricinula*, including *Sistrum* of De Montf.; *Cancellaria*; *Purpura*, including *Monoceros* of De Montf. *d.* (Patteloid Entomostomes, or those whose shell is in its totality very wide, very flat, with a spire but little marked, and no columella), *Concholepas.*

Family 3. *Angyostomata.* Genera, *a.* (an operculum), *Strombus*, including *Pterocerus* of Lam.; *Conus*, including *Rhombus*, *Cylinder*, *Rollus*, and *Hermes* of De Montf. *b.* (no operculum), *Terebellum*, including *Seraphs* of De Montf.; *Oliva*; *Ancillaria*; *Mitra*, including *Turris* of De Montf.; *Imbricaria* of Schum., and *Conœlix* of Swainson; *Voluta*, including *Turbinellus* of Oken and *Cymbium* of De Montf.; *Marginella*, including *Volvaria* of Lam.; *Peribolus*; *Cypræa*; *Ovula*, including *Calpurnus*, *Ultimus*, and *Radius* of De Montf.

Order 2. *Asiphonobranchiata.*

Family 1. *Goniostomata* (*Trochus*, Linn.). Geuera, *Solarium*, including *Maclurites* of Lesueur and *Euomphalus* of Sowerby; *Trochus*, including *Infundibulum*, *Phorus*, *Calcar*, *Tectus*, *Telescopium*, and *Cantharidus* of De Montf., and *Rotella* of Lam.

Family 2. *Cricostomata* (*Turbo*, Linn.). Genera, *Turbo*, including *Clanculus* and *Meleagris* of De Montf.; *Labio* of Oken, *Monodonta* of Lam., and *Littorina* of De Férussac; *Pleurotomarium*; *Delphinula*, including *Trigonostoma*; *Turritella*; *Proto*; *Scalaria*, including *Aciona* of Leach; *Vermetus*; *Siliquaria*; *Magilus*; *Valvata*; *Cyclostoma*, including *Cyclophorus* of De Montf.; and *Paludina.*

Family 3. *Ellipsostomata.* Genera, *Melania*; *Rissoa*, including *Alvania* of Risso; *Phasianella*; *Ampullaria*, including *Lanistes* of De Montf.; *Helicina*, including *Ampullina* and *Olygira* of Say; *Pleurocerus*, including *Oxytrème* of Rafinesque.

Family 4. *Hemicyclostoma* (*Nerita*, Linn.). Genera, *Natica*, including *Polinices* of De Montf.; *Nerita.* *a.* (right lip dentated, *Nerita*, Lam.), *Peloronta* of Oken; and *Clithon* of De Montf. *b.* (right lip not toothed), *Neritina*, Lam.; *Velates*, De Montf.; *Pileolus*, Sowerby; *Septaria.*

Family 5. *Oxystoma.* Genus, *Janthina.*

Sub-Class II.—*Paracephalophora Monoica.*

Section I. Organs of Respiratiou, and Shell, where it exists, non-symmetrical.

Order 1. *Pulmobranchiata.*

Family 1. *Limnacea.* Genera, *Limnæa*, including *Radix* of De Montfort and *Omphiscola* of Rafinesque; *Physa*; *Planorbis.*

Family 2. *Auriculacea* (*Voluta*, pars, Linn.). Genera, *Pedipes*, including *Tornatella* and *Conovulus*, Lam.; *Auricula*, iucluding *Scarabus* of De Montf., *Carychium* of Müll., and *Phytia* of Gray; *Pyrimidella.*

Family 3. *Limacinea* (*Helix*, Linn., terrestrial). *a.* (anterior border of the mantle elevated into a roll—hourrelet—and not a buckler; a shell). Genera, *Succinea*, including *Amphibulimus*, Lam.; *Bulimus*, including *Bulimulus*, Leach; *Achatina*, including *Liguus* and *Polyphemus* of De Montf.; *Clausilia*; *Pupa*, including *Chondrus* of Cuvier, *Gibbus* of De Montf., *Vertigo* of Müll., and *Partula* of De Féruss.; *Tomogeres* (*Anostoma*, Lam.); *Helix*, *a.* (circumference of the shell constantly carinated or subcarinated at all ages, *Carocolla*, Lam.), including *Iberus*, *Caracolus*, *Acavus*, and *Zonites* of De Montf., and *Helicella* of Lam. *b.* (anterior border of the mantle enlarged into a kind of buckler; shell null or nearly membranous), *Helicolimax*, including *Helicarion* of De Féruss.; *Testacella*; *Parmacella*; *Limacella*; *Limax*, including *Arion* of De Féruss.; Philomique and Eumèle of Rafin.; *Onchidium*, including *Veronicella* of De Blainv.

Order 2. *Chismobranchiata.*

Genera, *Coriocella*, *Sigaretus*, *Cryptostoma*, *Oxinöe*, *Stomatella*, *Velutina.*

Order 3. *Monopleurobranchiata.*

Family 1. *Subaplysiacea.* Genera, *Berthella*; *Pleurobranchus*; and *Pleurobranchidium.*

Family 2. *Aplysiacea.* Genera, *Aplysia*, including *Acteon* of Oken; *Dolabella*; *Bursatella*; *Notarchus*; and *Elysia.*

Family 3. *Patelloidea.* Genera, *Umbrella* (*Acardo* of Megerle); *Siphonaria*; and *Tylodina.*

Family 4. *Akera.* Genera, *Bulla* (including *Aplustre* of Schum., and *Atys* and *Scaphander* of De Montf.; *Bellerophus*; *Bullæa*; *Lobaria*; *Sormetus*; *Gasteroptera*; and *Atlas.*

Section II.

Order 1. *Aporobranchiata.*

Family 1. *Thecosomata.* Genera, *Hyalæa*; *Cleodora*, including *Vaginella* of Daudin and *Styliola* of Lesueur; *Cymbulia*, including *Argivora* of Lesueur; and *Pyrgo.*

Family 2. *Gymnosomata.* Genera, *Clio*, including *Cliodites*, Quoy and Gaimard; and *Pneumoderma.*

Family 3. *Psilosomata.* Genus, *Phylliroe.*

Order 2. *Polybranchiata.*

Family 1. *Tetracerata.* Genera, *Glaucus*; *Laniogerus*; *Tergipes*; *Cavolina*; *Eolida*; *Dermatobranchus*; and *Placobranchus.*

Family 2. *Dicerata.* Genera, *Scyllæa*; *Tritonia*; and *Tethys.*

Order 3. *Cyclobranchiata.*

Genera, *Doris*, including *Polycera* of Cuvier; *Onchidoris*; and *Peronia*.

Order 4. *Inferobranchiata.*

Genera, *Phyllidia* and *Linguella*.

Order 5. *Nucleobranchiata.*

Family 1. *Nectopoda.* Genera, *Pterotrachea*, including *Firola*, *Firoloides*, and *Sagitella* of Lesueur; and *Carinaria*.
Family 2. *Pteropoda.* Genera, *Atlanta*, *Spiratella*, and *Argonauta*.

Sub-Class III.—*Paracephalophora Hermaphrodita* (*Patella*, Linn.).

Section I. Organs of Respiration and Shell symmetrical.

Order 1. *Cirrhobranchiata.*

Genus, *Dentalium*, including *Entale* of Defrance.

Order 2. *Cervicobranchiata.*

Family 1. *Retifera.* Genus *Patella*, including *Helcion* of De Montf.
Family 2. *Branchifera.* Genera, *Fissurella*; *Emarginula*, including *Rimula* of Defrance; and *Parmophorus*.

Section II. Organs of Respiration and Shell non-symmetrical.

Order 3. *Scutibranchiata.*

Family 1. *Otidea.* Genera, *Haliotis*, including *Padollus* of De Montf., and *Stomatia* of Lam.; and *Ancylus*.
Family 2. *Calyptracea.* Genera, *Crepidula*; *Calyptræa*; *Capulus*; *Hipponyx*; and *Notrema*.

Class III.—*Acephalophora.*

Order 1. *Palliobranchiata.*

Section I. Shell symmetrical.

Genera, *Lingula*; *Terebratula*, including *Pentamerus*, *Spirifer*, and *Productus*, Sow.; *Strygocephalus*, Defr.; and *Magas*; *Thecidea*; *Strophomena*; *Pachytes*; *Dianchora*; and *Podopsis*.

Section II. Shell non-symmetrical, irregular, constantly adherent.

Genera, *Orbicula*, including *Discina*, Lam., and *Crania*.

Order 2. *Rudista.*

Genera, *Spherulites*; *Hippurites*; *Radiolites*; *Birostrites*, including *Iodamia* of Defr.; and *Calceola*.

Order 3. *Lamellibranchiata.*

Family 1. *Ostracea.* Genera, *Anomia*; *Placuna*; *Harpax*; *Ostrea*; and *Gryphæa*.
Family 2. *Subostracea* (*Ostrea*, Linn.). Genera, *Ostrea*; *Spondylus*; *Plicatula*; *Hinnites*; *Pecten*, including *Amusium* and *Pandora* of Megerle, and *Neithea* of Drouet; *Pedum*; and *Lima*.
Family 3. *Margaritacea.* Genera, *Vulsella*; *Malleus*; *Perna*; *Crenatula*; *Inoceramus*; *Catillus*; *Pulvinites*; *Gervillia*; and *Avicula*, including *Margaritiphora* of Megerle, *Margarita*, Leach, *Meleagrina*, Lamarck.
Family 4. *Mytilacea.* Genera, *Mytilus*, including *Modiola* and *Lithodomus* (*Lithophaga* of Megerle); *Pinna*.
Family 5. *Polyodonta*, or *Arcacea* (*Arca*, Linn.). Genera, *Arca*, including *Trisis* of Oken, and *Cucullæa* of Lam.; *Pectunculus*; and *Nucula*.
Family 6. *Submytilacea.* *a.* (Species with an epidermis and nacreous; freshwater). Genera, *Anodonta*, including *Berpolis*, Leach, *Iridina*, Lam., *Dipsas* of Leach, *Alasmisodonta* of Say, and *Cristaria* of Schum.; *Unio*, including *Hyria* and *Castalia* of Lam. *b.* (Species without an evident epidermis, not nacreous, and more or less pectinated; marine). *Cardita*, including *Venericardia* and *Cyprieardia* of Lamarck.
Family 7. *Chamacea.* *a.* (Shell irregular).—Genera, *Chama*, including *Chamostrea* of De Roissy; *Diceras*; *Etheria*. *b.* (Shell regular). *Tridacna*, including *Hippopus*, *Isocardia*; *Trigonia*, including *Opis* of Defrance.
Family 8. *Conchacea.*
Section 1. Regular *Conchacea*, with lateral distant teeth. Genera, *Cardium*, including *Hemicardium*; *Donax*, including *Capsa*, Lam.; *Tellina*, including *Tellinides*, Lam.; *Lucina*, including *Loripes* of Poli, *Amphidesma* of Lam., *Fimbria* of Megerle, *Corbis* of Cuvier; *Cyclas*, including *Cornea*, *Corbicula*, and *Pisum* of Megerle, *Cyrena* and *Galathæa* of Lam.; *Cyprina*; *Mactra*; and *Erycina*.
Section 2. Regular *Conchacea*, without lateral distant teeth; *Crassatella*; *Venus*, including *Arthemis* of Poli, *Venus*, *Cytheræa*, and *Crassina* of Lam. (*Astarte* of Sowerby, *Nicania*, Leach), *Triquetra* of De Blainville, and *Macoma* of Leach.
Section 3. Irregular *Conchacea*; *Venerupis*, including *Rupellaria* of Fl. de Bell., and *Petricola* of Lam.; *Coralliophaga*; *Clotho*; and *Ungulina*.
Family 9. *Pyloridea.*
Section 1. Ligament internal. Genera: *a. Corbula*; *Sphæna*; *Osteodesma*, including *Rupicola* of Fl. de Bell.; *Thracia*; *Hemicyclostoma*; and *Anatina*. *b. Mya*, including *Erodona* of Daudin; *Lutricola*, including *Ligula* of Leach, and *Lutraria* of Lamarck.
Section 2. Ligament external and convex.—*Psammocola*, including *Psammobia* and *Psammotea* of Lam.; *Soletellina*; *Sanguinolaria*; *Solecurtus*; *Solen*; *Solemya*; *Glycimera*, including *Myoconcha* (?), *Panopæa*, *Saxicava*, *Byssomya*, *Rhomboides*; *Hiatella*, including *Biapholius* of Leach; *Gastrochæna*; *Clavagella*; and *Aspergillum*.
Family 10. *Adesmacea.* Genera, *Pholas*, including *Martesia* of Leach; *Teredina*; *Teredo*; *Fistulana*; and *Septaria*.

Order 4. *Heterobranchiata.*

Family 1. *Ascidiacea* (*Ascidia*, Linn.).
Tribe 1. Simple Ascidians. Genera, *Ascidia*; *Bipapillaria*; *Fodia*.
Tribe 2. Aggregated Ascidians. Genera, *Pyura*; *Distoma*, including *Sigellina* of Savig.; *Botryllus*, including *Diazoma* and *Polyclina* of Savig., and *Polycyclus* and *Botryllus* of Lam.; *Synoicum*, including *Enocœlium*, *Didermum*, and *Aplidium* of Savig., and *Pulmonella* of Lam.
Family 2. *Salpacea.*
Tribe 1. Simple Salpians. Genus, *Salpa*, including the genera *Monophore* and *Timorienne* of Quoy and Gaimard.
Tribe 2. Aggregated Salpians. Genus *Pyrosoma*.

Sub-Type Malentozoaria.

Class I.—*Nematopoda.*

Family 1. *Lepadicea.* Genera, *Lepas*; *Gymnolepas*, including *Otion* and *Cineras* of Leach; *Pentalepas*, including *Pentalasmis* and *Pollicipes* of Leach; *Polylepas*, including *Scalpellum* of Leach; and *Litholepas*.
Family 2. *Balanidea* (*Balanus*, Brug.).
a. Operculum articulated, and more or less vertical. Genera, *Balanus*, including *Acasta* of Leach; *Ochthosia*; *Conia*, including *Asemus* of Ranzani; *Creusia*, including *Pyrgonia* of Savig.; and *Chthalamus*.
b. Operculum not articulated, and more or less horizontal. Genus, *Coronula*, including the genera *Chelodobia* of Leach, *Cetopira* and *Diadema* of Ranzani, and *Tubicinella* of Lam.

Class II.—*Polyplaxiphora.* (*Chiton*, Linn.)

Genus, *Chiton*, including the genera *Chitonellus* of Lam., and *Chitonellus* of De Blainv.

Our limits will not allow us to do more than refer to the systems of Schumacher, Latreille, and Rang, though they will, the latter especially—which is in many respects a happy combination of the systems of Cuvier, Lamarck, and De Blainville, with some alterations—well repay the student for their perusal.

The recent publication of the work of Professor Edward Forbes and Mr. Sylvanus Hanley on the 'British Mollusca,' enables us to give the classification adopted in that work, and also the names of the British genera of *Mollusca*:—

Acephala Tunicata.

Botryllidæ, or True Compound Ascidians.—*Aplidium. Sidnyum. Polyclinum. Amouroucium. Leptoclinum. Distoma. Botryllus. Botrylloides.*
Clavelinidæ, or Social Ascidians.—*Clavelina. Perophora. Syntethys.*
Ascidiadæ.—*Ascidia. Molgula. Cynthia.*
Pelonaiadæ.—*Pelonaia.*
Salpidæ.—*Salpa. Appendicularia.*

Acephala Lamellibranchiata.

Pholadidæ.—*Teredo. Xylophaga. Pholas. Pholadidea.*
Gastrochænidæ.—*Gastrochæna. Saxicava. Petricola. Venerupis.*
Myadæ.—*Mya. Panopæa.*
Corbulidæ.—*Corbula. Neæra. Poromya.*
Pandoridæ.—*Pandora. Lyonsia.*
Anatinidæ.—*Thracia. Cochlodesma.*
Solenidæ.—*Solen.*
Solecurtidæ.—*Ceratisolen. Solecurtus.*
Tellinidæ.—*Psammobia. Diodonta. Tellina. Syndosmya. Scrobicularia.*
Donacidæ.—*Donax. Ervelia.*
Mactridæ.—*Mactra. Lutraria.*
Veneridæ.—*Tapes. Cytherea. Venus. Artemis. Lucenopsis.*
Cyprinidæ.—*Cyprina. Circe. Astarte. Isocardia.*
Cardiadæ.—*Cardium.*
Lucinidæ.—*Lucinia. Diplodonta.*
Kelliadæ.—*Montacuta. Turtonia. Kellia. Lepton. Galeomma.*
Cycladidæ.—*Cyclas. Pisidium.*
Unionidæ.—*Unio. Anodonta.*
Mytilidæ.—*Dreissena. Mytilus. Modiola, Crenella.*
Arcadæ.—*Nucula. Leda. Arca. Pectunculus.*
Aviculaceæ.—*Avicula. Pinna.*
Ostreadæ.—*Lima. Pecten. Ostrea. Anomia.*

Acephala Palliobranchiata, or Brachiopoda.

Terebratulidæ.—*Hypothyris. Terebratula. Argiope.*
Craniadæ.—*Crania.*

Lamellibranchiata.

Pteropoda.—*Hyalea. Spiralis.*

GASTEROPODA PROSOBRANCHIATA.

CHITONIDÆ.—*Chiton.*
PATELLIDÆ.—*Patella. Acmæa. Pilidium. Propilidium.*
DENTALIADÆ.—*Dentalium.*
CALYPTRÆIDÆ.—*Pilcopsis. Calyptræa.*
FISSURELLIDÆ.—*Fissurella. Puncturella. Emarginula.*
HALIOTIDÆ.—*Haliotis.*
TROCHIDÆ.—*Trochus. Phasianella. Adeorbis. Scipurella.*
JANTHINIDÆ.—*Janthina.*
NERITIDÆ.—*Neritina.*
PALUDINIDÆ.—*Paludina. Bithuria. Valvata.*
LITTORINIDÆ.—*Littorina. Lacuna. Assiminea. Rissoa. Jeffreysia. Skenea.*
TURRITELLIDÆ.—*Turritella. Cœcum.*
CERITHIADÆ.—*Aporrhais. Cerithium.*
SCALARIADÆ.—*Scalaria.*
PYRAMIDELLIDÆ.—*Aclis. Stylifer. Eulima. Chemnitzia. Odostomia. Eulimella. Truncatella. Otina.*
NATICIDÆ.—*Natica.*
VELUTINIDÆ.—*Velutina. Lamellaria.*
CANCELLARIADÆ.—*Trichotropis. Cerithiopsis.*
MURICIDÆ.—*Murex. Lachesis. Purpura. Nassa. Buccinum. Fusus. Trophon.*
CONIDÆ.—*Mangelia.*
CYPRÆADÆ.—*Cypræa. Ovula. Marginella.*

GASTEROPODA OPISTHOBRANCHIATA.

BULLIDÆ.—*Cylichna. Amphisphyra. Tornatella. Akera. Bulla. Scaphander. Philine.*
APLYSIADÆ.—*Aplysia.*
PLEUROBRANCHIDÆ.—*Pleurobranchus.*
DORIDIDÆ.—*Doris. Goniodoris. Triopa. Ægirus. Thecacera. Polycera. Idalia. Aucula.*
TRITONIADÆ.—*Tritonia. Scyllæa.*
EOLIDIDÆ.—*Lomonotus. Dendronotus. Doto. Oithona. Eolis. Embletonia. Proctonotus. Antiopa. Hermæa. Alderia. Runcina. Limapontia. Acteonia. Cenia.*

GASTEROPODA PULMONIFERA.

ONCHIDIADÆ.—*Onchidium.*
LIMACIDÆ.—*Arion. Geomalacus. Limax.*
TESTACELLIDÆ.—*Testacella.*
HELICIDÆ.—*Vitrina. Zonites. Helix. Bulimus. Pupa. Balea. Clausilia. Zua. Azeca. Achatina. Succinea.*
LIMNÆADÆ.—*Physa. Planorbis. Limnæus. Ancylus.*
AURICULIDÆ.—*Conovulus. Carychium.*
CYCLOSTOMIDÆ.—*Cyclostoma. Acme.*

CEPHALOPODA DIBRANCHIATA.

OCTOPODIDÆ.—*Octopus. Eledone.*
TEUTHIDÆ.—*Sepiola. Rossia. Loligo. Ommastrephes.*
SEPIADÆ.—*Sepia.*

The organisation of the animals above treated of will be found under the titles CEPHALOPODA, CONCHIFERA, GASTEROPODA, MOLLUSCA, and many of the families and genera.

MALACONE. [ZIRCON.]

MALACOPTERY'GII, according to Cuvier, the second great division, or order, of Osseous Fishes, the species of which are distinguished by all the rays of the fins being soft and cartilaginous; exhibiting minute articulations and often divided into small fibres at their extremities. It frequently happens however that the anterior ray of the dorsal or of the pectoral fins is hard and bony, a character observable in nearly all the species of the *Siluridæ*, and in many belonging to other families.

The greater portion of the fishes of this order have the scales formed of simple laminæ and with smooth margins; in this respect differing from the species of the *Percidæ*, *Sciænidæ*, &c., in which the edges of the scales are pectinated or serrated. The *Pleuronectidæ*, or Flat-Fishes, however present the latter structure of scale; and yet, according to Cuvier, are placed in the *Malacopterygii*. M. Agassiz, on this account removes this group to another section, and he also arranges the *Siluridæ* in another group, owing to the structure of their scales. [SILURIDÆ.]

The *Malacopterygii* are divided into three sections. First, the *Abdominales*, in which the ventral fins are situated in the abdomen, far behind the pectorals. In the second section (*Subbrachiales*) the ventral fins are situated immediately beneath the pectorals, and the pelvis is suspended to the bones of the shoulder. In the third section (*Apodes*) the ventrals are wanting.

The section *Abdominales* contains the following families:—1. *Cyprinidæ*, or fishes allied to the Carp, such as Barbel, Gudgeon, Teuch, Bream, Roach, &c. [CYPRINIDÆ.] 2. *Esocidæ*, of which the Common Pike may be regarded as the type. [ESOCIDÆ.] 3. *Siluridæ*, a family of which there are no representatives in this country, at least not well authenticated. [SILURIDÆ.] 4. *Salmonidæ*, or fishes of the Salmon Tribe. [SALMONIDÆ.] 5. *Clupeidæ*, of which we have familiar examples in the Herring, Sprat, Whitebait, Pilchard, Shad, &c. [CLUPEIDÆ.]

The section *Subbrachiales* contains the families *Gadidæ* (Cod-Fish, Haddock, Whiting, Ling, &c.) [GADIDÆ]; the *Pleuronectidæ*, or Flat-Fishes, such as the Flounder, Halibut, Sole, &c. [PLEURONECTIDÆ]; the *Discoboli*, of which family the common Lump-Fish will furnish an example [DISCOBOLI]; and, finally, the *Echeneididæ*, containing the species of *Remora*. [ECHENEIS.]

The third section (*Apodes*) contains the Eels, Lance-Fishes, &c.

MALACORHYNCHUS. [DUCKS.]

MALACO'STRACA (Μαλακόστρακα), a term employed by Aristotle to designated the *Crustacca* generally, but confined by Dr. Leach in his arrangement to the second order of the class.

The *Malacostraca* of Leach are divided into three tribes:—

1. *Brachyuri*, including the families *Canceridæ* and *Oxyrhyncidæ*.
2. *Macrouri*, including the families *Paguridæ*, *Palinuridæ*, *Astacidæ*, and *Squillidæ*.
3. *Gasteruri*, including the families *Gnathidæ*, *Gammaridæ*, *Corophiidæ*, *Caprellidæ*, and *Apseudiidæ*. [CRUSTACEA.]

MALACO'TA, Schumacher's name for a genus of Cirrhipeds, *Otion* of Leach. [CIRRIPEDIA.]

MALACOZOA. [MALACOLOGY.]

MA'LAXIS, a genus of Plants belonging to the natural order *Orchidaceæ*, and to the tribe *Malaxideæ*. It has a patent perianth, the lip posterior, erect, entire, similar to the petals and smaller than the sepals; the spur absent; the stigma rhomboidal; the rostellum short, entire, acute; the anthers terminal, continuous with the short column, out of the apex of which it appears as if it were excavated with two imperfect cells; the pollen-masses connected at their apex; the germen upon a twisted stalk.

Of this genus there is one British representative, *M. paludosa*. It is a small plant, with a stem from one to four inches in height. The leaves are remarkable for being fringed at the end with bulbous gemmæ or leaf-buds. It is a native of spongy bogs, where it grows upon the moss, in the character of an epiphyte, and not amongst it as other bog-plants.

MALDANIDÆ, or *Maldanians*, the second family of Sedentary Annelids in Lamarck's system, including *Clymene* and *Dentalium*, which last is not an Anuelid, according to the latest and best authorities, but a Mollusc. [DENTALUM.] Savigny established the family.

MALE FERN. [ASPIDIUM.]

MALENTOZOA'RIA, Articulated *Mollusca*, the second sub-type in the system of M. De Blainville. [MALACOLOGY.]

MALESHERBIA'CEÆ, *Crownworts*, a natural order of Polypetalous Exogenous Plants, with a tubular inflated inferior calyx, within the throat of which are inserted five petals, five or ten stamens, and a short rim or crown of the same nature as that of *Passifloraceæ*, but more rudimentary. The ovary is stipitate, superior, 1-celled, with parietal or free placentation. The order is therefore nearly allied to *Passifloraceæ*, from which however it differs in habit. The species are in many cases remarkable for the beauty of their yellow or blue flowers, and have been cultivated in this country, their seeds having been brought from Chili. They are however seldom seen, and are of no known use.

MALLARD. [DUCKS.]

MALLEA'CEA, or MA'LLEIDÆ, a family of Monomyarian *Conchifera* according to the system of Lamarck, most of the genera of which are to be found in the family *Margaritacea* of De Blainville. They belong to the *Ostracea* of Cuvier, and the Oxygones of Latreille. Lamarck makes the family consist of five genera only—*Crenatula*, *Perna*, *Malleus*, *Avicula*, and *Meleagrina*. It has the following characters:—

Animal, with the mantle non-adherent, entirely open in its whole circumference, without tube or particular opening, prolonged into irregular lobes, especially backwards; foot canaliculated, and almost always furnished with a byssus.

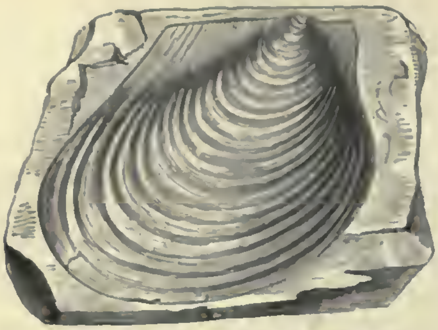
Shell black or horn-colour, inequivalve, inequilateral, very irregular; hinge without teeth; marginal ligament sublinear, simple, or interrupted by crenulations; muscular impression subcentral, fixed generally by a byssus furnished by the animal.

M. Raug places the fossil genus *Posidonia* at the head of the family, so that the position of that genus is approximated to *Lima*, which is arranged as the last of the *Pectinidæ*.

Posidonia (Bronn).—Animal unknown. Shell very delicate, nearly membranous, equivalve, inequilateral, oblique, rounded, not gaping (?); cardinal border straight, a little prolonged on each side, so as to be auriculated; hinge toothless; no pit for the ligaments; nor passage for a byssus.

M. Rang remarks that this genus had been established in 1829 for impressions sufficiently common in the schists of Dillemburg, and which some naturalists had been tempted to refer to rudimentary shells of *Aplysia* or *Pleurobranchus*. M. Rang agrees with M. Bronn in opinion that these are the impressions of bivalve shells, and assigns to *Posidonia* the position above stated. M. Deshayes however, in the last edition of Lamarck (1836), does not mention the genus among the *Malleacca*.

Vulsella (Lam.).—Animal elongated, compressed; mantle very much prolonged backwards, and bordered with two rows of papillary tubercles which are very close set; foot small, canaliculated, without a byssus; mouth large; labial appendages very much developed and



Posidonia. From specimens in Irish limestone.

triangular; branchiæ narrow, very long, and united nearly throughout their extent.

Shell subcorneous, delicate, elongated, flattened, irregular, inequilateral, subequivalve, the umbones nearly anterior, distant, and a little recurved; hinge toothless, and offering simply on each valve a projecting calosity comprehending a pit for the insertion of the ligament; muscular impression subcentral.

The species are found in the seas of warm climates, where the species, none of which are furnished with a byssus, are found in *Alcyonia*, Sponges, &c.

V. lingulata may be taken as an example. It is found in the East Indian Ocean.

Vulsella lingulata.

a, Valves closed; *b*, inside view of valve, showing the hinge and muscular impression.

Crenatula (Lam.)—Animal not known, but very probably bearing a close relation to that of *Perna*. Shell foliated, flattened, subequivalve, inequilateral, irregular, a little gaping behind, but without any aperture for a byssus; hinge linear, marginal, marked with serial crenulations, which are callous and hollowed into rounded pits for the reception of the divisions of the ligament; muscular impression subcentral.

The species inhabit the seas of warm climates, principally those of the East Indies and Australia, as far as is yet known. The species, which are not numerous, are not fixed by their valves nor by a byssus, but, like the *Vulsellæ*, are found in submarine bodies, such as sponges, &c.

C. aviculoides is an example. It is found in the seas of America, especially those of the south.

Crenatula aviculoides.

Perna (Brug.).—Animal compressed; mantle very much prolonged backwards, and fringed at its lower border; foot very small, with a byssus. Shell corneous or black, lamellar, very much flattened, subequivalve, inequilateral, very irregular, gaping in front for the passage of the byssus; hinge straight, marginal, having on each side a row of small parallel furrows, which are transverse, not intrant, and in which the divisions of the ligament are inserted; muscular impression subcentral.

The species are found in the seas of warm climates, more particularly those of the East Indies, though some species are found westward, as at the Antilles, Cape Verd, and the Azores. The species are moored to the rocks and mangrove-trees by means of their byssus, and have been found at depths ranging from the surface to ten fathoms.

P. Isognomum is an example. It is found in the East Indian Ocean.

Perna Isognomum.

a, Valves closed, showing the byssus; *b*, inside view of valve, showing hinge and muscular impression.

The number of recent *Pernæ* given by M. Deshayes, in his 'Tables,' amounts to ten recent and four fossil (tertiary). In the last edition of Lamarck, the same recent number is stated, but the fossil species amount to six. Professor Phillips notes one (*P. quadrata*, not mentioned by Lamarck or Deshayes) in the Coralline Oolite (Malton), and also in the Bath Oolite. He also notices a *Perna* in the Oxford Clay. ('Geology of Yorkshire.') The genus is recorded in the Inferior Oolite, and in the Coral Rag, by Mr. Lonsdale (Oolitic District of Bath, in 'Geol, Trans.'), and by Dr. Fitton, in the Lower Greensand and the Blackdown Sands.

Malleus (Lam.).—Animal considerably compressed; mantle prolonged backwards, and fringed with very small tentacular appendages; foot very distinct, canaliculated, and furnishing a byssus; buccal appendages spherico-triangular; branchiæ short and semicircular. Shell foliated, black or corneous, subnacreous, subequivalve, inequilateral, very irregular, often auriculated, and presenting a hammer or T shape; umbones not distant; an oblique notch in front for the passage of a byssus; hinge linear, very long, toothless; with a conical oblique pit, partially external, for the reception of the ligament, which is triangular and subexternal; muscular impression of considerable size and subcentral.

The species inhabit the East and West Indies (Guadaloupe and Martinique) and Australasia. They are found at depths ranging from the surface to seven fathoms. M. Rang speaks of the species from Guadaloupe and Martinique as having occurred at great depths. The species, which are not numerous, are moored by their byssus to submarine rocks, &c. They are very variable, and indeed M. Deshayes observes that he never saw any two individuals of a species alike. Age makes a considerable change in the shape of the shells, especially in the auricles.

M. De Blainville divides the genus into three sections:—1, consisting of species scarcely auriculated (*M. vulsellatus*); 2, consisting of uniauriculated species (*M. normalis*); and 3, consisting of biauriculated species (*M. vulgaris*). M. Deshayes thinks that the greater part of the individuals occurring in collections under the name of *M. vulsellatus* may be the young of the variety of *M. vulgaris* with short ears, and he considers *M. vulsellatus* and *M. anatinus* as identical.

M. vulgaris is the most common species, and we subjoin an illustration as an example. It is found in the East Indian and South seas.

Malleus vulgaris.

a, Valves closed, showing the byssus; *b*, inside view of valve, showing the hinge and muscular impression.

Gervillia (Fossil only). [GERVILLIA.]

Inoceramus (Parkinson).—(Fossil only). Though some malacologists consider *Inoceramus* and *Catillus* to be identical, M. De Blainville, M. Rang, and M. Deshayes consider them as distinct species, and as belonging to this family. M. Deshayes gives the following description of *Inoceramus*:—

Shell gryphoid, inequivalve, irregular, subequilateral, with a lamellar shell, pointed anteriorly, and enlarged at its base; umbones opposed, pointed, and strongly recurved; hinge short, straight, narrow, and forming a right angle with the longitudinal axis, with a series of crenulations gradually smaller for the reception of a multiple ligament. Muscular impression unknown. The species are of moderate size.

Inoceramus sulcatus, natural size. From the Folkestone Blue Marl.

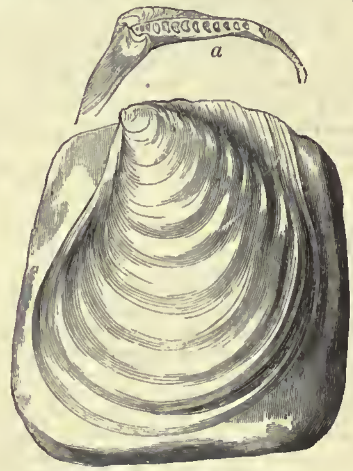
The smaller specimen shows the hinge of one valve, the other valve being a cast.

Dr. Mantell records several species in the Chalk, two in the Chalk-Marl, two in the Gault or Folkestone Marl, and one (from Martin) in the Shanklin Sand (Lower Greensand). ('Organ. Remains of Sussex,' 'Geol. Trans.,' 1829.) Some of the species in the Chalk—*I. Brongniarti. I. Lamarckii*, and *I. Mytiloides*—are *Catilli.* Professor Phillips records three (one a *Catillus*) in the White Chalk, one in the Red Chalk, and one in the Lias. ('Geology of Yorkshire.') Mr. Lonsdale notices two in the Lower Chalk (Oolitic District of Bath). Dr. Fitton records six named species and one nudetermined from the Upper Greensand, Gault, and Lower Greensand. ('Strata between the Chalk and Oxford Oolite,' in 'Geol. Trans.,' 1836.) In Tenant's 'List of British Fossils' 17 species are recorded as present in the Cretaceous Group. Woodward, in his 'Treatise,' says there are 40 species.

Catillus (Brongn.).—(Fossil only). M. Deshayes thus defines *Catillus*: —Shell sometimes flattened, elongated, or suborbicular, sometimes convex, cordiform, subequivalve, inequilateral, with umbones more or less projecting. Hinge straight, a little oblique or perpendicular to the longitudinal axis, its border furnished with a row of small cavities which are very short and gradually increasing; structure of shell fibrous; muscular impression unknown.

M. Deshayes observes that among the genera proposed by Mr. Sowerby in his 'Mineral Conchology,' there is one to which he has given the name of *Pachymya*. This genus appears to M. Deshayes to possess all the external characters of *Catillus*, and he states that he has been led to remark the approximation of that genus to *Catillus* by studying a fine specimen in the collection of M. Duchastel. M. Deshayes proceeds to observe that M. Brongniart has established a genus under the name of *Mytiloides* for those *Catilli* which are very much elongated. and that consequently the genus *Mytiloides* cannot be retained. The genus *Catillus* then, as reformed by M. Deshayes, will consist of the genera *Pachymya, Mytiloides*, and *Catillus*. Some of the *Catilli* are of enormous size, and are mentioned as being many feet in length. M. Deshayes thinks that the animals of *Inoceramus* and *Catillus* both wanted a byssus.

C. Cuvieri, may be taken as an example. It is found in the White Chalk in England and France.



Catillus Cuvieri. *a*, the hinge.

Pulvinites (Defrance).—(Fossil only). Animal unknown. Shell delicate, rounded, equivalve, subequilateral, with the umbones inclined a little forwards; hinge composed of eight or ten divergent teeth, forming so many pits.

Pulvinites Adansonii. Inside view of valve.

The genus *Avicula*, which is placed by Lamarck among his *Malleacea*, but is arranged by M. De Blainville, with many of the genera above described, under his family *Margaritacea*, is separated by M. Rang into a family which immediately succeeds the *Malleidæ* under the name of Aviculés, containing the sub-genera *Avicula* (properly so called) and *Meleagrina*. [AVICULA.]

The following is M. Deshayes' description of the genus:—Animal oval, flattened, having the lobes of the mantle separated throughout their length, thickened, and fringed on the edges; body very small, having on each side a pair of large branchiæ, nearly equal; mouth oval, rather large, with foliaceous lips, and with a pair of labial palps on each side, which are large and obliquely truncated; foot conical, vermiform, rather long, with a rather large byssus composed of stout filaments, united in some species at its base.

There are about 25 recent species known, and 300 fossil species.

M. Deshayes, in his 'Tables,' states the number of recent *Aviculæ* (including *Meleagrinæ*) at 30, and gives 5 as the number of fossil (tertiary). In the last edition of Lamarck he makes the number of recent *Aviculæ* 21, and the number of fossil species 6. (Paris, Grignon, Seulis, &c.; Chaumont, Paris Basin, Maastricht, aud Cypli; the Cornbrash in England and France, the Middle and Upper Oolite in England and France, and the Muschelkalk in Germany, Lorraine, and Toulon.) The *Meleagrinæ* are two in number, both recent. Dr. Mantell mentions species in the Chalk Marl. ('Organic Remains of Sussex.') Professor Phillips records species in the Coralline Oolite and Calcareous Grit, in the Oxford Clay, Kelloways Rock, Bath Oolite, Inferior Oolite, aud Marlstone. ('Geology of Yorkshire.') Mr. Lonsdale uotices species in the Lias, Inferior Oolite, Fuller's Earth, Bradford Clay, Cornbrash, and Kelloway Rock. ('Oolitic District of Bath.') Professor Sedgwick and Sir R. Murchison mention the genus among the Gosau Fossils. ('Geological Transactions.') Dr. Fitton records species in the Upper Greensand, the Gault, the Lower Greensand, and the Portland Sand. ('Strata between the Chalk and Oxford Oolite,' 'Geological Transactions.') Sir R. Murchison figures species from the Old Red-Sandstone (middle and lower beds only), from the Upper Ludlow Rock, the Amestry Limestone, the Lower Ludlow Rock, the Wenlock Limestone, and tho Caradoc Sandstone.

M. Deshayes also concurs in merging the genus *Meleagrina* in that of *Avicula*, which, according to M. Deshayes's reformation of the genus, will coutain also the fossil genus *Monotis* of Bronn.

Vulsella.—M. Deshayes, in his 'Tables' (Lyell), gives the number of recent species as 5 and 1 fossil (tertiary). In the last edition of Lamarck he makes the recent species 6, with no addition to the fossil species. (Grignon, Lamarck; Paris, Deshayes.) Woodward, in his 'Treatise,' gives 4 as the number of fossil species from the Upper Chalk.

MALLEUS. [EAR.]

MALLOW. [MALVA.]

MALLOW, MARSH. [ALTHÆA.]

MALLOW-WORTS. [MALVACEÆ.]

MALOPE, a genus of Plants belonging to the natural order *Malvaceæ*, consisting of two species, ono of which is commonly cultivated as a favourite hardy annual. This plant, *Malope malacoides*, is common in Barbary, where it is fouud among stones and rocks, which it ornaments with its large crimson flowers; it is also met with in Sardinia and other parts of the south of Europe. The geuus differs from *Malva* in having its carpels distinct, and heaped irregularly over a central receptacle, instead of being placed in a whorl and consolidated. Three or perhaps four other species are known to botanists.

MALPIGHIA'CEÆ, *Malpighiads*, a natural order of Exogenous

Malpighia macrophylla.

1, An entire flower, much magnified; 2, the stamens and pistils; 3, a transverse section of the ripe fruit.

Plants, with polypetalous flowers, trygynous pistils, usually monadelphous stamens, and alternate exstipulate leaves, inhabiting various parts of the tropics. They are usually shrubs or trees, and but seldom herbaceous plants. In addition to the more geueral characters already mentioned they have, in a majority of cases, a pair of convex oval glands on the face of each sepal, and in many species the hairs are attached to the leaves, &c., by the middle; so that hairs of that description have acquired the name of Malpighiaceous. Many of them are beautiful objects, especially the *Galphimias* and climbing species of *Hiræa* and *Banisteria*. A few only are useful. The bark of *Malpighia Moureila* and *M. crassifolia* is a kind of febrifuge. The fruit of *Malpighia glabra* is the Barbadoes Cherry of the West Indies; it varies iu size from that of a large pea to a small cherry, is smooth, shining, and has three triangular stones; its flesh is juicy and sweet, but insipid. The fruit of *Byrsonima coriacea*, or Lotus-Berry of the West Indies, is of much better quality; it is yellow, and contains a single stone. A few kinds produce timber of a bright yellow colour. The bark of some of the species is used for tanning and as a tonic and astriugent.

The order is nearly related to the *Aceraceæ*, or Sycamores of colder climates, differing iu little except the ternary division of the fruit, the symmetrical flowers with unguiculate petals, and the pendulous or suspended seeds.

There are 42 genera and 555 species of the order.

MALTHA. [PETROLEUM.]

MALTHACITE, a Mineral, occurring in thin plates and massive. Fracture uneven or conchoidal. Colour white or yellowish. Streak shining. Soft like wax. Lustre waxy, weak. Streak shining. Translucent. Specific gravity 1·99 to 2·01. It is found at Stendorfal, between Lohau and Bauzen, and uear Beraun in Bohemia. Its analysis by Meissner gives—

Silica	50·2
Alumina	10·7
Lime	0·2
Peroxide of Iron	3·1
Water	35·8
	——100

MALVA (the Latiu *Malva*), a geuus of Plants belonging to the natural order *Malvaceæ*. It has numerous styles, a double calyx, the outer one 3-leaved, the inner ono 5-leaved. The capsules are orbicular and many celled; the cells 1-seeded and circularly arranged.

M. Moschata, the Musk Mallow, has an erect stem, kidney-shaped leaves, with five or seven deep pinnatifid lobes, the lower leaves inciso-crenate, the stipules lanceolate-acute, the fruit-stalks erect, and the fruit hairy. The flowers are large and rose-coloured, on axillary single-flowered peduncles, crowded at the extremity of the stem and branches. It is native in many parts of Europe, and is found in Britain in grassy borders of fields and by waysides.

M. sylvestris, Common Mallow, has an erect stem, and is distiuguished by its kidney-shaped leaves with seven deep crenate lobes; the fruit is glabrous, reticulate-rugose. The flowers are large and of a purple colour, much longer than the calyx, which is hairy. It grows on waste places and roadsides in Britain, and is native iu most parts of Europe. The whole plant, but especially the root, yields when boiled a plentiful tasteless mucilage, which is used in some cases of internal irritatiou. Decoctious of the leaves are employed in dysentery and in general for removing supposed acrimonious humours, but their chief utility is iu clysters, fomentations, and poultices. The fruit of this and the next species are eaten by children and are called Cheeses, and in France, Fromagions. This species is the *Malva* of Pliny, lib. 20, cap 21; also, iu Columella, lib. 10, cap. 247; it is the Μαλάχη of Theophrastus, lib. 9, cap. 17, and the Κηπευτὴ μαλάχη of Dioscorides, lib. 2, cap. 144.

M. rotundifolia, Dwarf Mallow, has a decumbent stem, roundish heart-shaped leaves with five shallow acutely crenate lobes, the outer sepals linear-lanceolate, shorter than the ovate acuminate stellately hairy inner ones. The flowers are small aud purple, and two or three times longer than the calyx. It is common in waste places iu most parts of Europo, and is native of Britain. It is the *M. vulgaris* of Fries, the Ἀγρία μαλάχη of Dioscorides, loc. cit., and the Malache sylvestris of Pliny, loc. cit.

M. borealis has its outer sepals linear, as long as the ovate-acute glabrous but strongly-ciliated inner ones; the petals as long as the calyx; the fruit pubescent, margined, reticulate-rugose. It is the *M. pusilla* of Smith, tho *M. rotundifolia* of Fries. It is found in Britain, near Hythe in Keut. There are many other species of Mallow.

M. verticillata has an erect stem, cordate leaves, with five deep crenate-dentate triangular acute lobes; flowers axillary, clustered, nearly sessile; outer sepals linear, half as long as the reticulated diaphanous pilose enlarged inner ones; petals about as long as the calyx; fruit glabrous; carpels rounded on the edge, reticulated. The flowers are small; carpels separated by a deep furrow, into which the clavate reticulated surface extends. Central disc very small; stem quite erect, like a little hollyhock. Petioles several times longer than the clusters. It is found near Llanelly, South Wales.

Those mentioned are the only natives of Britain, and the others are of little importance excepting as ornamental plants. Those best worth cultivation for this purpose are *M. Moschata*, *M. Morenii*, *M. alcea* *M. Muroana*, and *M. purpurata*. The stove species will succeed iu any kind of rich soil, and cuttings of them will strike root freely if planted in light soil underneath a hand-glass. The greenhouse species may be propagated in the same manner. The hardy perennial kinds should be planted in the open border, and may be propagated either by seed or by dividing the roots.

(Don, *Dichlamydeous Plants;* Babington, *Manual of British Botany.*)

MALVA'CEÆ, *Mallowworts*, are a large natural order of Exogenous Plants, the distinguishing marks of which are polypetalous flowers, monadelphous stamens, unilocular anthers, and a valvate calyx. They also have alternate leaves, the hairiness of which, if present, is usually stellate; and conspicuous stipules. A large proportion of the order consists of herbaceous or annual plants, inhabiting all the milder parts of the world, but much the most plentiful in hot countries, where alone a comparatively small number of species become trees. In many cases they are remarkable for the large size and beautiful colours of their flowers, which are however fugitive, expanding for a single day only; but the great number of them and the regularity of their succession during the flowering season make this of little importance. Among the very numerous species several are of essential service to man. As emollients they are well known in medical practice, the Marsh-Mallow (*Althæa officinalis*) being one of the most useful among this kind of remedial substances, and a large proportion of the whole order being capable of supplying its place. [ALTHÆA.] The hairy covering of the seeds of the various species of *Gossypium* forms the raw cotton so important to our manufacturers. [GOSSYPIUM.] *Malva tricuspidata* is used by the negroes in the West Indies as a substitute for soap. [MALVA.] The seeds of *Hibiscus abelmoschus* are warm and musky, and are employed in perfumery as a substitute for musk; those of *H. esculentus* form the ochra, so much used in hot countries as a mucilaginous ingredient in soups. A few species are acid, especially *H. sabdariffa.* Finally the tenacious fibres procured from the inner bark of many kinds of Malvaceous Plants form a good description of cordage. [HIBISCUS.] *H. elatus* and *H. tiliaceus*, and several kinds of *Sida*, are principally used for this purpose. [SIDA.] The order is related to *Sterculiaceæ* and *Byttneriaceæ.* There are 37 genera and 1000 species.

Gossypium tricuspidatum.

1, a section of a corolla, with adhering monadelphous stamens.

The only modern systematical account of the genera and species of the order is to be found in the first volume of De Candolle's 'Prodromus;' but the genera have been since constructed upon principles so much more precise, and the number of species has been so very considerably increased, that this enumeration is of little use at present. There is a good account of Indian species in Wight and Arnott's 'Prodromus Floræ Peninsulæ Indiæ Orientalis;' of Brazilian species in Auguste de St. Hilaire's 'Flora Braziliæ Meridionalis;' and of Mexican kinds many are described in the various volumes of the 'Linnæa.' A few African species are also to be found in Guillemin and Perrottet's 'Flora Senegambiæ,' vol. i.

MAMMA'LIA, MAMMALS, a term employed by Linnæus to designate those animals which suckle their young, and which seems preferrible to the term Mammifères generally used by the French zoologists. Mammals are vertebrated animals whose blood is red and warm, and whose system of circulation is double; whose fœtus, in most species, is nourished in utero by means of a placenta; whose young, when born at the proper period, give signs of life at their birth, and are, in a state of nature, afterwards fed with milk secreted by the mammæ of the mother [MAMMARY GLANDS], till they are old enough to procure their food, or to have it supplied from other sources.

Linnæus, who makes the *Mammalia* the first class of the Animal Kingdom, gives the following definition:—Heart with two auricles and two ventricles; blood warm, red; lungs respiring reciprocally; jaws incumbent, covered: armed with teeth in most; penis intrans, viviparas, lactiferas; senses—tongue, nostrils, eyes, ears, papillæ (touch); covering—hairs, &c.; support (fulcra)—four feet, except in those which are entirely aquatic, in which the posterior feet are bound together (compedes) into the fin of the tail; a tail in most.

This class Linnæus divides into orders, principally resting on the basis of dentition. His name for the incisor teeth is Primores; for the canine or cuspidate teeth, Laniarii; and for the back or grinding teeth, Molares.

The orders, which are six in number, are comprised in three sections, depending on the nature of the extremities:—1. The *Unguiculata*, containing the orders *Bruta, Glires, Primates,* and *Feræ.* 2. The *Ungulata*, comprising the *Belluæ* and *Pecora.* 3. The *Mutica*, consisting of the order *Cete* (Whales) only.

1. The *Primates* consist of the genera *Homo, Simia, Lemur,* and *Vespertilio.* 2. The *Bruta* comprise the genera *Elephas, Trichechus, Bradypus, Myrmecophaga, Manis,* and *Dasypus.* 3. Under the *Feræ* are arranged the genera *Phoca, Canis, Felis, Viverra, Mustela, Ursus, Didelphis, Talpa, Sorex,* and *Erinaceus.* 4. The *Glires* embrace the genera *Hystrix, Lepus, Castor, Mus, Sciurus,* and *Noctilio.* 5. The *Pecora* comprehend the genera *Camelus, Moschus, Cervus, Capra, Ovis,* and *Bos.* 6. To the *Belluæ* belong the genera *Equus, Hippopotamus, Sus,* and *Rhinoceros.* 7. Under the order *Cete* are arranged the genera *Monodon, Balæna, Physeter,* and *Delphinus.*

The following Table exhibits the geographical distribution of the species of *Mammalia* contained in the collection of the British Museum, one of the most extensive collections in the world:—

	Europe.	North Asia.	South Asia.	Africa.	North America.	Tropical America.	South America.	Australasia.	Not known.
PRIMATES.									
Simiadæ	1	—	27	32	—	—	—	—	—
Cebidæ	—	—	—	—	—	41	—	—	—
Lemuridæ	—	—	3	14	—	—	—	—	—
Galeopithecidæ	—	—	1	—	—	—	—	—	—
Vespertilionidæ	14	—	47	19	4	42	—	11	7
FERÆ.									
Felidæ	13	5	70	47	21	15	5	1	—
Ursidæ	1	—	6	—	4	5	—	—	—
Talpidæ	10	1	12	14	4	—	—	—	—
Macropidæ	—	—	3	—	1	8	—	79	—
Phocidæ	3	—	—	—	1	—	3	1	—
CETE.									
Balænidæ	3	—	—	1	—	—	—	—	—
Delphinidæ	4	—	4	3	—	—	—	1	3
Manatidæ	—	—	—	1	—	1	—	—	—
Halicoridæ	—	—	1	—	—	—	—	—	—
Rytenadæ	—	—	—	—	—	—	—	—	—
GLIRES.									
Muridæ	11	1	19	20	16	10	1	14	—
Hystricidæ	1	—	1	1	1	15	2	—	—
Leporidæ	5	4	6	4	5	—	—	—	1
Jerboidæ	7	7	43	19	24	4	1	—	—
Aspalacidæ	1	1	3	6	2	1	—	—	—
UNGULATA.									
Boridæ	8	8	36	49	6	2	2	—	1
Equidæ	—	1	—	3	—	—	—	—	—
Elephantidæ	1	—	6	11	—	3	—	—	1
Dasypidæ	—	—	2	3	—	9	—	3	—
Bradypidæ	—	—	—	—	—	4	—	—	—
Total	83	28	290	247	89	160	14	110	13

"The extent of the collection," says Dr. J. E. Gray, "in each of the families of *Mammalia*, compared with those of the Museum of the Zoological Society of London and of the Senkenbergian Society at Frankfurt (the only two large collections of which, as far as I am aware, complete catalogues have been published), may be deduced from the following statement. The numbers in the two latter columns of the table are derived from Mr. Waterhouse's 'Catalogue of the Mammalia in the Museum of the Zoological Society,' and its Supplement, published just before the packing up of that collection in store in 1839, and from Dr. Rüppell's 'Catalogue of the Mammalia in the Museum of the Senkenbergian Society,' published in the summer of 1842. It is much to be regretted that there are no means of continuing the comparison with reference to the museums of Paris, Leyden, Berlin, Vienna, or Brussels; no catalogue, or even estimate, of the contents of any of those collections having, to my knowledge, been given to the world. It is almost unnecessary to add, that such a comparison as that now given cannot be at all points perfectly correct, Mr. Waterhouse or Dr. Rüppell occasionally regarding as species what in the present catalogue are considered varieties, and the reverse; but this difference of opinion will be found to have very little influence on the general results."

	British Museum.		Zool. Society.		Francf. Museum.	
	Species.	Individ.	Species.	Individ.	Species.	Individ.
PRIMATES.						
Simiadæ . .	59	158	63	132	36	131
Cebidæ . . .	41	84	24	42	24	60
Lemuridæ . .	17	34	19	32	0	18
Galeopithecidæ.	1	8	2	7	1	3
Vespertilionidæ	143	403	48	73	68	149
	261	687	156	286	138	361
FERÆ.						
Felidæ . . .	174	516	140	253	97	333
Ursidæ . . .	16	41	15	27	11	36
Talpidæ . .	40	124	43	67	23	68
Macropidæ . .	91	326	55	83	19	45
Phocidæ . .	8	21	3	5	9	22
	329	1028	256	435	159	504
CETÆ.						
Balænidæ . .	4	6	1	1	3	4
Delphinidæ .	15	27	2	3	5	10
Manatidæ . .	2	3	—	—	1	1
Halicoridæ . .	1	2	1	2	1	4
Rytenadæ .	—	—	—	—	—	—
	22	38	4	6	10	19
GLIRES.						
Muridæ . . .	02	255	97	170	49	165
Hystricidæ . .	21	43	17	26	11	32
Leporidæ . .	25	68	17	31	11	32
Jerboidæ . .	106	275	73	127	52	140
Aspalacidæ . .	14	34	6	8	9	25
	258	675	212	362	132	394
UNGULATA.						
Bovidæ . . .	114	486	89	136	78	259
Equidæ . . .	4	7	5	7	4	7
Elephantidæ .	22	61	11	20	16	67
Dasypidæ . .	17	67	18	36	13	28
Bradypidæ . .	4	13	3	5	4	11
	161	634	126	204	115	372
Total . .	1031	3062	754	1293	554	1650

"It may be remarked," adds Dr. Gray, "that the last general work on the species of *Mammalia*, Fischer's 'Synopsis Mammalium,' published in 1829 and 1830, contained 1126 which he considers well established, and 220 very doubtful species. Though the Museum collection nearly approaches these numbers, and is the largest assemblage of species hitherto brought together and arranged in one series, yet there are at least between 300 and 400 other species now known as existing in the different European collections wanted to complete the series, and many of these are inhabitants of our own possessions, or places with which we have considerable trade: it is therefore to be hoped that we shall soon be able greatly to reduce the number of our desiderata."

This was written in 1843: since then a large number of the desiderata have been added to the collection, an account of which will be found in the detailed catalogues of the museum, not yet completed. These are given under the heads of the families in this work.

For the history of the science relating to the arrangement of the *Mammalia* generally, the reader is referred to the article MAMMALOGY; and for the natural history and organisation of the beings which form the class, to that article and the articles MAN, MAMMARY GLANDS, LOCOMOTION IN ANIMALS, DENTITION, TEETH, and HEART, as well as the various titles referrible to the orders, families, and genera belonging to the class in this work.

MAMMA'LOGY, a hybrid word, the roots being derived from the Latin and the Greek. Accordingly, M. Desmarest has proposed the term Mastology, and M. De Blainville that of Mastozoology, as being entirely of Greek origin, and therefore of more legitimate construction. Vicious however as the word is, the term Mammalogy is in such general use by the zoologists of England and France that it seems to be less objectionable to retain it, with all its faults, than to attempt to supersede it by another word, which, though it may be more correct, would be comparatively very little known.

Mammalogy then is the science which has for its object the study and classification of animals with mammæ, or teats, that is to say, Man, and Quadrupeds properly so called, including the Quadrumanous Animals and Whales.

The objects of this science are numerically much less than those which constitute the other classes of animated beings; their bulk, as compared with that of the others, is generally speaking of greater volume, and their structure is more readily laid open by the knife of the zootomist; whilst, with the exception of those passages by which nature gradually passes from one form to another, their differences are more strongly marked. Their habits too are better known, and consequently they afford materials for classification capable of a comparatively certain arrangement.

To a certain extent the knowledge of *Mammalia* and their nominal distinctions, as regards their habits and economic uses, must have been of the earliest date. The Holy Scriptures abound with passages to confirm this statement, if indeed it needed confirmation. Ancient monuments too, long anterior to the times of the Greeks and Romans, speak the same language. When we come down to the time of Aristotle, we find that the science had not proceeded further than a knowledge of the external and internal structure of these animals, without any attempt at a systematic arrangement of them. If we descend lower, we find the science in the same state, whether we consult the works of Pliny, or of the other ancient writers who followed Aristotle.

Conrad Gesner, though he treated of the *Mammalia* alphabetically in his 'History of Quadrupeds' (1551), finally divided them into groups, such as Monkeys, Horses, Deer, Oxen, &c., as indeed he did with regard to the Oviparous Quadrupeds (Tortoises, Lizards, Frogs, &c.)

Aldrovandus, Johnston, and the rest of that class of mammalogists, seem to have followed Gesner as closely as the ancient writers followed Aristotle.

The first great step in system was made by our countryman John Ray, in his 'Synopsis Methodica Animalium' (1693), wherein he separated the *Mammalia* into two great classes, the Ungulated or Hoofed animals, and the Unguiculated, or animals with nails or claws.

The Ungulated class are divided into—1, the *Solipedes*, as the Horse; 2, quadrupeds with a divided hoof, properly so called, as the Ox or Sheep; and 3, quadrupeds which have the feet divided into more than two parts, as the Elephant.

The animals with a divided hoof are again subdivided into two sections:—1. Those which do not ruminate, as the Hog. 2. Ruminants, which consist of four genera—Sheep, Goats, Stags or Deer, and Oxen.

Those of the Unguiculated Mammals which have the nails wide and resembling those of Man, such as the Apes or Monkeys, are separated from those which have the nails sharp and narrow. These last he separates into those which have a bifid foot, as the Camels, and into those which have a multifid foot, which he names *Fissipedes*.

The *Fissipedes* are subdivided into—1, the Analogous Group, which have more than two incisor teeth in each jaw, as the Lions, or Great Cats, the Dogs, &c., or two incisors only, as the Beaver, the Hares, the Guinea Pigs, the Squirrels, the Marmots, &c.; 2, the Anomalous Group, which have no teeth at all, as the *Tamandua*, and other Ant-Eaters [ANT-EATER], or which have teeth differing in form, in number, and position from those of the other Mammals, as the Hedgehogs, Armadilloes, Moles, Sloths, &c.

Our limits will not permit us to do more than allude to the authors, and they were not few, who entered upon this branch of the science after Ray. Of these Seba may be considered one of the principal, and his work is justly appreciated for the number, and generally speaking for the accuracy of the well-executed plates which illustrate his voluminous work. But there now arose one who was eminently distinguished from the crowd of zoological authors. Linnæus, an outline of whose system is given in another place [MAMMALIA], fixed the science upon a basis which his penetrating genius immediately saw was the secure one. He may be said to have invented a language admirably adapted to the wants of that science; and it is in this department that the great Swedish naturalist shines preëminently as a zoologist. In vain was the splendid genius of Buffon arrayed against him and his pupils; in vain did Klein, who seemed to live for no other purpose than to attack the Swede, publish his 'Quadrupedum Dispositio brevisque Historia Naturalis' (1751), wherein he separated the *Mammalia* into two groups, the Ungulated and the Unguiculated, each consisting of five families; in vain did Brisson (1756) publish his 'Animal Kingdom divided into Eleven Classes,' containing 18 orders and 42 genera, some of the latter well defined and still admitted; the philosophical system of Linnæus daily gained ground, and at length became almost the universal language of zoology.

About a year before the death of Linnæus (1777) Erxleben published his 'Systema Regni Animalis.' It contained several new genera, as for example *Papio*, *Cercopithecus*, *Cebus*, *Callithrix* (all at the expense of the great Linnæan genus *Simia*), *Lutra*, *Cavia*, *Glis*, *Spalax*, *Dipus*, *Antilope*, and *Hydrochœrus*, all of which are still retained; and indeed his work, which should be in the hands of the student, seems to have been intended as a further development of the Linnæan system, and of the principles contained therein.

The excellencies of the work last-mentioned are strongly contrasted with the edition of the 'Systema Naturæ' which Gmelin gave to the world in 1788. It is not passing a severe judgment to characterise it as a jumble of all that had been previously contributed to this department of zoology, and a farrago of species heaped together, without care, and in many instances without inquiry. The student whose lot it may be to follow out the synonyms of the *Mammalia* will perceive in what a labyrinth he gets involved as soon as he sets to work upon the names and references which swell out the 'Systema Naturæ' from the neat proportions which graced it when it left the hand of Linnæus, to the undigested and overladen mass which Gmelin has made it.

Previous to this publication, a work of a very different character had made its appearance. In 1780 Professor Storr published his 'Prodromus,' which gave a direction to those employed in classifying the *Mammalia* still in a great measure followed. He divided the class into three phalanxes: the first consisting of those Mammals which have feet proper for walking; the second, of those whose feet are fin-shaped, but with distinct toes; and the third, of those which have true fins without any apparent toes. These phalanxes are separated into cohorts, orders, tribes, sections, and genera; and the system is well worthy the deep attention of the reader.

Boddaert (1785), in his 'Elenchus Animalium,' divided the *Mammalia* into two great groups, the Terrestrial and the Aquatic. In the first (*Terrestria*) he placed—I. The Unguiculated Mammals, divided into two sections: *α*. The *Quadrumania*; *β*. The *Unguiculata*, with long claws (Sloth, Bats, Armadilloes, Pangolins, and other Ant-Eaters). II. The Carnivorous Mammals (*Feræ*). III. The Rodent Mammals (*Glires*). IV. The Ruminants. V. *Ungulata* not Ruminants (Hog, Horse, Tapir, Rhinoceros, and Elephant). In the second group (*Aquatilia*) were arranged the Hippopotamus, Beaver, Otter, Walrus, the Seals and Dugongs, and the Manatee.

Not to detain the reader with the anatomical system of M. Vicq.-d'Azyr, which broke up the *Mammalia* into 15 classes and 38 genera, and is seldom referred to, we proceed to notice the system of Blumenbach, who separated the *Mammalia* into 9 orders. I. *Bimana* (Man). II. *Quadrumana* (Apes, Monkeys, and Macaucos). III. *Cheiroptera* (Bats). IV. *Digitata*, consisting of three sections, the Rodents (*Glires*), the Carnivorous (*Feræ*), and the *Edentata* (*Bruta*). V. *Solidungula* (Horse, &c.). VI. *Bisculа* (Ruminants). VII. *Multungula* (Hog, Tapir, Elephant, Rhinoceros, &c.). VIII. *Palmipeda*, consisting of three sections, namely, the Rodent Palmipedes (*Glires*, Beavers), the Carnivorous Palmipedes (Seals, Otters), and the Edentate Palmipedes (*Bruta*, *Ornithorhynchus*, Walruses, Dugongs). IX. The *Cetacea* (Whales).

In 1798 Cuvier published his Elementary Table of Animals, which was afterwards further developed in his 'Anatomie Comparée' and the 'Règne Animal.' The method of this great zoologists bears considerable resemblance in some of its parts to the 'Prodromus' of Storr, as Cuvier himself remarks: it is so generally adopted that we shall presently give it in detail.

M. Desmarest (1804—'Dictionnaire d'Histoire Naturelle'), principally taking Cuvier and Storr for his guides, divided the *Mammalia* into three great sections. I. The Unguiculated *Mammalia*. II. The Hoofed *Mammalia* (Mammifères à Sabots). III. The Finned *Mammalia* (Mammifères à Nageoires), containing the orders *Amphibia*, Seals, Walruses, Dugongs, &c., and *Cetacea* (Whales). Our limits will not permit us to enter at length into the classification of M. Desmarest, which should however be carefully perused by the student.

We now proceed to lay before the reader Cuvier's arrangement after it had received the benefit of the joint labours of M. Geoffroy and himself, and as it finally left his hands in his last edition of the 'Règne Animal.'

Class Mammifères.

Order I. *Bimana*. Man.

Order II. *Quadrumana*. Two families. 1. Apes and Monkeys (*Simia*, Linn.). 2. Macaucos (*Lemur*, Linn.).

Order III. Carnassiers. Family 1. *Cheiroptera* (Bats). 2. *Insectivora* (Hedgehogs. Tenrecs. *Tupaia*. Shrews. *Mygale*. *Chrysochloris*. *Talpa*. *Condylura*. *Scalops*). 3. *Carnivora*. Tribe 1. *Plantigrades*. Bears (*Ursus*, Linn.). Raccoons (*Procyon*, Storr.). *Panda* (*Ailurus*, F. Cuv.). Benturongs (*Ictides*, Valenciennes). Coatis (*Nasua*, Storr.). Kinkajous or Pottos (?) (*Cercoleptes*, Illiger). Badgers (*Meles*, Storr.). Gluttons (*Gulo*, Storr). Ratels. Tribe 2. Digitigrades. Martins (*Mustela*, Linn.). Skunks (*Mephitis*, Cuv.). Otters (*Lutra*, Storr). Dogs (*Canis*, Linn.). Civets (*Viverra*). Genets (*Genetta*, Cuv.). *Paradoxurus*. Ichneumons (*Herpestes*, Illiger). Suricates (*Ryzæna*, Illiger). *Crossarchus*. *Proteles*. The last subdivision of the Digitigrades is composed of the Hyænas (*Hyæna*, Storr), and the Cats (*Felis*, Linn.), in which last the sanguinary development is at its height. Tribe 3. *Amphibia*. The Seals (*Phoca*, Linn.). The Walruses (*Trichechus*, Linn.).

Order IV. *Marsupialia*. Subdivision 1. Opossums (*Didelphis*, Linn., including *Cheironectes*, Illiger, and *Thylacinus* and *Phascogale*, Temminck). *Dasyurus* (Geoffroy). *Peramcles* (Geoffroy). Subdivision 2, *Phalangista* (Cuv.), including the true Phalangers (*Balantia*, Illiger) and the Flying Phalangers (*Petaurus*, Shaw; *Phalangista*, Illiger). Subdivision 3, the Potoroos, or Kangaroo Rats (*Hypsiprymnus*, Illiger). The Kangaroos (*Macropus*, Shaw; *Halmaturus*, Illiger). The Koalas (*Lipurus*; Goldfuss; *Phascolarctos*, Blainville). *Phascolomys* (Geoffroy).

Order V. *Rodentia*. The Squirrels (*Sciurus*, Linnæus, including *Tamia?* Illiger; *Pteromys* and *Cheiromys*, Cuvier). The Rats (*Mus*, Linnæus, including *Arctomys*, Gmelin; *Spermophilus*, F. Cuvier). The Souslik (*Cynomys* of Rafinesque); *Myoxus*, Gmelin; *Echimys*, Geoffroy (*Loncheres*, Illiger); *Hydromys*, Geoffroy; *Capromys*, Desmarest. The Rats, properly so called (*Mus*, Cuv.). The Jerbilles, *Gerbillus*, Desmarest; *Meriones*, Illiger; *Meriones*, F. Cuvier. The Hamsters, *Cricetus*, Cuv., and *Arvicola*, Lacépède. The Ondatras, Fisher, F. Cuv. The Field Rats and Mice, *Arvicola*, Cuv., *Hypudæus*, Illiger. The Lemmings, *Georychus*, Illiger; *Otomys*, F. Cuv. The Jerboas, *Dipus*, Gmelin; *Helamys*, F. Cuv.; *Pedetes*, Illiger; *Spalax*, Guldenstädt; *Bathyergus*, Illiger; *Geomys*, Rafinesque; *Pseudostoma*, Say; *Axomys*, Lichtenstein; *Diplostoma*, Rafinesque. The Beavers (*Castor*, Linn.), *Myopotamus*, Commerson. The Porcupines (*Hystrix*, Linnæus, including the Ursons, Erétisons of F. Cuv., and the Cœndous, Synethères of F. Cuv.). The Hares (*Lepus*, Linnæus, including *Lagomys* Cuvier). The *Capybara*, *Hydrochœrus*, Erxleben. The Guinea Pigs (*Anœma*, F. Cuv.; *Cavia*, Illiger, including *Keradon*, F. Cuv.). The Agoutis (*Chloromys*, F. Cuv., *Dasyprocta*, Illiger). The Pacas (*Cœlogenys*, F. Cuv.); and the Chinchillas.

Order VI. *Edentata*. Tribe 1. Tardigrades. The Sloths* (*Bradypus*, Linnæus, including *Acheus*, F. Cuv.). Tribe 2. Ordinary *Edentata*. The Armadilloes (*Dasypus*, Linnæus), and the sub-genus *Chlamyphorus*, Harlan. The Aard-Vark (*Orycteropus*, Geoffroy). The Ant-Eaters (*Myrmecophaga*, Linnæus). The Pangolins (*Manis*, Linnæus). Tribe 3, The Monotremes. The *Echidna*, Cuv. (*Tachyglossus*, Illiger), and the *Ornithorhynchus*, Blumen. (*Platypus*, Shaw).

Order VII. *Pachydermata*. Family 1. Probroscidians. Elephants (*Elephas*, Linnæus) and Mastodons (*Mastodon*, Cuvier). Family 2, Ordinary *Pachydermata*. *Hippopotamus* (Linn.). The Hogs (*Sus*, Linnæus, including Phascochæres, F. Cuvier, and Dicotyles, Cuv.). *Anoplotherium* (Cuv., extinct). The Rhinoceroses (*Rhinoceros*, Linnæus). The Damans (*Hyrax*, Hermann). *Palæotherium* (Cuv., extinct). *Lophiodon* (Cuv., extinct). The Tapirs (*Tapir*, Linnæus). Family 3. *Solipeda*. The Horses, &c. (*Equus*, Linn.).

Order VIII. *Ruminantia* (*Pecora*, Linnæus). *a*. No Horns.—The Camels (*Camelus*, Linnæus, including the Llamas, *Auchenia*, Illiger). The Musks (*Moschus*, Linnæus). *b*. True Horns shed periodically.—The Stags or Deer (*Cervus*, Lnnæus). *c*. Persistent Horns.—The Giraffe (*Camelopardalis*, Linnæus). *d*. Hollow Horns.—The Antelopes (*Antilope*). The Goats (*Capra*, Linnæus). The Sheep (*Ovis*, Linnæus). The Oxen (*Bos*, Linnæus).

Order IX. *Cetacea*. Family 1. Herbivorous *Cetacea*. The Manatees (*Manatus*, Cuvier). The Dugongs (*Halicore*, Illiger). *Rytina* (Illiger). Family 2. Ordinary *Cetacea*. The Dolphins (*Delphinus*, Linn., including *Delphinus*, Cuvier, *Delphinorhynchus*, De Blainv.). The Porpoises (*Phocæna*, Cuv.). *Delphinapterus*, Lacépède; *Hyperoodon*, Lacépède. The Narwhals (*Monodon*, Linnæus). The Cachalots (*Physeter*, Linnæus). The Whalebone Whales (*Balæna*, Linnæus, including *Balænoptera*, Lacépède).

Illiger (1811), in his 'Prodromus Systematis Mammalium et Avium,' divided the *Mammalia* into 14 orders, 39 families, and 125 genera, most of which last are characterised with great neatness. We have only room for a mere sketch of this system, which has considerable merit:—

Order I. *Erecta* (Man).

Order II. *Pollicata*. Family 2. *Quadrumana* (Apes and Monkeys). Family 3. *Prosimia* (the Lemurs, &c.). Family 4. *Macrotarsi* (Tarsiers. *Galago*, &c.). Family 5. *Leptodactyle* (*Cheiromys*). Family 6. *Marsupialia* (except the Potoroos and Kangaroos).

Order III. *Salientia*. Family 7. *Salientia* (*Hygsiprymnus* and *Halmaturus*, Potoroos and Kangaroos.)

Order IV. *Prensiculantia*. Family 8. *Macropoda* (Jerboas, &c.). Family 9. *Agilia* (*Myoxus*, the Squirrels, and *Pteromys*). Family 10. *Murina* (Marmots, Hamsters, Rats, &c.). Family 11. *Cunicularia* (Lemmings, *Hypudæus*, &c.). Family 12. *Palmipeda* (*Hydromys* and Beavers). Family 13. *Aculeatea* (Porcupines and Lonchères, or *Echimys*). Family 14. *Duplicidentata* (Hares, &c.). Family 15. *Subangulata* (*Paca*, Agoutis, Guinea-Pigs, *Capybara*).

Order V. *Multungulata*. Family 16. *Lamnunguia* (*Hyrax*, &c.). Family 17. *Proboscidea* (Elephants). Family 18. *Nasicornia* (Rhinoceroses). Family 19. *Obesa* (Hippopotamus). Family 20. *Nasuta* (Tapirs). Family 21. *Setigera* (Hogs).

* It is here that Cuvier mentions the extinct genera *Megatherium* and *Megatonyx*, noticing however the differences, and observing that the former, though it has a skull very like the sloths, wants the canines, and inclines, as to the rest of the skeleton, partly to the sloths, and partly to the ant-eaters.

Order VI. *Solidungula* Family 22. (Horse, &c.).

Order VII. *Bisula*. Family 23. *Tylopoda* (Camels and Llamas). Family 24. *Devexa* (Giraffe). Family 25. *Capreoli* (Deer and Musks). Family 26. *Cavicornia* (Antelopes, Goats, and Oxen).

Order VIII. *Tardigrada*. Family 27. *Tardigrada* (Sloths, tridactylous and bidactylous). Sloth-Bear, or *Prochilus*.

Order IX. *Effodientia*. Family 28. *Cingulata* (Armadilloes). Family 29. *Vermilinguia* (Aard-Vark, Ant-Eaters, and Pangolins).

Order X. *Reptantia*. Family 30. *Reptantia* (Monotremes and *Pamphractus*, which last is no Mammal, but a Tortoise).

Order XI. *Volitantia*. Family 31. *Dermoptera* (*Galeopithecus*). Family 32. *Cheiroptera* (Bats).

Order XII. *Falculata*. Family 33. *Subterranea* (Hedgehogs, Shrews, Moles, &c.). Family 34. *Plantigrada* (Kinkajou, Coatis, Raccoon, Glutton, Badgers, and Bears). Family 35. *Sanguinaria* (Fennec, Dogs, Hyænas, Cats, Civets, and Suricate). Family 36. *Gracilia* (Ichneumons, Skunks, Weasels, Otters).

Order XIII. *Pinnipedia*. Family 37. *Pinnipedia* (Seals and Walruses).

Order XIV. *Natantia*. Family 38. *Sirenia* (Manatee, Dugong, and Rytina.) Family 39. *Cete* (Whalebone Whales, Narwhals, Cachalots, Dolphins, &c.).

M. De Blainville (1816) divided the Mammifères into two sub-classes. 1. The Monodelphes, containing the six orders—*Quadrumana*, Carnassiers, *Edentata*, *Rodentia*, Gravigrades, and Ongulogrades. 2. The Didelphes. All the orders of the Monodelphes, with the exception of the fourth and fifth, are subdivided into the Normal and Anomalous, and so is the sub-class of Didelphes, the Normal forms being the Carnassiers and Rongeurs, and the Anomalous *Echidna* (for burrowing) and *Ornithorhynchus* (for swimming). M. De Blainville observes that it may be that the *Cetacea* should form a separate order or degree of organisation; and that the *Echidnæ* and *Ornithorhynchi* may make a distinct sub-class.

In 1825 Dr. J. E. Gray published his 'Outline of an Attempt at the Disposition of Mammalia into Tribes and Families, with a List of the Genera apparently appertaining to each Tribe.' For the details we must refer the reader to the 'Annals of Philosophy' (vol. xxvi.), and the 'Catalogues of the British Museum.' We present here his 'Systematic List of the Genera of Mammalia.' The indented names are synonyms of the one that precedes them.

Order I. PRIMATES.

Family 1. *Hominidæ*.

Homo, Linn.

Family 2. *Simiadæ*.

Troglodytes, Geoff.
Pithecus, Cuv.
Anthropithecus, De Blainv.
Simia, Linn.
Pithecus, Geoff.
Pongo, Lacép.
Lophotus, G. Fischer.
Siamanga, Gray.
Hylobates, Geoff.
Hylobates, Illiger.
Presbytis, Eschsch.
Semnopithecus, F. Cuv.
Lasiopyga, Illiger.
Nasalis, Geoff.
Pygathrix, Geoff.
Colobus, Illiger (not Dum.).
Ateles, Geoff.
Cercopithecus, Buffon, Erxl., Geoff.
Cercocebus, Geoff.
Guenon Macaque, Lesson.
Macacus, Lacép.
Rhesus, Lesson.
Cercocebus, Lesson (not Geoff.).
Pithex, Hodgson.
Innus, Geoff.
Magus, Lesson.
Cynopithecus, Blainv.
Silenus, Lesson, Gray.
Ouida, Lesson, Gray.
Cynocephalus, Brisson.
Chæropithecus, De Blainv.
Sphinx, Lesson.
Hamadryas, Lesson.
Papio, Brisson, Geoff.
Mormon, Lesson.

Family 3. *Cebidæ*.

Ateles, Geoff.
Brachyteles, Spix.
Eriodes, I. Geoff.
Lagothrix, Geoff.
Gastromargus, Spix.
Mycetes, Illiger.
Stentor, Geoff.
Alouata, Lacép.
Cebus, Erxl., Cuv.
Sapajou and *Sai*, Lacép.
Callithrix, Erxl.
Saguinus, Lacép., Lesson.
Pithesciurus, Lesson.
Brachyurus, Spix.
Chiropotes, Lesson.
Cacajao, Lesson.
Pithecia, Desm.
Yarkea, Lesson.
Nyctipithecus, Spix.
Aotus, Illiger.
Nocthora, F. Cuv.
Aotes, Humb., Swain.
Chirogaleus, Vig. and Horsf., Wagler (not Geoff.).
Jacchus, Geoff.
Hapale, Illiger.
Mico, Lesson.
Arctopithecus, Geoff.
Callithrix, Wagler.
Midas, Geoff.
Œdipus, Lesson.
Leontopithecus, Lesson.
Marikina, Mikan.

Family 4. *Lemuridæ*.

Lemur, Linn.
Prosimia, Brisson.
Propithecus, Bennett.
Macromerus, A. Smith.
Lichanotus, Illiger.
Pithelemur, Lesson.
Loris, Geoff.
Stenops, Illiger.
Arachnocebus, Lesson.
Microcebus (?), Geoff.
Myscebus, Lesson.
Scartes, Swainson.
Gliscebus, Lesson.
Nycticebus, Geoff.
Stenops, Illiger.
Bradylemur, De Blainv.
Cucang, Cuv.
Tardigradus, Bodd.
Perodicticus, Bennett.
Potto, Bosm. (?), Lesson.
Indri, Geoff.
Lichanotus, Illiger, Wagler.
Indris, Geoff.
Avahi, Jourd.
Semnocebus, Lesson.
Otolicnus, Illiger.
Macropus, G. Fischer.
Galago, Cuv.
Khoyah, Cuv.
Chirogaleus, Geoff. (not Vig.).
Cebugale, Lesson.
Galago, Geoff.
Myoxicebus, Lesson.
Microcebus, Geoff.
Tarsius, Storr.
Prosimia, Bodd.
Macrotarsus, Lacép., Link.
Tarsier, Cuv.
Cephalopachus, Swainson.
Hypsicebus, Lesson.
Microcebus, Geoff. (?)
Cheiromys (?), Cuv.
Aie-Aie, Lacép.
Daubentonia, Geoff.
Myspithecus, Blainv.
Chiromys, Illiger.

Family 5. *Galeopithecidæ*.

Galeopithecus, Pallas.
Galeolemur, Lesson.
Galeopithecus, Temm.

Family 6. *Vespertilionidæ*.

a. Phyllostomina.

Sturnira, Gray.
Arctibeus, Leach.
Medateus, Leach.
Vampyrus, Geoff., Leach.
Phyllostoma, Geoff., Gray.
Pteropus, Erxl.
Phyllostomus, Illiger.
Carollia, Gray.
Lophostoma, D'Orbig.
Guandira, Gray.
Macrophyllum, Gray.
Phyllophora, Gray.
Glossophaga, Geoff.
Monophyllus, Leach.
Anoura, Gray.
Diphylla, Spix.
Stenoderma, Geoff.
Endostoma, D'Orbig.
Brachyphylla, Gray.
Desmodus, Pr. Max.
Macrotus, Gray (not Leach).
Rhinopoma, Geoff.
Megaderma, Geoff.
Phyllostomus, Illiger.
Lavia, Gray.

b. Rhinolophina.

Ariteus, Gray.
Istiophorus, Gray (not Cuv.).
Rhinolophus, Geoff.
Noctilio, Bechst., Kuhl.
Hipposideros, Gray.
Phyllorhina, Bonap.
Asellia, Gray.

c. Vespertilionina.

Nycteris, Geoff.
Petalia, Gray.
Nyctophilus, Leach.
Barbastellus, Gray.
Barbastellus, Gray.
Synotus, Blasius.
Plecotus, Geoff.
Macrotus, Leach.
Romicia, Gray.
Vespertilio, Linn.
Trilatitus, Gray.
Myotis, Gray.
Kerivoula, Gray.
Furia, F. Cuv. (not Linn.).
Furipterus, Bonap.
Natalus, Gray.
Miniopterus, Bonap.
Capaccinus, Bonap.
Scotophilus, Leach.
Vesperus and *Vesperugo*, Keysl. and Blasius.
Nyctalus, Bowditch, Lesson.
Noctulinia, Gray.
Vesperugo, part, Keysl. and Blasius.
Lasiurus, Rafin., Gray.
Atalapha, Rafin.
Nycticeyx, Wagler.
Murinia, Gray.
Harpiocephalus, Gray.
Nycticejus (?), Rafin.
Hypexodon (?), Rafin.

d. Noctilionina.

Taphozous, Geoff.
Saccopteryx, Illiger.
Saccolaimus, Kuhl.
Noctilio, Linn., Cuv.
Celæno, Leach.
Pteropus, Erxl.
Proboscidea, Spix.
Centronycteris, Gray.
Emballonura, Kuhl., Temm.
Urocryptus, Temm.
Ællo, Leach.
Mosia, Gray.
Mystacina, Gray.
Chilonycteris, Gray.
Lobostoma, Gundl.
Phyllodia, Gray.
Mormoops, Leach (not F. Cuv.).
Centurio, Gray.
Diclidurus, Pr. Max.
Pteronotus, Gray.
Cheiromeles, Horsf.
Nyctinomus, Geoff.
Dysopes, part, Temm.
Thyroptera, Spix.
Thyropterus, Bonap.
Molossus, Geoff.
Dysopes, Illiger (not F. Cuv.).
Dinops, Savi.
Tadarina, Blainv.
Myopteris, Geoff.
Myopterus, Lesson.
Mops (?), 'F. Cuv.,' Lesson.

e. Pteropina.

Pteropus, Brisson (not Bechst.).
Spectrum, Lacép.
Eleutherura, Gray.
Epomophorus, Bennett.
Xantharpyia, Gray.
Cynopterus, F. Cuv.
Pachysoma, I. Geoff.
Megæra, Temm.
Macroglossus, F. Cuv.
Macroglossa, Lesson.
Harpyia, Illiger.
Cephalotes, Geoff.
Gelasinus, Lesson (?).
Cephalotes, Geoff., F. Cuv.
Hypoderma, Geoff.
Acerodon, Jourdan.

Order II. FERÆ.

* Normales.

Family 1. *Felidæ*.

A. *Sanguinaria*.

a. Felina.

Leo, Leach, Gray.
Tigris, Gray.
Leopardus, Gray.
Puma, Jardine.
Felis, Linn.
Cattus, Brisson, Lesson.
Chaus, Gray.
Caracala, Gray.

Lyncus, Gray.
Lynchus, Jardine.
Lynx, Swains.
Gueparda, Gray.
Cynailurus, Wagler.
Cynofelis, Lesson.
Guepardus, Duvern.

b. *Hyænina.*

Hyæna, Brisson.
Crocuta, Gray.
Crocotta, Wagler.

B. *Necrophaga.*

c. *Viverrina.*

Proteles, I. Geoff.
Geocyon, Wagler.
Viverra, Linn., Gray.
Civetta, Geoff.
Viverricula, Hodgson.
Linsang, Müller.
Prionodon, Horsf. (not Cuv.).
Prionodontes, Lesson.
Genetta, Cuv., Gray.
Galidia, I. Geoff.
Galictis, Geoff. (not Bell).
Galidictis, I. Geoff.
Bassaris, Licht.
Mungos, Ogilby.
Atylax, F. Cuv.
Ichneumia, I. Geoff.
Lasiopus, I. Geoff.
Urva, Hodgson.
Mesobema, Hodgson.
Herpestes, Illiger.
Mangusta, Olivier.
Ichneumon, Lacép., Geoff.
Martes, Wagler (not Cuv.).
Cynictis, Ogilby.
Cynopus, I. Geoff.
Crossarchus, F. Cuv.
Rhyzæna β, Wagler.
Suricata, Desm.
Ryzæna, Illiger.
Hemigalea, Jourd.
Nanoinia, Gray.
Arctictis, Temm.
Ictides, Valenc.
Paguma, Gray.
Ambliodon, Jourd.
Paradoxurus, F. Cuv.
Platyschista, Otto.
Cynogale, Gray.
Potamophilus, Müller, Temm.
Lamictis, Blainv.
Cryptoprocta (?), Bennett.
Eupleres (?), Doyère.

d. *Canina.*

Cuon, Hodgson.
Primævus, Lesson.
Canis, Linn.
Lupus, Swains.
Lycaon, Lesson.
Sacalius, H. Smith.
Oxygöus, Hodgson.
Vulpicanis, Blainv.
Vulpes, Ray.
Otolicnus, G. Fischer.
Megalotis, Illiger.
Galago, Desm.
Fennecus, Desm., Child.
Nyctereutes, Temm.
Otocyon, Licht.
Megalotis, H. Smith.
Lycaon, Brooks.
Cynhyæna, F. Cuv.

e. *Mustelina.*

Martes, Cuv.
Putorius, Cuv.
Fœtorius, Keys. and Blas.
Mustela, Linn.
Putorius, part, Cuv.
Gymnopus, Gray.
Vison, Gray.
Zorilla, Gray.
Galera, Brown.
Eraria, Lund.
Grisonia, Gray.
Galictis, Bell (not I. Geoff.).
Huro, I. Geoff.
Eraria, Lund.
Mellivora, Storr, F. Cuv.
Ursus, Shaw.
Ratelus, Gray.
Ursitaxus, Hodgson.
Gulo, Storr.
Helictis, Gray.
Melogale, I. Geoff.
Mephitis, Cuv.
Chinchia, Gray, Lesson.
Marputius, Gray.
Thiosmus, part, Licht.
Conepatus, Gray.
Thiosmus, part, Licht.
Mydaus, F. Cuv.
Mephitis, Desm.
Arctonyx, F. Cuv.
Meles, Brisson.
Taxus, Cuv.
Taxidea, Waterh.
Meles, Sabine,
Lataxina, Gray.
Latax, Gray (not Gloger).
Lontra, Gray.
Saricoria, Lesson.
Lutra, Linn.
Aonyx, Lesson.
Aonix, Lesson.
Leptonix, Lesson.
Pteronura, Gray.
Pteronurus, Lesson.
Enhydra, Fleming.
Enhydris, Fischer.
Pusa, Oken.
Latax, Gloger (not Gray).

Family 2. *Ursidæ.*

a. *Ursina.*

Ursus, Linn.
Danis, Gray.
Helarctos, Horsf.
Melursus, Meyer.
Prochilus, Illiger.
Chondrorhynchus, G. Fischer.
Thalarctos, Gray.
Thalassarctos, Wiegm.

b. *Procyonina.*

Procyon, Storr.
Lotor, Tiedem.
Campsiurus, Link.
Nasua, Storr.
Coati, Lacép.
Campsiurus, Link.

c. *Cercoleptina.*

Cercoleptes, Ill., Desm.
Kinkajou, Lacép.
Potos, Cuv., Geoff.
Caudivolvulus, Dum., Tiedem.
Lemur, Penn.
Ursus, Linn.
Campsiurus, Link.

d. *Ailurina.*

Ailurus, F. Cuv.

** Abnormales.

Family 3. *Talpidæ.*

* *Fossores.*

a. *Talpina.*

Talpa, Linn.
Hylomys, Temm.

b. *Chrysochlorina.*

Scalops, Cuv.
Talpasorex, Lesson (not Schinz).
Chrsyochloris, Cuv.
Aspalax, Wagl. (not Oliv.).
Astromyctes, Harris.
Rhinaster, Wagler.
Condylura, Illiger.
Talpasorex, Schinz. (not Lesson).

** *Ambulatores.*

c. *Tupaina.*

Tupaia, Raffles.
Cladobates, F. Cuv.
Sorexglis, Diard.
Glisorex, Desmar.
Hylogale, Temm., Wagler.

d. *Erinacina.*

Macroscelides, A Smith.
Rhinomys, Licht.
Sorex, Linn.
Pachyura, Selys.
Crocidura, Wagler.
Suncus, Ehrenb.
Myosorex, Gray.
Corsira, Gray.
Amphisorex (No. 1), Duvern.
Blaria, Gray.
Blarina, Lesson.
Otisorex (?), Dekay.
Crossopus, Wagler.
Hydrosorex, Nath. Duvern.
Pinalia, Gray.
Solenodonta, Braut.
Solenodon, Lesson.
Myogalea, Fischer.
Mygale, Cuv. (not Fab.).
Caprios α, Wagler.
Galemys, Wagler.
Mygalina, I. Geoff.
Caprios β, Wagler.
Gymnura, Raffles, Lesson.
Echinosorex, De Blainv.
Echinops (?), Martin.
Erinaceus, Linn.

e. *Centetina.*

Centetes, Illger.
Centenes, Desm.
Setifer, Cuv.
Tenrec, Lacép.
Ericulus, I. Geoff.

Family 4. *Macropidæ.*

a. *Phalangistina.*

Acrobates, Desm.
Phalangista β, Wagler.
Petaurus, Shaw, F. Cuv.
Phalangista, Illiger.
Phalanger, Lacép.
Ptilotus, G. Fischer.
Belideus, Waterh.
Petaurista, Desm.
Schoinobates, Lesson.
Cuscus, Lacép., Lesson.
Coescocs, Dum.
Ailurops, Wagler.
Ceonyx, Temm.
Sipalus, G. Fischer.
Pithechier (?), F. Cuv.
Hepoona, White, Gray.
Pseudocheirus, Ogilby.
Trichosurus, Lesson.
Ptenos, Jourd.
Dromicia, Gray.
Phalangista, Cuv.
Balantia, Illiger.
Tarsipes, Gervais, Gray.
Phascolarctos, De Blainv.
Koala, Cuv.
Wombat, Knox.
Lipurus, Goldf.
Morodactylus, Goldf.

b. *Macropina.*

Dendrolegus, Temm.
Macropus, Shaw.
Kangurus, Lacép.
Halmaturus, Illiger.
Onichogalea, Gray.
Halmaturus, Illiger (?), F. Cuv.
Thylogale, Gray.
Setonix, Lesson.
Osphranter, Gould.
Petrogale, Gray.
Heteropus, Jourd.
Bettongia, Gray.
Pelandor, Gray.
Conoyces, Lesson.
Hypsiprymnus, Illiger.
Potorous, Desm.
Lagorchestes, Gould.
Phascolomys, Geoff., Illiger.
Wombatas, Geoff.
Amblotis, Illiger.

c. *Peramelina.*

Perameles, Geoff.
Thylacis, Illiger, Wagler.
Isoodon, Geoff.
Echymipera, Lesson.
Perigalea, Gray.
Chœropus, Ogilby (?), Gray.

d. *Dasyurina.*

Peracyon, Gray.
Thylacinus, part, Temm.
Lycaon, Wagler (not Less.).
Diabolus, Gray.
Sarcophilus, F. Cuv.
Thylacinus, part, Temm.
Dasyurus, Geoff., Temm.
Phascogale, Temm.
Antechinus, M'Leay.
Phascogale, part, Waterh.
Myrmecobius, Waterh.

e. *Didelphina.*

Didelphis, Linn.
Philander, Brisson.
Micoureus, Lesson (?).
Thylamys, Gray.
Peramys, Lesson (?).
Chironectes, Illig.

Family 5. *Phocidæ.*

a. *Stenorynchina.*

Pelagius, F. Cuv.
Stenorhynchus, F. Cuv.
Leptonyx, Gray.

b. *Phocina.*

Phoca, Linn.
Calocephalus, part, F. Cuv.
Calocephalus, part, F. Cuv.

c. *Trichecina.*

Halichœrus, Hornsch., Nilson.
Trichecus, Linn.
Odobenus, Brisson.
Rosmarus, Scopoli.

d. *Cystophorina.*

Cystophora, Nilson.
Stemmatopus, F. Cuv.
Morunga, Gray.
Macrorhinus, F. Cuv.
Rhinophoca, Wagler.

c. *Otariarina.*

Otaria, Pérou.
Otoës, G. Fischer.
Platyrhynchus, F. Cuv.
Arctocephalus, F. Cuv.

Order III. CETE (Linn.).

* *Cete.*

Family 1. *Balænidæ.*

Balæna, Linn., Lacép.
Balænoptera, Lacép.
Mysticetus, Wagler.
Catodon, Lacép.
Physalus, Lacép.
Physeter, Linn.
Cetus, Brisson.

Family 2. *Delphinidæ.*

Delphinus, Linn.
Tursio, Gray.
Delphinorhynchus, Lacép.
Beluga, Gray.
Phocæna, Cuv., Gray.
Grampus, Gray.
Globiocephalus, Lesson.
Cetus, Wagler.
Beluga, Gray.

Delphinapterus, Lacép.
Delphis, Wagler.
Inia, D'Orbign.
Orca, Wagler.
Heterodon, De Blainv.
Platanista, Gray, Wagler.
Susu, Lesson.
Monodon, Fab., Linn. (not Sw.).
Ceratodon, Briss., Illig.
Diodon, Storr (not Linn.)
Narwhalus, Lacép.
Ancylodon, Illig.
Anarnacus, Lesson.
Uperoodon, Lacép.
Uranodon, Illig.
Nodus, Wagler.
Aodon, Lesson.
Ananarcus, Lacép.
Epiodon (?), Rafin.
Oxypterus (?), Rafin.

** *Sirenia*.

Family 3. *Manatidæ*.

Manatus, Rondel, G. Cuv.
Trichecus, Linn.
Manati, Bodd.

Family 4. *Halicoridæ*.

Halicore, Illig.
Rosmarus, Bodd.
Dugungus, Tiedem.
Dugong, Lacép.

Family 5. *Rytinadæ*.

Rytina, Illig.
Stellerus, F. Cuv.
Hydrodamalis, Retz.

Order IV. GLIRES.

Family 1. *Muridæ*.

a. Murina.

Acanthomys, Gray.
Acomys, I. Geoff., Mss.
Acanthomys, part, Lesson.
Mus, Linn.
Micromys, Selys.
Hesperomys, Waterh.
Phyllotis, Waterh.
Scapteromys, Waterh.
Calomys, Waterh.
Eligmodontia, F. Cuv.
Nesokia, Gray.
Vandeleuria, Gray.
Pseudomys, Gray.
Golunda, Gray.
Leggada, Gray.
Holochilus, Brandt.
Holochyse, Lesson.
Oxymycterus, Waterh.
Abrothrix, Waterh.
Cricetomys, Waterh.
Cricetus, Cuv.
Dendromys, A. Smith.
Akodon, Meyen.
Phlæomys, Waterh.
Hapalotis, Licht.
Conilurus, Ogilby.
Notomys, Lesson.
Perognathus, Pr. Max.

b. Arvicolina.

Mystromys, Wagn.
Rhombomys, Wagn.
Psammomys, Rupp. (not Leconte.)
Ammomys, Bonap.
Meriones, F. Cuv.
Jaculus, Wagler.
Euryotis, Brandt.
Otomys, F. Cuv.
Otomys, A. Smith (not F. Cuv.).
Sigmodon, Say and Ord.
Neotoma, Say.
Teonoma, Gray.
Ellobodon.
Reithrodon, Waterh.
Ctenodactylus, Gray.
Arvicanthis, Lesson.
Arvicola, Lacép.
Hypudæus, Illiger.
Brachyurus, G. Fischer.
Hemiotomys, Selys.
Microtus, Selys.
Sminthus, Nordm.
Mynomes (?), Rafin.
Myodes, Pallas.
Lemmus, Ol. Mag., Cuv.
Hypudeus, Illig.
Cuniculus, Wagler.

c. Saccomyna.

Saccomys, F. Cuv.
Heteromys, Desm., Gray.
Dasynotus, Wagler.
Dipodomys, Gray.

d. Castorina.

Castor, Linn.
Myopotamus, Comm.
Potamys, Larr.
Hydromys, part, Geoff.
Fiber, Cuv.
Ondatra, Lacép.
Simotes, G. Fischer.
Guillinomys (?), Lesson.
Hydromys, Geoff.

e. Echimyna.

Habrocoma, Wagler.
Abrocoma, Waterh.
Octodon, Bennett.
Psammoryctes, Pöppig.
Psammoryctus, Lesson.
Poëphagomys, F. Cuv.
Oryctomys, Blainv.
Capromys, Desm.
Isodon, Say (not Geoff.).
Plagiodonta, F. Cuv.
Mysateles, Lesson.
Capromys, Pöppig.
Aulacodus, Temm.
Loncheres, Illig.
Nelomys, Jourdain.
Echimys, Geoff.
Phyllomys (?), Lund.
Cercomys, F. Cuv.
Dactylomys, I. Geoff.
Petromys.

Family 2. *Hystricidæ*.

a. Hystricina.

Hystrix.
Atherura, F. Cuv.
Acanthion (?), F. Cuv.

b. Cercolabina.

Erethizon.
Eretizon, Lesson.
Chætomys Gray.
Cercolabes, Brandt.
Coendu, Lacép.
Synetheres, F. Cuv.
Eucritus, G. Fischer.
Sphiggurus, F. Cuv.
Sphingura, Wagler.

c. Dasyproctina.

Dasyprocta, Illig.
Chloromys, F. Cuv.
Platypyga, Illiger.
Aguti, Lacép.
Dolichotis, Desm.
Chloromys, Cuv.
Mara, Lesson.
Cœlogenys, F. Cuv.
Osteopora, Harlan.

d. Hydrochærina.

Hydrochærus.

e. Caviina.

Cavia, Klein.
Cobaia, Cuv.
Anœma, F. Cuv.
Kerodon, F. Cuv.
Galea, Meyen.

Family 3. *Leporidæ*.

Lepus, Linn.
Cuniculus, Ray.
Lagomys, Geoff.
Pica, Lacép.
Ogotona, Link.

Family 4. *Jerboidæ*.

a. Chinchillina.

Chinchilla, Gray
Eriomys, Licht.
Callomys, I. Geoff.
Lagotis, Bennett.
Lagidium, Meyen.
Viscaccia, Schinz.
Lagostomus, Brooks.

b. Pedetina.

Helamys, F. Cuv.
Pedetes, Illiger.

c. Dipina.

Dipus, Linn.
Alactaga, F. Cuv.
Scirtites, Wagn.
Jaculus, Erxl. (not Wagler).
Gerbillus, F. Cuv.
Meriones, Illiger, Wagler.
Psammomys, Rüppell.

d. Myoxina.

Myoxus, Schreb.
Glis, Brisson.
Muscardinus, Ray.
Graphiurus, F. Cuv.
Eliomys, Wagler.

e. Sciurina.

Anomalurus, Waterh.
Aroæthrus, Waterh.
Pteromys, Cuv.
Petauristus, G. Fischer.
Sciuropterus, F. Cuv.
Sciurus, Linn.
Funambulus, Lesson.
Macroxus, F. Cuv.
Rhinosciurus, Gray.
Xerus, Ehrenb.
Geosciurus, A. Smith.
Spermosciurus, Lesson.
Tamias, Illiger.
Spermophilus, F. Cuv.
Cynomys (?), Rafin.
Citillus, Pallas.
Arctomys, Schreb.

Family 5. *Aspalacidæ*.

Spalax, Guldenst.
Aspalax, Olivier.
Aspalomys, Laxm.
Ommatostergos, Blas. and Keys.
Siphneus, Brandt.
Chthonocrgus, Blas. and Keys.
Lemmomys, Lesson.
Georychus, Illiger.
Oryeterus, F. Cuv.
Bathyergus, Illiger.
Ellobius, G. Fischer.
Fossor, Forster.
Saccophorus, Kuhl.
Geomys, Rafin.
Ascomys, Licht., Wagler.
Pseudostoma, Say.
Diplostoma, Say, Richards.
Thomomys, Pr. Max.
Orycteromys, Blainv.
Chrysomys, Gray.
Bathyergus, Rüppell.
Rhizomys, part, Rüppell.
Aplodontia, Richards.
Anisonyx (?), Raf.
Haplodon, Wagler.
Ctenomys, Blainv.
Rhizomys, Gray.
Nyctocleptes, Temm.
Aspalomys, Gervais.

Order V. UNGULATA.

* *Furcipeda*.

Pecora, Linn.

Family 1. *Bovidæ*, Gray.

a. Bovina.

Bos, Linn.
Taurus, H. Smith.
Bison and *Bibos*, Hodgson.
Bubalus, H. Smith (not Ogilby), Hodgson.
Poëphagus, Gray.
Ovibos, Blainv.
Anoa, Leach, H. Smith.
Catoblepas, Gray.
Connochetes, Licht.
Bos, Forster.
Portax, H. Smith.
Boselaphus, Blainv.
Tragelaphus, Ogilby.
Strepsiceros, H. Smith.
Calliope, Ogilby.
Boselaphus, H. Smith.
Oryx, Blainv., H. Smith.
Kemas, H. Smith (not Ogilby).
Pantholops, Hodgson.
Acronotus, H. Smith.
Bubalus, Ogilby.
Alcelaphus, Blainv.
Bubalides, Licht.
Damalis, H. Smith.
Ægocerus, Desm., H. Smith.
Kolus, A. Smith.
Tetracerus, Leach.
Cervicapra, Blainv.
Antilope, Ogilby.
Gazella, H. Smith, Ogilby.
Dorcas, Bennett.
Antilope, Pallas, H. Smith.
Saiga, Gray.
Cephalophorus, H. Smith.
Sylvicapra, Ogilby.
Grimmia, Laur.
Madoqua, Ogilby.
Neotragus, H. Smith.
Oreotragus
Tragulus, H. Smith, Ogilby
Eleotragus, Gray.
Redunca, H. Smith (?).
Nagor, Laur. (?).
Sylvicapra, Ogilby.
Raphicerus (?), H. Smith.
Tragelaphus, H. Smith.
Nemorrhedus, H. Smith.
Kemas, Ogilby.
Capricornis, Ogilby.
Rupicapra, H. Smith.
Aplocerus, H. Smith.
Antilocapra, part, Ord.
Capra, Ogilby.
Dicranocerus, H. Smith.
Mazama, Ogilby (not Smith).
Capra, Linn.
Hircus, Brisson.
Hemicapra, Hodgson.
Kemas, Ogilby.
Hemitragus, Hodgson.
Ovis, Linn.
Aries, Brisson.
Musmon, Schrank.
Ixalus (?), Ogilby.
Antilocapra, Ord.
Mazama, Rafin.
Oreammos, Rafin.

b. Camelopardina.

Camelopardalis, Gmelin, Illiger.
Giraffa, Brisson, Scop.

c. Camelina.

Camelus, Linn.
Lama, Cuv.
Auchenia, Illiger (not Marshall).
Dromedarius, Wagler.

d. Moschina.

Moschus, Linn., Pallas.
Meminna, Gray.
Tragulus, Brisson, Gray (not Ogilby).
Napu, Lesson.
Tragus, Klein.

e. Cervina.

Muntjacus, Gray.
Stylocerus, H. Smith.
Cervulus, De Blainv.
Prox, Ogilby.
Coassus, Gray.
Subula, H. Smith, Lesson.
Cariacus, Gray.
Mazama, H. Smith (not Rafin.).
Capreolus, Brisson, Gray, H. Smith (not Ogilby).
Caprea, Ogilby.
Cervus, Linn.
Elaphus, H. Smith.
Axis, H. Smith, Ogilby.
Rusa, H. Smith, Hodgson.
Rucervus, Hodgson.
Hippelaphus, Gray.
Pseudocervus, Hodgson.
Panolia, Gray.
Dama, Gray, H. Smith (not Bennett).
Rangifer, H. Smith.
Tarandus, Gray, Ogilby.
Alces, H. Smith, Ogilby.

Family 2. *Equidæ.*

Equus, Linn., Gray.
Asinus, Gray.

** *Belluæ* and *Bruta*, Linn.

Family 3. *Elephantidæ.*

a. Elephantina.

Elephas, Linn.
Loxodonta, F. Cuv.

b. Tapirina.

Tapirus, Brisson,
Tapir, Zimmerman.
Rhinochœrus, Wagler.

c. Suina.

Sus, Linn., F. Cuv.
Babirussa, F. Cuv.
Porcus, Wagler.
Suckoteirus (?), Shaw.
Koiropotamus, Gray.
Phascochœrus, Cuv.
Eureodon, G. Fischer.
Dicotyles, Cuv.
Notophorus, G. Fischer.

d. Rhinocerina.

Rhinoceros, Linn.

Hyrax, Herm.
Lipura, Illiger.
Cavia, Pallas.

e. Hippopotamina.

Hippopotamus, Linn.

Family 4. *Dasypidæ.*

a. Manina.

Manis, Linn.
Pamphractus, Illiger.
Pholidotus, Brisson.
Pangolinus, Raf.
Phatiginus, Raf.

b. Dasypina.

Dasypus, Linn.
Tolypeutes, Illiger.
Cataphracta, Storr.
Dasypus, Linn., F. Cuv.
Armadillo, Brisson.
Tatusia, F. Cuv.
Euphractus, Wagler.
Xenurus, Wagler.
Priodontes, F. Cuv.
Prionodon, Gray (not Horsf.).
Chiloniscus, Wagler.
Chlamyphorus, Harlan.

c. Orycteropina.

Orycteropus, Geoff.

d. Myrmecophagina.

Myrmecophaga, Linn., Gray.
Tamandua, Gray, F. Cuv.
Uroleptes, Wagler.
Cyclothurus, Gray.
Myrmydon, Wagler.
Didactylis, F. Cuv.

e. Ornithorhynchina.

Platypus, Shaw.
Ornithorhynchus, Blum.
Dermipes, Wiegm.
Echidna, Cuv.
Tachyglossus, Illiger.

Family 5. *Bradypidæ.*

Cholœpus, Illiger.
Bradypus, F. Cuv.
Bradypus, Linn., Illiger.
Tardigradus, Brisson.
Arctopithecus, Gesner.
Achæus, F. Cuv.

Mr. Swainson, who does not admit Man into the zoological circle for reasons stated in his 'Natural History and Classification of Quadrupeds' (1836), gives in the third part of his book an arrangement of 'the Class *Mammalia*, according to its natural affinities.' He makes the *Quadrumana*, the first order, consist of the following families:—1, *Simiadæ*. 2, *Cebidæ*. 3, *Lemuridæ*. 4, *Vespertilionidæ*, consisting of Dr. Gray's sub-families *Rhinolophina*, *Phyllostomina*, *Pteropina*, *Noctilionina*, and *Vespertilionina*.

The second order, *Feræ*, includes the families—1, *Felidæ*. 2, *Mustelidæ*, consisting of the sub-families *Viverinæ* (*Viverrinæ*), *Mustelinæ*, and *Ursinæ*. 3, *Didelphidæ* (Opossums). 4, *Soricidæ*. 5, *Phocidæ*.

The third order, *Cetacea*, comprehends the families—1, *Sirenia* (Herbivorous *Cetacea*). 2, *Cete*, with the sub-families *Delphinæ* and *Balæninæ* (?).

The fourth order, *Ungulata*, embraces—Tribe 1, *Pachydermes*. Tribe 2, *Anoplotheres*. Tribe 3, *Edentates*, including the *Monotremes*. Tribe 4, *Ruminantes* (comprehending the families—1, *Bovidæ*. 2, *Antilopidæ*. 3, *Cervidæ*. 4, *Moschidæ*. 5, *Camelopardæ*). Tribe 5, *Solipedes*.

The fifth order, *Glires*, consists of—Division 1, *Glires* proper, with clavicles. Division 2, Clavicles rudimentary or none.

Immediately following the genus *Cavia* and its sub-genera we find the 'Marsupial *Rodentia*, situation uncertain;' and next to them the family '*Marsupidæ*' (Herbivorous Marsupials), formed of the genera *Halmaturus*, *Hypsiprymnus*, and *Phalangista*, the latter with two sub-genera, *Petaurista* and *Petaurus*.

The works of Buffon can hardly be said to present any principle of classification as applicable to the *Mammalia*. Pennant indeed gives what he calls a systematic index of the genera, species, and varieties, and divides the Quadrupeds into two grand divisions (the first without a name, and including:—1, Horse; 2, Ox; 3, Sheep; 4, Goat; 5, Giraffe; 6, Antelope; 7, Deer; 8, Musk; 9, Camel; 10, Hog; 11, Rhinoceros; 12, Hippopotame; 13, Tapir; 14, Elephant, as generic appellations: and the second grand division, with the name of Digitated Quadrupeds, including the genera (Section 1)—15, Ape; 16, Macauco; (Section 2)—17, Dog; 18, Hyæna; 19, Cat; 20, Bear; 21, Badger; 22, Opossum; 23, Weasel; 24, Otter; (Section 3)—25, Cavy; 26, Hare; 27, Beaver; 28, Porcupine; 29, Marmot; 30, Squirrel; 31, Jerboa; 32, Rat; 33, Shrew; 34, Mole; 35, Hedgehog; 36, Sloth; 37, Armadillo; 38, Manis; 39, Ant-Eater; 40, Walrus; 41, Seal; 42, Manati; 43, Bat); but this catalogue can hardly be called systematic. In his later editions he formed his catalogue into a more complete 'Method,' with four grand divisions:—1, Hoofed Quadrupeds; 2, Digitated; 3, Pinnated; 4, Winged; but his work will always be consulted more for the natural history of the 'Quadrupeds' there treated of than for their arrangement.

For further information the reader must consult the works of Pallas, Allamand, Schreber, Shaw, Marcgrave, Catesby, Hernandez, D'Azara, Sonnerat, Steller, Sparrman, Le Vaillant, Bruce, Barrow, Burchell, Humboldt, Peron, Lesueur, Fischer, Lesson, Rüppell, Smith, Richardson, Bennett, Bell, Owen, Ogilby, Sykes, Darwin, and a host of others, who have enriched the subject by their writings or the observations which they have made in their travels.

MAMMARY GLANDS, LACTEAL GLANDS, or MAMMÆ, are organs of considerable interest from their occurring only in that important class of animals to which they give a name [MAMMALIA], and whose greatest peculiarity is that, while young, their food is the milk secreted by the mammary gland of their mother.

The number of mammary glands varies in different animals. They are composed of ramified ducts which open on the surface of a nipple or teat by a very minute orifice. In some animals, as ruminants, there is but one orifice at the extremity of each nipple; in others, and in man, there are several. Each orifice leads into a fine canal, which however soon dilates, and ramifies with irregular and tortuous branches in the substance of the breast or udder. Each branch has either a simple closed extremity or terminates in a minute cellule, and numerous capillary blood-vessels ramify on their walls and secrete the milk into them. When the mouth of the young animal, by the action of sucking, produces a partial vacuum over the nipple, the weight of the surrounding medium presses lightly and equally upon the surface of the breast or udder, and propels the milk from the ducts in minute and gentle streams.

With respect to their structure, the lacteal glands, in all essential particulars completely correspond with the larger racemose glands, for instance, the parotid and the pancreas. Each gland consists of 15, 24, or more irregular flattened lobes, $\frac{1}{2}''$ to $1''$ wide, with a rounded, angular outline, which, although their cavities are quite distinct from each other, cannot externally always be definitely separated. Each is composed of a certain number of smaller and smallest lobules, and these lastly of gland-vesicles. The latter are rounded or pyriform, $0\cdot05'''$—$0\cdot07'''$ in size, with a distinct construction between them and the smallest excretory duct, as for instance in the small mucous glands, and as everywhere else are formed of a structureless membrane and tesselated epithelium, which at the time of lactation undergoes peculiar metamorphoses. All these glandular elements are surrounded by dense white connective tissue, particularly abundant between the gland vesicles and smaller lobules, and are united into a compact large glandular mass, which is ultimately covered by a quantity of adipose tissue, or in part by the skin. The lacteal glands are properly speaking not simple glands, but like the lachrymal, aggregations of these. From each glandular lobe by the coalescence of the excretory ducts of the smaller and larger lobules, there ultimately proceeds a shorter or longer duct, $1'''$—$2'''$ in diameter, the lacteal duct or canal (ductus lactiferus or galactophorus), which running towards the nipple dilates beneath the areola into an elongated sacculus, $2'''$—$4'''$ wide, the lacteal sac or receptacle (sacculus or sinus lactiferus), afterwards contracting to $1'''$ or $\frac{1}{2}'''$ it bends round into the nipple, and ultimately opens at its apex, in an independent orifice, not more than $\frac{1}{3}'''$—$\frac{1}{2}'''$ in diameter, between the papillæ that exist in that situation. All these excretory ducts, besides an epithelium, which in the largest of them presents cylindrical cells $0\cdot006'''$—$0\cdot001'''$ long, and in the finer ramifications rounded polygonal smaller cells, and a homogeneous layer beneath them, also possess a white dense fibrous membrane longitudinally plicated in the larger canals, in which hitherto no muscular fibres have been discovered, nothing but a nucleated longitudinally fibrous connective tissue, with fine elastic fibres. Henle however more recently thinks that he has noticed longitudinal muscles in the lacteal ducts; not those of the nipple, but more deeply within the gland.

The nipple (mamilla) and the areola present numerous smooth muscles to which the contractibility of those parts is owing. The bloodvessels of the lacteal glands are numerous, and surround the gland-vesicles with a rather close plexus of capillaries. The veins in the areola constitute a circle which is not always quite complete. The lymphatics are equally abundant in the skin covering the gland, whilst in the gland itself they have not yet been demonstrated. The nerves of the skin covering the mamma are derived from the supraclavicular nerves, and the cutaneous branches of the second, third, and fourth intercostals. In the interior of the gland no other nerves can be traced than a few fine twigs accompanying the vessels, whose termination is unknown.

The lacteal gland in its development follows the same course as the other cutaneous glands, and is, according to Langer, originally nothing but a solid papillary projection of the mucous layer of the epidermis, which is invested by a layer of denser dermal tissue. In the sixth to the seventh month it throws out a certain number of buds, and in this way arise the first rudiments of the subsequent lobes. These are, at first, nothing but minute pyriform or flask-shaped processes of the common rudiment of the gland, which do not separate from each other until towards the end of fœtal life, at which time they open externally; whilst at the same time rounded or elongated buds begin to appear at their ends, which at this time are also solid. At the period of birth the gland measures from $1\frac{1}{4}'''$—$4'''$, and already distinctly exhibits a certain number (12—15) of divisions, of which the internal still approximate. The rudimentary papillæ in fact have either simple flask-like ends, or terminate in two or three sinuosities; whilst the others are in connection with a greater number. The excretory duct of each of these rudimentary lobules, which is either simple or possesses two or three branches, is composed of a fibrous membrane of immature nucleated connective tissue, and an epithelium of small cylindrical cells, and is manifestly hollow; whilst the dilated ends, which cannot in this case, any more than in other glands in the process of development, at this time be termed terminal vesicles, are still solid; being wholly composed, besides the fibrous tunic continued upon them, from the ducts of minute nucleated cells. From this very simple form the latter one is thus developed; by the long-continued germination of the primary and subsequently-formed clavate ends, and their simultaneous excavation, a much-branched duct, beset in its offsets with whole groups of hollow gland-vesicles, is at last formed.

At the commencement of pregnancy the mammary gland, which up to the period of puberty had been but little developed, enlarges; its increase of size keeps pace with the progress of gestation, and before its termination a thin serous milky fluid begins to be secreted. Directly after parturition the quantity of milk increases, and it becomes more thick and rich, combining in itself all the best principles for the nourishment of the young animal. It continues to flow for a length of time proportioned to the age at which the young animal can seek its own food, and then gradually subsiding, the gland decreases to the same size which it had before pregnancy.

The Milk, the secretion of the mammary glands, consists of a fluid, the milk-plasma, and innumerable spherical opaque corpuscles, with the brilliant aspect of fat-drops suspended in it. These corpuscles—the milk-globules—vary in size from immeasurable minuteness up to $0{\cdot}001'''$—$0{\cdot}002'''$, and more, and most probably do not consist of the fatty part of the milk alone, but have also a delicate investment of casein, and it is to them that the whiteness of the milk is owing. With respect to the formation of the milk, it is to be remarked that, except at the periods of lactation and pregnancy, the glands contain nothing but a small quantity of yellowish viscid mucous, with a certain number of epithelial cells, and are lined up to their extremities by an epithelium, which in that situation is tesselated, but externally is more cylindrical. With conception this state of things is altered. The cells of the gland-vesicles begin to develop, at first a little, and subsequently more and more fatty matter within them, and to enlarge, so as to fill the terminal vesicles. To this is added, before the end of pregnancy, a new formation of fat, containing cells in them, by which the older cells are forced into lactiferous ducts, which they gradually fill. Thus it happens, that although a true secretion is not at that time set up, still in the latter half of pregnancy a few drops of fluid may be expressed from the gland, which, as is shown by its yellow colour, is not milk, but nevertheless contains a certain number of fat-globules from the more or less disintegrated fatty cells, exactly resembling the subsequent milk-globules, and also contains such cells either with or without a tunic, the so-termed colostrum corpuscles. On the commencement of lactation after parturition the cell-formation in the gland-vesicles proceeds with excessive energy, in consequence of which the secretion collected in the lactiferous ducts and gland-vesicles is evacuated as the colostrum or immature milk, the true milk taking its place. The latter in the extremities of the gland consists only of some fluid and cells entirely filled with fat-globules, which sometimes occupy the gland-vesicles alone, sometimes associated with pale epithelial cells, which however always contain more or less fat, and originate either in a free cell-formation or from epithelial cells, in a way analogous to that in which the cutaneous sebaceous matter is formed, by their continued multiplication. These cells, which Kölliker designates as milk-cells, break up so soon as they reach the lactiferous ducts into their elements, the milk-globules, the membrane, and for the most part also the nucleus, disappearing without a vestige being left, so that the milk when secreted usually presents no indication of its mode of origin. At most there occur in it a very few larger or smaller aggregations of milk-globules, which from their similarity to those met with in the colostrum may likewise be termed colostrum corpuscles. The secretion of the milk therefore depends essentially upon a formation of fluid and fat containing cells in the gland-vesicles, and consequently falls into the category of those secretions into the composition of which morphological elements enter; above all to the fatty secretions, such as the cutaneous sebaceous matter, in which cells of a precisely similar kind occur to those met with in the gland-vesicles of the lacteal glands and in the colostrum.

(Kölliker, *Manual of Human Histology.*)

MAMMEA, a genus of Plants belonging to the natural order *Guttiferæ*. It has two deciduous equal sepals; 4 or 6 petals, coriaceous, somewhat equal, and deciduous; stamens distinct, or slightly united at the base, indefinite, deciduous; filaments short; anthers adnate, 2-celled, opening longitudinally; ovary 4-celled; ovule solitary, erect; style short; stigma 4-lobed, with emarginate lobes; fruit pointed by the remains of the style, with a hard putamen and fleshy rind; 4- or by abortion 2- or 3-celled; seeds thick and large.

M. Americana, or the American Mammee-tree, the only species of this genus, forms a handsome tree with a spreading elegant head, which is compared with that of a *Magnolia*. The flowers are odoriferous, and employed as an aromatic addition to liqueurs called Eau and Crême des Creoles in some of the West India Islands. The fruit is large and has a double rind, of which the outer is thick and leathery; the inner one is thin and bitter, and contains the pulp closely adhering to it, which is of a yellow apricot-colour, whence it is sometimes called Abricot de Saint Domingue. This pulp has a pleasant but peculiar taste with an aromatic smell; it may be eaten raw, or cut in slices, with wine or sugar; or cooked, which deprives it of its gummy portion. It is also preserved in wine sweetened with sugar, or in brandy. (Labat.) The fruit is considered nourishing and pectoral, and is much esteemed in America. The bark abounds in a strong resinous gum, used by the negroes for extracting chigoes from their feet. A bath of the bark renders the soles of the feet like Mangrove bark. Attempts have been made to cultivate it in stoves in this country. According to Sweet, it grows freely in sandy loam; and ripened cuttings, with the leaves not shortened, root in sand under a hand-glass in heat.

MAMMELLIPORA. Bronn proposes this name instead of *Lymnorea*, Lam., for a genus of Fossil Zoophyta, analogous to *Alcyonium*. [LYMNOREA.]

MAMMOTH, a term employed to designate the Fossil Elephants. The name has been erroneously applied sometimes to the Mastodon. [ELEPHANT.]

MAN, the highest being in the animal series. Although attempts have been often made to establish a close affinity between man and the highest forms of *Mammalia*, the most recent writers on the structure of the higher forms of animals are inclined to place him not only as a species and genus distinct from all others, but as occupying a position of ordinal value. Thus Professor Owen says, "Man is the sole species of his genus, the sole representative of his order."

The study of man may be pursued under three different heads. Thus we may examine the structure of the organs of his body and the functions they perform, and this constitutes the sciences of Human Anatomy and Physiology. We may also compare his structure with that of the lower animals from a zoological point of view, using our anatomical and physiological knowledge for this purpose. This is called the science of Anthropology. In the third place we may study him in his relations to himself, and consider the varieties he presents. This constitutes the science of Ethnology. All these departments of science are contemplated in the natural history of man.

In this work the anatomy and physiology of man are treated under the various separate heads of the organs and functions of man. In the present article we address ourselves to the principal features of the sciences of Anthropology and Ethnology. The following apothegms by Dr. Robert Gordon Latham, to whom the science of ethnology is deeply indebted, will present to the reader a view of the object and range of these sciences:—

1. The natural history of man is chiefly divided between two subjects—Anthropology and Ethnology.

2. Anthropology determines the relations of man to the other *Mammalia*.

3. Ethnology the relations of the different varieties of mankind to each other.

4. Anthropology is more immediately connected with zoology; ethnology with history.

5. Whilst history represents the actions of men as determined by moral, ethnology ascertains the effects of physical influences.

6. History collects its facts from testimony, and ethnology does the same; but ethnology deals with problems upon which history is silent, by arguing backwards, from effect to cause.

7. This throws the arena of the ethnologist into an earlier period of the world's history than that of the proper historian.

8. It is the method of arguing from effect to cause which gives to ethnology its scientific in opposition to its literary aspect; placing it, thereby, in the same category with geology, as a palæontological science. Hence it is the science of a method—a method by which inference does the work of testimony. Furthermore, ethnology is history in respect to its results; geology in respect to its method. And in the same way that geology has its zoological, physiological, and such other aspects as constitute it a mixed science, ethnology has them also.

9. The chief ethnological problems are those connected with—1, the unity; 2, the geographical origin; 3, the antiquity; 4, the future destination upon earth of man.

10. Ethnological facts are physical or moral—physical, as when we determine a class from the colour of the skin; moral, as when we determine one from the purity or impurity of the habits.

11. Moral characteristics are either philological (that is, connected with the language), or non-philological (that is, not so connected).

12. A protoplast is an organised individual, capable (either singly or as one of a pair) of propagating individuals; itself having been propagated by no such previous individual or pair.

13. Hence, a species is a class of individuals, each of which is hypothetically considered to be the descendant of the same protoplast, or of the same pair of protoplasts.

14. A variety is a class of individuals, each belonging to the same species, but each differing from other individuals of the same species in points wherein they agree amongst each other.

15. A race is a class of individuals concerning which there are doubts as to whether they constitute a separate species or a variety of a recognised one.

Two interesting questions arise out of the study of man's relation to the lower animals, and the differences he presents in various parts of the world. The first is his distinctness as a species from all the lower animals; and the second, the specific unity of all men. In pointing out the structural differences between man and the lower animals, we shall find conclusive evidence of his specific distinctness from the highest forms of *Mammalia*. The second question has been put in the following form by an eloquent writer:—"Does the Bosjesman, who lives in holes and caves, and devours ants' eggs, locusts, and snakes, belong to the same species as the men who luxuriated in the hanging gardens of Babylon—or walked the olive-grove of Academe—or sat enthroned in the imperial homes of the Cæsars—or reposed in the marble palaces of the Adriatic—or held sumptuous festivals in the gay salons of Versailles? Can the grovelling Wawa, prostrate before his fetish, claim a community of origin with those whose religious sentiments inspired them to pile the prodigious temples of Thebes and Memphis—to carve the friezes of the Parthenon—or to raise the heaven-pointed arches of Cologne? That ignorant Ibo, muttering his all but inarticulate prayer—is he of the same ultimate ancestry as those who sang deathless strains in honour of Olympian Jove or of Pallas Athenè—or of those who, in a purer worship, are chanting their glorious hymns or solemn litanies in the churches of Christendom? That Alfouro woman, with her flattened face, transverse nostrils, thick lips, wide mouth, projecting teeth, eyes half-closed by the loose swollen upper eyelids, ears circular, pendulous, and flapping, the hue of her skin of a smoky black, and (by way of ornament!) the septum of her nose pierced with a round stick some inches long—is she of the same original parentage as those whose transcendant and perilous beauty brought unnumbered woes on the people of ancient story, convulsed kingdoms, entranced poets, and made scholars and sages forget their wisdom? Did they all spring from one common mother? Were Helen of Greece, and Cleopatra of Egypt, and Joanna of Arragon, and Rosamond of England, and Mary of Scotland, and the Eloïses, and Lauras, and Ianthes—were all these, and our poor Alfouro, daughters of her who was fairer than any of them—Eve? The Quaigua, or Saboo, whose language is described as consisting of certain snapping, hissing, grunting sounds—all more or less nasal—is he too of the same descent as those whose eloquent voices 'fulmined over Greece,' or shook the forum of Rome—or as that saint and father of the church surnamed the 'golden-mouthed'—or as those whose accents have thrilled all hearts with indignation, or melted them with pity and ruth, in the time-honoured halls of Westminster?"

We shall find as we proceed that the evidence of relation of structure is so strong, and of descent from a common pair so evident, that we cannot but answer this question in the affirmative.

We shall first speak of the bony or osseous structure of man, referring the reader to the articles CHIMPANZEE, LOCOMOTION IN ANIMALS, and SKELETON, for illustrations of the various points of structure spoken of, and also for comparison with the lower animals.

In every part of the human frame we find adaptations to the erect attitude, the most peculiar characteristic of mankind. Examining the skeleton, we find that the two condyles, or articulating surfaces of the occiput, by which the skull is connected with the spine, are so placed on each side, that a vertical line passing through the centre of gravity of the head would fall almost exactly between them and on the top of the spine. The condyles are not placed at the very centre of the base of the skull, but just behind it, so as to compensate in some measure for the greater specific gravity of the posterior part of the head, which is composed chiefly of thick heavy bone and brain, while the anterior is formed in part by the light bones of the face, and contains numerous cavities. Still however there is a slight preponderance in front of the condyles, which, when the head is not held up by some external force, tends to carry it forwards and downwards, as we may see in persons falling asleep in the erect posture. But the muscles attached to the back of the head are far larger and more numerous, as well as more conveniently arranged for the full exercise of their power, than those in front of the condyles; and the effort required of them to hold up the head is so slight, that it may be made throughout the day without producing fatigue.

The surfaces of these condyles moreover have a horizontal direction (when the head is held upright), and thus the weight of the skull falls vertically upon them and the top of the vertebral column. Comparing with these arrangements the position and direction of the occipital condyles in other *Mammalia*, we find that in the latter they are placed much nearer the back of the head, and that their plane is more oblique. Thus, if a line be drawn in the median plane along the base of a human skull, the foramen magnum and occipital condyles will be found immediately behind the point at which that line is bisected; while in the chimpanzee (in which also the condyles are proportionally smaller) the same parts are placed in the middle of the posterior third of a line similarly drawn, and in other animals are still farther back. Hence there is in all animals a greater proportion of the weight of the head in front of the vertebral column than there is in man; and all the parts anterior to the condyles are proportionally shorter in man than in other *Mammalia*, in which the jaws, the bony palate, the basilar part of the occipital bone, and the petrous portions of the temporal, are always long and large.

Besides being placed so far behind the centre of gravity of the head, the condyles of other *Mammalia* are directed more obliquely downwards than those of man; so that, if the head were supported on the top of a vertical column, its weight (even if it fell entirely upon the condyles) would press on an inclined plane, and constantly tend to carry the head forwards and downwards. The degree of obliquity in the direction of the condyles varies in different animals. It may be nearly estimated by the angle formed by two lines, one of which is drawn in the plane of the occipital foramen, and the other from its posterior edge to the lower margin of the orbit. This angle is of 3° in man, and of 37° in the orang-outan; but in the horse it is 90°, the plane of the foramen being vertical. If therefore the natural posture of man were horizontal, he would in this respect be circumstanced like the horse, for the plane of his condyles, which is nearly horizontal in the upright position, would then be vertical; the head, instead of being nearly balanced on the top of the column, would hang at the end of the neck, and its whole weight would have to be suppported by some external and constantly-acting power. But for this there is neither in the skeleton nor in the muscular system of man any adequate provision. In other *Mammalia* the head is maintained in such a position by a strong and thick ligament (ligamentum nuchæ), which passes from the spines of the cervical and dorsal vertebræ to the most prominent part of the occiput, but of which in man there is little or no trace. In the horizontal position therefore he would have the heaviest head, with the least power of supporting it.

The position of the face immediately beneath the brain, so that its front is nearly in the same plane as the forehead, is peculiarly characteristic of man; for the crania of the chimpanzee and orang, which approach nearest to that of man, are altogether posterior to and not above the face. This form, at the same time that it remarkably distinguishes the human from the brute features, is exactly adapted to the erect attitude. In that posture the plane of the orbits is nearly horizontal; the cavities of the nose are in the best direction for inhaling odours, proceeding from before or from below them; the jaws do not project in front of the forehead and chin. But suppose the posture changed, as painful an effort would be required to examine an object in front of the body as is now necessary to keep the eyes fixed on the zenith, and the heavens would be almost hidden from our view; the nose would be unable to perceive any other odours than those which proceeded from the earth or from the body itself; and the teeth and lips would be almost useless, for they would scarcely touch an object on the ground before the forehead and chin were in contact with it; while the view of that which they attempted to seize would be obscured by the nose and cheeks.

The vertebral column in man, though not absolutely straight, yet has its curves so arranged, that when the body is in the erect posture, a vertical line drawn from its summit would fall exactly on the centre of its base. It increases in size in the lumbar region, and is therefore somewhat pyramidal in form. The lumbar portion of the human vertebral column is also of considerable length, and is composed of five vertebræ; while in the chimpanzee and orang there are but four. The processes for the attachment of muscles upon it are long and strong; an arrangement well adapted to overcome the tendency which the weight of the viscera in front of the column has to draw it forwards and downwards. Thus the spinous processes of the cervical and dorsal vertebræ, which are in other *Mammalia* large and strong for the attachment of the ligamentum nuchæ to support the head, are in man scarcely prominent, and his head is nearly balanced on the vertebral column; while those of the lumbar vertebræ, by which the weight of the thoracic and abdominal viscera is partly supported, are proportionally much larger in man than in other *Mammalia*.

The base of the human vertebral column is placed on a sacrum of greater proportional breadth than that of any other animal, and remarkably arched forwards. The sacrum is again fixed between two widely-expanded haunch-bones, forming the lateral walls of a peculiarly broad pelvis. By its great width the pelvis forms an ample cavity for the support and defence of many of the viscera, and especially of the pregnant uterus: by the distant separation of the haunches and thighs the basis of support is rendered wider, and by its oblique direction the weight of the body is transmitted more directly from

Man is further remarkable for his slow growth, and for the length of time during which he remains in a state of helpless infancy and of youth. The process of ossification and the closure of the sutures of the skull are completed later in him than in any other animal: he is unable to seek his own food for at least the first three years of his life, and does not attain to the adult period or to his full stature till he is from 15 to 20 years old. The length of time to which his life may be prolonged is however proportionally greater than that of any animal, and is especially interesting when compared with that of those who in many respects resemble him. The greatest longevity to which the orangs attain is about 30 years, while in all nations of men instances occur of life being prolonged to upwards of 100 years.

However widely man may be distinguished from other animals in the peculiarities of his structure and economy already detailed, yet we must agree with Dr. Prichard ('Researches,' &c., i. 175) that "the sentiments, feelings, sympathies, internal consciousness, and mind, and the habitudes of life and action thence resulting, are the real and essential characteristics of humanity." The difference in these respects between man and all other animals is indeed so great that a comparison is scarcely possible. The highest moral endowments of animals are shown in their attachment to their offspring; but this ceases when the period of helplessness is past, and there is no evidence of attachment between individuals, except in the associated labours of some species, and the consentaneous actions of the male and female for the safety of the offspring. The arts of which animals are capable are limited and peculiar to each species; and there seems to be no evidence of a power of invention, or of construction for any purpose beyond that to which the original and instinctive powers are adapted. Among the monkeys the adults exercise authority over the young, and it is said maintain it even by chastisement; but there is no instance in which the stronger species has exercised authority over the weaker, or brought it into a state of servitude. Even when made the associates of man, and instructed by him, how little have animals learned: a few unmeaning tricks unwillingly performed, a few words uttered and constantly repeated, without choice or a conception of their meaning, and sullen passive submission, are in general the best results that can be found. There is not a proof in the whole history of animals that any species or individual has ever made an advance towards an improvement, or an alteration in its condition; whether solitary or living in herds, the habits of all remain the same; all of the same species appear endowed with the same faculties and dispositions, and each is in mental power the same throughout his life.

Contrast with these the progress of man. In his origin weak, naked, and defenceless, he has not only obtained dominion over all the animate creation, but the very elements are made to serve his purpose. Of the earth he has built his houses, and constructed weapons and the implements of art; he uses the wind to carry him in ships and to prepare his food; and when the wind will not suit him he employs fire and water to replace or to resist it. By artificial light he has prevented the inconveniences of darkness; he has stopped and made rivers, and has forced deserts, marshes, and forests alike to bear his food; he has marked out and measured the course of the celestial bodies, till he has discovered from them the size and form of the earth that he himself inhabits.

In intimate connection with his exalted mental endowments is man's peculiar possession of language. Other animals are naturally speechless, not from any material difference in the form of their organs (for man can teach some of them to imitate him), but from their inability to form those associations of ideas which are essential to the construction and utterance of words.

The peculiarities above described will probably be deemed sufficient to justify the separation of man as a distinct species from all others in the animal kingdom. In these respects indeed the difference between the lowest man and any animal is far greater than the change which any species can be proved or supposed to have undergone in any period of time, and under however varied circumstances; so that if degrees of difference of this kind could be measured, there would probably be as much justice as convenience in the classifications of those naturalists who have separated man from other animals to the greatest possible distance by constituting of the single species a separate genus and order.

We come now to the consideration of the variations to which the general characteristics of the human race are subject.

Varieties in form are of course chiefly referrible to differences in the structure and proportion of the parts of the skeleton, and we find the most marked characters of the different races in the varied forms of the skull. Dr. Prichard ('Researches,' i. 281) refers the varieties in the form of the skull to three principal divisions:—1st. The symmetrical or oval form, in which are included all those of the Indo-Atlantic, or Iranian, nations, comprising the countries from the Himalaya Mountains to the Indian Ocean, including the whole of Hindustan and the Deccan, as well as Persia and Arabia; and from the Ganges to the borders of the Atlantic, including the north of Africa and nearly the whole of Europe. In this variety the head is rounder than in the others, the forehead is more expanded, and the upper jaw-bones and zygomatic arches are so formed as to give the face an oval shape, while it is nearly on a plane with the forehead and cheek-bones, and does not project towards the lower part. The cheek-bones neither project outwards and laterally, nor forwards. The alveolar process of the upper jaw is well rounded and slightly curved vertically, so that the teeth are almost exactly perpendicular. 2nd. The narrow and elongated or prognathous skull, which is found in the negroes, the Papuas, Alfourous, New Zealanders, Australians, and other neighbouring Oceanic nations, and of which the most marked specimens occur in the negroes of the Gold Coast. The chief character of these skulls is that they give the idea of lateral compression and elongation. The cheek-bones project forward and not outward. The upper jaw is lengthened and projects forwards, giving to the alveolar ridge and the teeth a similar projection, and thus diminishing the facial angle. 3rd. The broad and square-faced, or pyramidal skull, which is that of the Turanian, or northern Asiatic nations, Samoiedes, Yukagers, Koriacs, Tschuktschi, Kamtchatkadales, Tungusians, Chinese, Indo-Chinese, Tangutians, and Japanese, part of the Tartar race, and of the Finnish nations of Europe, the Esquimaux, the aboriginal Americans, and the Hottentots. The Mongols afford a good specimen of this form, and the Esquimaux an exaggerated one. Its most striking character is the lateral or outward projection of the zygomata, so that lines drawn from each, touching the sides of the frontal bone, will meet only a little above the apex of the forehead. The cheek-bones project from under the middle of the orbit, and turn backwards in a large arch or segment of a circle. The orbits are large and deep; the upper part of the face remarkably plane and flat; and the nasal-bones, as well as the space between the eyebrows, nearly on the same plane with the cheek-bones.

The varieties of features dependent on the differences in the form of the frame-work just described will be at once evident. The first variety is distinguished by an evenness and regularity of features, an absence of any excessive prominence of one part in proportion to the other, a smooth and gently-rounded cheek, compressed and small lips, a full and prominent chin, and the whole face of a tolerably regular oval form. It is probable that among European nations the Greeks have displayed the greatest perfection in the form of the head, at least according to the European standard of perfection. Blumenbach has described a Greek skull in his collection, which, in the beauty of its form, agrees perfectly with the finest works of Grecian sculpture, and renders it probable that the latter were actual copies of nature, and not, as some have supposed, ideal compositions, intended to give the expression of exalted intellect or of dignity. The same author describes also the skull of a Georgian woman, equally remarkable for its elegance and symmetry, and says that its form agrees exactly with that of the head of a marble statue of a nymph in the Townley Collection at the British Museum.

The features corresponding with the narrow elongated skull are distinguished by the prominence of the jaws, from which they acquire a peculiarly ferocious and animal character. The compressed, narrow, and retreating forehead; the scarcely prominent nose, with its wide expanded nostrils; the thick protruding lips, and the retreating chin; the projecting cheeks, and the heavy jaws, combine to add to the characteristics which approximate, though they do not identify, the form of the negro with that of animals.

The features of the third variety differ scarcely less from the European than those of the negro, but in a different direction. Instead of the long and prominent face, we here find a face which is broadest transversely from one cheek bone to the other; and which, as it gradually narrows, both above and below, acquires somewhat of a lozenge shape. The nose is flat, the space between the eyes generally depressed, and the eyes themselves most frequently placed obliquely, with their internal angles descending towards the nose, rounded and open; the lips large, but not so prominent as those of the negro; the chin short, but not retreating under the lips.

But these varieties are not separated by very definite limits. There are numerous instances of negroes remarkable for the beauty and European character of their features; and daily observation shows Europeans who, in the narrowness of the skull, the lowness of the forehead, and the prominence of the jaws, closely approximate to the negro; while others in their features resemble the broad and flat-faced Tartars or Chinese. Within each of these varieties moreover are included numerous smaller divisions, which are certainly, though less prominently, distinct in their features. The varieties of national appearance between the Scotch, English, French, and Germans, for example, are in general distinguishable, though it would be difficult to define their differences. Similar subdivisions of character exist among all the varieties, and so fill up the intervals between the extreme specimens of each as to form a regular and nearly perfect series, of which the Esquimaux and negro might occupy the extremities, and the European the middle place, between the broad and high features of the one, and the narrow, elongated, and depressed skull and face of the other.

Differences in the shape of the pelvis (on which depend some important differences in the external form of the body) have been often supposed characteristic of different races of men. But from an extended series of observations by Professor Weber, it has been shown that every form of the pelvis which deviates from the ordinary type, in whatever race it may most frequently occur, finds its analogues in other races. He has arranged the various shapes of the human pelvis in four classes, the oval, the round, the square, and the cunciform or oblong; and he shows that although the first is the most general form in Europeans, the second in the Americans, the third in the Mongolians, and the last in the Africans, yet that specimens of each kind may be found in all the different races.

The chest of the negro is somewhat more expanded than that of the European, the sternum more arched, the ribs larger, and more roundly curved. In general also the negro's fore arm, measured in proportion to his upper arm and to the height of the body, is longer than in the European. The knees of negroes often appear to Europeans misshapen, the bones of the leg bending out from beneath them, and the feet turned outwards in the manner commonly called splay-footed. The tibia and fibula also are rather more convex than in Europeans; the feet are flat, and the os calcis, instead of being arched, is nearly in a straight line with the rest of the tarsus; and the gastrocnemii muscles have the greater part of their mass high up in the legs, so that the calves seem to encroach upon the hams. The hands are generally narrow; the fingers long and very flexible.

It is from these modifications which the negro presents, and taking extreme cases of each peculiarity, that there has appeared some ground for supposing the negro to form a grade intermediate between the European and the monkey. But there is no character in which the difference between the lowest negro and the highest ape is not many times greater than that between the same negro and the highest European; and in all the important points of structure which we have already mentioned the differences which the negro presents are but slight, never amounting to what would be regarded as a specific character amongst the lower animals. The length of the base of the skull, the somewhat more backward situation of the foramen magnum, the decrease of the facial angle, and the projection of the teeth, depend almost entirely on the prominence of the alveolar process of the upper jaw; and if a slight allowance be made for it, the negro in these points resembles the European. So also, in the prominence of his two ossa nasi, the position of the cranium over the greater part of the face, the equal length and approximation of all his teeth, the full development of the mastoid and styloid processes, which are nearly or quite wanting in all apes, and numerous other essential characteristics, there is no difference between the two races. At the same time therefore that it is allowed that the characters of form which the lowest class of negroes presents are more like those of the monkey than those of the European are, it is certain that the approximation is but slight, and that a vast space is still left between them. It is true that there coincides with this degradation of form a very low degree of intellectual development, but it is not lower than that of the Esquimaux and Hottentots and many of the third variety, who in some respects, as the breadth of the skull and face, are even more distantly removed from the monkeys than Europeans are.

Considerable differences occur in the general stature of the several races of mankind. In the temperate climates of Europe the general height varies from 4½ to 6 feet; the instances in which individuals have fallen far short or have much exceeded this standard are too exceptional to be taken into a general account. [GIANT.] Among the native inhabitants of America great varieties occur. The Peruvians, the natives of Tierra del Fuego and of Nootka Sound, the Esquimaux, and the Chaymas are all described as very diminutive; while the Payaguas, Caribees, Cherokees, and the natives of the regions immediately north of Canada are said to be generally much above the standard of Europeans. The height of the Patagonians also, though often exaggerated, is yet remarkable; the most authentic accounts agree that they commonly attain the height of 6 feet, and that they not unfrequently surpass it. The standard of height among the Africans appears about the same as that of Europeans. The Hottentots are below the general size, and the Bushmen still more so, for among them 4½ feet is said to be the average height of the men, and 4 feet that of the women. The Kaffirs on the contrary, the neighbouring tribe to the Hottentots, are distinguished for their height and strength. The people of the north of Asia and the Laplanders and Samoiedes in Europe are generally shorter than the inhabitants of the warmer climates, but the Chinese and Japanese, who in other respects much resemble them, are about the same stature as the rest of the Europeans.

With these varieties in stature it is interesting to compare the amounts of physical power possessed by different nations. The result of all observation has been the exact contrary of popular belief, which ascribes a decrease of physical strength proportionate to the increase of intellectual power acquired by civilisation. The Spaniards in their first intercourse with America found the natives in general much weaker than themselves; and the inability of the natives to sustain the severe labour of the mines led to the introduction of African slaves, one of whom was equal to three or four Indians. Hearne and others have found the same feebleness in the natives of various parts of the North American continent, and Pallas in the Buriats. But the most exact observations were made by Peron with the dynamometer upon 12 natives of Van Diemen's Land, 17 of Australia, 56 of the Island of Timor, 17 Frenchmen belonging to the expedition, and 14 Englishmen in the colony of New South Wales. The mean results were as follows:—

	Strength of the Arms. Kilogrammes.	Strength of the Loins. Kilogrammes.
Van Diemen's Land . . .	50·6	
Australia	50·8	10·2
Timor	58·7	11·6
France	69·2	15·2
England	71·4	16·3

The substance on which the varieties of colour in the human race depend, is seated chiefly in the soft and most internal layers of the cuticle; the true skin (cutis, derma), is similar in all nations, and the outer hardened layers of the cuticle have only a light tinge of the colour of those beneath them, which constitute what is often called the rete mucosum. [SKIN.] The human complexion depends in part on the condition of the cutis and its vessels, and in part on that of the cuticle. In white nations, according to the fulness or comparative emptiness of the bloodvessels of the skin, we find all the gradations of complexion, from the deep ruddiness of full health, to the blanched pallor of sickness; and in negroes, the same changes are indicated by a greater intensity of the blackness and by a dull leaden hue. These differences however chiefly characterise individuals; the national variations depend rather on the cuticle. A thick and opaque though colourless cuticle, obscuring the blood of the cutis, assists greatly in giving that deadness of hue and phlegmatic aspect which distinguishes some Europeans from others who with a thinner and more translucent epidermis are marked by a florid ruddy complexion. As the cuticle becomes darker in colour, it obscures more completely the colour of the blood in the subjacent tissue, and hence it is only in nations of light complexion that sudden blushing or paleness is at once perceptible.

With the varieties in the colour of the skin there generally coincide analogous differences in the hair and eyes. It is probable indeed that the colouring matter is the same in all; being combined in the cuticle with its peculiar cells and scales, in the hair with a horny substance, and in the choroid membrane and uvea with their minute roundish particles.

Dr. Prichard refers all the differences of complexion in man to three principal varieties:—1. The Melanocomous, or black-haired, which is the complexion generally prevalent, except in the northern parts of Europe and Asia. The coincident colour of the skin varies from a deep black, as in some Africans, to a much lighter or more dilute shade. In the copper-coloured nations of America and Africa the dusky hue is combined with red, whils in the olive-coloured races of Asia it is mixed with a tinge of yellow. In intensity of colour there is every shade from the black of the Senegal negro to the light olive of the northern Hindoos, and from the latter there may be traced every variety of shade among the Persians and other Asiatics, to the complexion of the swarthy Spaniards, and of black-haired Europeans in general. 2. The Leucous, or Albino variety, examples of which occur in all countries [ALBINO], but perhaps most frequently in hot climates. They are distinguished by the total absence of the colouring matter of the cuticle, hair, and eyes; hence their skin is of a milk-white or pinkish-hue, the hair silky-white or at most yellowish, the iris rosy and the pupil intensely red. 3. The Xanthous, or yellow-haired variety, which includes all those individuals who have light-brown, auburn, yellow, or red air. Their general complexion is fair, acquiring on exposure to heat and light not a brown hue, but more or less of a red tint. The eyes are light-coloured. This is the variety most prevalent in the temperately cold regions of Europe and Asia, whose climate seems peculiarly favourable to the constitution of body connected with it. This variety may spring up in any black-haired tribe; as it has in the Jews, who, though generally black-haired, present many examples of the light fair complexion and reddish hair. Dr. Prichard also adduces ('Researches,' &c., i. 228) ample evidence that instances of this variety occur not only among the Greeks, Romans, Russians, Laplanders, Tartars, and other melanocomous races of the least swarthy shade, but among the Egyptians, African negroes, and the islanders of the Pacific. The majority of these last cases have been confounded, under the term of white negroes, with the real Albinos; but they differ from them in the more ruddy hue of the skin, the colour of the iris, the blackness of the pupil, and the flaxen or red colour of the hair.

Other varieties besides those of colour occur in the skin and its appendages. The skin of many tribes of negroes is peculiarly sleek and oily, from the abundance of sebaceous and perspiratory secretion. From many also there is emitted a peculiarly strong odour, and Humboldt says that the Peruvians can by the sense of smell alone distinguish the European, the American Indian, and the negro. The cuticle of the dark tribes is thicker and coarser than that of white nations, and, from the greater difficulty of separating the latter into two layers, it has been imagined that there is no rete mucosum, or soft cuticle, in Europeans. The hair also varies almost as much in its texture as in its colour. Its chief varieties are observed in the copious, long, soft, and more or less curly hair of various colours in the European; the strong, straight, and scanty hair of the South Sea islanders; and the black, fine, wiry, crisp hair of the negro. A very general characteristic of the darker-coloured nations is either an entire want of beard, or a very scanty one developed later in life than in the white races. Mr. Lawrence ('Lectures,' 272) has adduced proofs of this in the Mongols, the Chinese, Japanese, Malays, South Sea Islanders, negroes, and the Indians of North and South America; but the fact has been somewhat obscured by the practice, which is generally prevalent among these nations, of extirpating the little hair which they have.

In the performance of the several functions of the economy, it has not yet appeared that any fixed difference exists in the several races of men, except in cases in which the variation is due to the difference of climate, and occurs alike in all races when subjected to the same influences. In physical endowments also, however great may be the distance between the degrees of intellectual and moral elevation possessed by civilised and uncivilised nations, yet there is sufficient evidence to prove that in all there may be traced the same mental endowments, similar natural prejudices and impressions, the same consciousness, sentiments, sympathies, propensities, in short a common physical nature, or a common mind. (Prichard, 'Researches.')

This accordance in the physiological and psychical properties of all nations affords one of the strongest possible arguments in favour of the whole human race being but one species; for, as Dr. Prichard observes, "the physiological characters of race are liable to few and unimportant variations;" and therefore when we find that in a number of individuals spread over the greater part of the globe no other differences occur, either in the average length of life, or the extreme length occasionally attained, in the periods of gestation, of infancy, of puberty, and of other changes in the economy, or in the habits, instincts, affections, and intellectual faculties, than may be fairly attributed to the differences of external circumstances, it may be at once concluded that they are all members of the same family, and the offspring of one common stock. This argument receives support from the fact that in many animals, of which from their forms alone it might be difficult to determine whether they belonged to the same or different species, a diversity occurs in their physiological characters. Thus the wolf and dog, though in many other respects closely resembling each other, differ in the period of gestation, the she-wolf carrying her young ninety days, and the bitch (of whatever variety) only sixty-two or sixty-three. In like manner the dog is strongly distinguished from the wolf in his inclination, which is everywhere observable, to associate with man; and the fox, from both the wolf and dog, in his solitary habits. Yet in form these three agree so nearly, that some naturalists have deemed them to be the same species. Similar differences may be observed in the ox kind, between the domesticated ox and the bison and buffalo, which, though nearly related to him in form, are totally opposite in disposition and habits. So also the most marked differences between the sheep (in all its varieties) and the goat are to be found in their instincts and consequent modes of life; and so on through numberless other instances, all tending to prove the permanence of physiological and psychical characters in each species, and their comparative independence of those influences by which modifications in form and colour are produced.

It is necessary however to show that the structural differences which seem to distinguish so clearly the several nations of mankind coincide with similar variations in other animals which are descended from a common stock. Such variations occur especially in animals which have been domesticated, and thus subjected to influences in many respects analogous to those under which man has fallen in the progress or decline of civilisation. No one, for example, will be inclined to deny that the varieties of dogs (which, according to Professor Owen, are undoubtedly all of one species) present far greater differences in form and colour, and in some parts of their habits and instincts, than any that are observed in man. And it is worthy of observation that in the most highly domesticated races, as the spaniel, the cranium is more fully developed, and recedes further from the form of the skull proper to the wolf, than in those which are less cultivated, as the mastiff. In this we can trace a series of varieties very analogous to those of the monkey, the negro, and the highly civilised European.

The races of swine present even more remarkable instances of variation, which have been particularly described by Blumenbach. ('Beyträge zur Naturgesch.'). It is certain that these all descend from the wild boar; and it is equally certain that swine were unknown in America till carried there by the Spaniards. Yet in that country they have already degenerated into breeds very different from each other and from their original. Those taken to Cubagua became a race with toes half a span long, and those of Cuba became more than twice as large as their progenitors. In Normandy the swine are remarkable for the length of the bone of the hind leg. Swine with solid hoofs were known to the ancients, and large breeds of them are found in Hungary and Sweden. In some also the hoof is divided into five clefts. In Guinea they have long ears couched upon the back; in China, a large pendant belly and very short legs; at Cape Verd and other places, very large curved tusks. Thus then in one species we find changes even greater than those which occur among men; and as to the most important, Blumenbach says that the whole difference between the cranium of the negro and that of a European is by no means greater than that which exists between the cranium of the wild boar and that of the domestic swine. An examination of the different breeds of sheep, horses, oxen, goats, cats, rabbits, and still more of domestic fowl, would in like manner show that all these species, even while under observation, are subject to greater variations than are found in the different races of men.

In respect of colour, a perfect analogy holds between the varieties of domestic animals and those of men. In all those enumerated above examples occur of the melanocomous, leucous, and xanthous varieties springing up casually or existing constantly in particular breeds. Thus even in England the cattle of different counties may be recognised by their colour as well as their forms. Azara remarks of the horses and oxen of Paraguay (where both species have run wild and multiplied very rapidly), that while all those that are domesticated vary considerably in colour, those that are wild have all the same colour; the horses a chestnut or bay-brown; the oxen reddish-brown on the back, and black on the rest of the body.

The analogy between the variations to which domesticated (and more rarely wild) animals are subject, and those which are observed in men, is a strong argument for the unity of the human species. Another which possesses much weight is drawn from the propagation of the several races. It is well known that among all other animals the hybrid productions of parents of different species are either quite barren or so little prolific that they soon become extinct, and that an intermediate race cannot be maintained even to the second generation without a return to the pure blood of one or other parent. On the other hand it is observed among domestic animals that the progeny of different varieties of the same species exceed in vigour, and are even more prolific than their parents; so that intermediate races are apt very soon to become more numerous than the originals from which they sprung. Exactly the same principle holds in the human race. All nations propagate together with equal facility, and Dr. Prichard has shown that the progeny of parents of different nations have in many instances exceeded those from whom they sprung in vigour and in the tendency to multiplication.

What may be the precise nature of the influences which have caused so much difference to exist between the individuals of the human race we are unable to say; but instances are constantly occurring, which seem to show us how possible it is that all the varieties of human beings have occurred in a common family. Even amongst the races of our own island, when exposed to circumstances which deprive them of their usual nutriment and means of developing the civilising instincts of mankind, we find that they sink in character, and become physically degraded to a level with races whose features at first sight are very far removed. We need but to travel across the Irish Channel to see many groups of our Celtic fellow-subjects, who have been reduced by famine and disease to a degraded condition closely bordering on that of these savages.

Although the colour of the skin and the character of the hair give so very decided an appearance to many of the races of man, yet there is on record a great number of cases, in which individuals, with hair and skin of one colour, have given birth to children with hair and skin of another colour and character. Dr. Prichard enumerates a great number of instances of individuals with yellow hair and fair skin, amongst tribes with dark hair and skin; and in the temperate regions of Asia whole tribes, evidently descended from dark-coloured races, presented the light colour. The Jews appear to have been originally a dark-skinned and woolly-haired race; but it is well known that the Jews of Europe very frequently present the characteristics of the lightest coloured races. On the other hand we have constantly individuals born of white parents having woolly hair, a dark skin, and other approaches to the black varieties of men. Even whole nations, as the Germans, have presented a tendency to become darker.

There is also evidence to prove that even the forms which the bones of the head assume amongst different nations are not fixed. Amongst the most highly developed races, having the most perfect forms of skull, we constantly see individuals with the projecting maxilla, which is prevalent amongst the lowest tribes; whilst, on the other hand, individuals are often seen among the least civilised races presenting forms of the skull approaching those of the most cultivated nations. Facts such as these are constantly accumulating, and clearly point to the derivation of the human race from one pair.

A very natural question arises here as to whether we have any natural history evidence as to the length of time man has existed on the surface of the earth. Recent inquiries into the history of the human race have resulted in confirming the view of the comparatively modern origin of the race, and disproved the statements of those who, relying on fabulous accounts of documents in the possession of the Chinese and Hindoos, have given to the human race an absurd antiquity. Geology reveals to us very clearly the fact, that man has not been created from the earliest period at which animal and vegetable life have appeared on the surface of the earth. Geologists can point to strata which were successively deposited at the bottoms of oceans and great rivers, and which present, for a long succession of ages, no evidence of the existence of human beings. These rocks unfold a condition of the earth's surface by which this world was gradually prepared to receive its highest and most potent inhabitant—man! Estimates have been formed by Sir Charles Lyell and others of the periods of time required for the production of certain changes upon the earth's surface; and comparing geological changes with the evidences of the existence of man, all the principles of the science of geology support the notion, that man is one of the most recently created beings upon the surface of the earth. The same evidence is also in favour of the supposition that many of the animals and plants by which man is surrounded at the present moment are contemporaneous creations with himself. What the exact date of man's creation is science cannot answer. Dr. Latham has however shown that the arguments raised in favour of a much higher antiquity than is given in the books of Moses, from the civilisation of the Chinese, are of no value; and he has also pointed out, in his 'Varieties of Man,' that the civilisation of the Chinese is much more modern than the Chinese believe.

It has only been within these last few years that the importance of employing the language spoken by man has been fully appreciated as a means of affording characters by which our knowledge of the relations of the races of men might be facilitated. It will be however speedily felt, when the nature of language is considered, that if properly studied it must be capable of throwing great light on the relation that exists between certain races and nations. The great cause that has retarded the application of the study of language in this direction has been the assumption of erroneous views with regard to the derivation and origin of languages. Thus, to take an example, writers on the English language have constantly assumed that our language has been derived from the Latin and Greek on the one hand, and the Celtic or supposed ancient British on the other. It never occurred to the old etymologist to inquire whether Latin, Greek, Celtic, and English might not all have been derived from a common stock, which is really the case; not that we have not, and do not constantly import words from both Latin and Greek—as such words as 'communicate,' 'investigate,' and 'condemnation,' from the former, and 'geology,' 'anatomy,' and 'ethnology,' from the latter, fully testify; but we find a vast number of words in Latin and Greek which correspond as much with words in the Sanscrit and Persian as they do with the English; and a complete investigation of the subject shows that the English, German, French, Celtic, Latin, Greek, Persian, and other languages, are but branches of a common root, which has hitherto been traced to the Sanscrit.

Although modern philologists have succeeded in tracing cognate languages to certain primitive stocks, they are not yet in a position to demonstrate that there was but one original language, or what was the probable nature of that language. But if, as we have seen, there is reason to believe that the human race originated in a single pair, we must assume an original language, or at least such modes of expression as would originate in a common family. In the investigation of language however, for ethnological purposes, we are not allowed to assume one language, and trace its roots through all known varieties; but we proceed from particular forms, and, comparing them with one another, ascend or pass back in time to those that were earlier, and have been parents of the first.

This process, although at first sight it might appear easy, is one that only can be pursued according to the special laws of change which it is known words in passing from one language to another have undergone. It appears that as long as a language is unwritten, it is subject to change; but these changes, although they go on more or less quickly according to circumstances, are never sudden, violent, or arbitrary. As an instance of the kind of change that takes place, we may quote the fact, that in the Teutonic languages the letter *c* of the Latin is almost invariably converted into *h*. Were it not for a knowledge of this fact, an inquirer would find it difficult to discover in the Latin word *cor* the analogue of our word 'heart;' yet when we call to mind the regularity of the conversion, the little importance of the vowels in all spoken languages, we shall see that the *r* with its preceding letter constitutes the true root of the word. This brings us to another point in the study of words, and that is, that for the sake of denoting a relationship, letters and syllables are either placed after or before certain words, called prefixes and affixes, and in order to discover the root of these words, it is necessary to separate such additions. In such Latin nominatives as *cani-s* and *lupu-s*, and accusatives, as *cane-m* and *lupu-m*, the last letters *s* and *m* are no essential parts of the word, but indicate the relations of the word to which they are attached to other words in a sentence. So with such words as *ama-b-am*, *mon-e-bam*, *audi-e-bam*, the syllables *ba*, or *eba*, are the sign of the past imperfect tense, whilst the letter *m* is the sign of the person or pronoun *I*. The root of the nouns then, in these cases, must be sought in the words *cani* and *lupu* in the nouns, and *ama*, *mon*, and *audi* amongst the verbs. As illustrations amongst the adjectives, we may take such words as *gracilis*, *similis*, *docilis*, *utilis*, in which *ilis* is evidently the sign of the adjective, and the root is to be found in the words *grac-*, *sim-*, *doc-*, and *ut-*.

In ascertaining the relation of languages to each other, there are three principal methods by which the relation between the different words that compose a sentence is indicated. Of these three different methods, the Chinese, the English, and the Latin and Greek, may be taken as examples. In referring to the roots of words in Latin, we spoke of the prefixes and affixes which altered their form; and this mode of expressing the relation of words in a language is characteristic of the Latin and Greek languages, and is called the classical method. The words added are called Inflections, and such languages Inflectional. In such a proposition as *te-tig-i homin-em*, the *em* in the last word indicates the relation between the object (the man touched), and the action expressed by the verb *tetigi*, that is, 'of touching.' In the verb the *te* denotes the time, the *i* the agent.

Now, although the English language has inflections, as is seen in such words as 'sister-s,' 'touch-ed,' 'lov-ed,' yet, as a language, it may be regarded, in contrast with the classical languages, as non-inflectional. Thus, instead of saying *tetigi*, we say 'I have touched;' and instead of *homin-i*, we say 'to a man.'

The Chinese resembles the English language in this respect, that it has a separate word to express relations and objects, and is thus non-inflectional. The great difference however between the English and Chinese languages is this, that the English has lost inflections which it once had, whilst the Chinese has never acquired inflections. This produces a great difference between the two languages, as in passing through the condition of an inflectional language the English has acquired certain abstract terms which are not found in the Chinese. Thus, when we should say 'I go *to* London,' the Chinese would say 'I go *end* London.' They have no preposition indicating direction. Instead of saying, 'The sun shines *through* the air,' the Chinese say, 'The sun shines *passage* air,' and so on.

In addition to these three kinds of language, we have another. Instead of the inflections being merely letters or syllables added to denote relationship, they are sometimes two words; so that inflection is developed as the result of juxtaposition, or composition.

By these methods we can arrange all languages under the four following heads:—

1. *Aptotic* (from *a*, not; and *ptosis*, a case).—Languages without inflections, and monosyllabic; as the Chinese.

2. *Agglutinate.*—Languages which are inflectional, but which have become so from the juxtaposition or composition of different words.

3. *Amalgamate.*—Languages with inflections, which cannot be shown to have originated in separate and independent words.

4. *Anaptotic* (from *ana*, back; and *ptosis*, a case).—Languages which, like the English, once possessed inflections, but have fallen back from or lost them.

In classifying the races of men, it must be remembered that the divisions and subdivisions which are employed do not resemble those which are used in the systematic classification of plants and animals. When the whole of the species of the vegetable or the animal kingdom have to be arranged, then we divide them into various primary and subordinate groups, which are called classes, families, or orders, genera, species, and varieties. Now man himself is but a species; he belongs to a subordinate group of a large division of the animal kingdom. Zoologically considered, man is an animal belonging to the class *Vertebrata*, the order *Mammalia*, the sub-order *Hominidæ*, the genus *Homo*, and species *sapiens*.

The characters of this species given by Blumenbach, and generally received, are:—"Erect, 2-handed, unarmed, rational, endowed with speech; a prominent chin; 4 incisor teeth above and below; all the teeth equally approximated; the canine teeth of the same length as the others; the lower incisors erect." The same author divides the species into five varieties, whose characters are as follows (Lawrence, 'Lectures,' p. 477):—

1. Caucasian Variety.—A white skin, either with a fair rosy tint, or inclining to brown; red cheeks; hair black, or of the various lighter colours, copious, soft, and generally curved or waving. Irides dark in those with brown skin; light in the fair or rosy complexioned. Large cranium with small face; the upper and anterior regions of the former particularly developed, and the latter falling perpendicularly under them. Face oval and straight, with distinct features; expanded forehead, narrow and rather aquiline nose, and small mouth; front teeth of both jaws perpendicular; lips, particularly the lower, gently turned out; chin full and rounded. Moral feelings and intellectual powers most energetic, and susceptible of the highest development and culture. This variety includes all the ancient and modern Europeans except the Finns; the former and present inhabitants of Western Asia, as far as the river Oby, the Caspian Sea, and the Ganges (that is, the Assyrians, Medes, and Chaldæans; the Sarmatians, Scythians, and Parthians; the Philistines, Phœnicians, Jews, and the inhabitants of Syria generally; the Tartars, properly so called; the tribes actually occupying the chain of Caucasus; the Georgians, Circassians, Mingrelians, Armenians; the Turks, Persians, Arabians, Afghans, and Hindoos of high castes); and the northern Africans, the Egyptians, Abyssinians, and Guanches.

2. The Mongolian Variety.—Characterised by olive colour, which in many cases is very light, and black eyes; black, straight, strong, and thin hair; little or no beard; head of a square form, with small and low forehead; broad and flattened face, with the features running together; the glabella flat and very broad; nose small and flat; rounded cheeks, projecting externally; narrow and linear aperture of the eye-lids; eyes placed very obliquely; slight projection of the chin; large ears; thick lips; stature, particularly in the countries near the North Pole, inferior to that of Europeans. It includes the tribes of Central and Northern Asia, as the Mongols, Calmucks, and Buriats; the Mantchoos, Daürians, Tungooses, and Coreans; the Samoiedes, Yukagers, Koriacs, Tschuktschi, and Kamtchatkadales; the Chinese and Japanese, the inhabitants of Tibet and Bootan, of Tonquin, Cochin-China, Ava, Pegu, Cambodia, Laos, and Siam; the Finnish races of Northern Europe, as the Laplanders and the tribes of Esquimaux.

3. The Ethiopian Variety.—Skin and eyes black; hair black and woolly; skull compressed laterally, and elongated towards the front; forehead low, narrow, and slanting; cheek-bones prominent; jaws narrow and projecting; upper front teeth oblique; chin receding. The eyes prominent; the nose broad, thick, flat, and confused with the extended jaw; the lips, and particularly the upper one, thick. All the natives of Africa, not included in the first variety, belong to this.

4. The American Variety.—Skin dark, and more or less of a red tint; black, straight, and strong hair; small beard; and a countenance and skull very similar to the Mongolian. The forehead low; the eyes deep; the face broad, particularly across the cheeks, but not so flattened as in the Mongols; mouth large; and lips rather thick. This variety includes all the native Americans except the Esquimaux.

5. The Malay Variety.—Brown colour, from a light tawny to a deep brown. Hair black, more or less curled, and abundant; head rather narrow; bones of the face large and prominent; nose full, and broad towards the apex; mouth large. In this are included the inhabitants of Malacca, of Sumatra, Java, Borneo, Celebes, and the adjacent Asiatic islands; of the Molucca, Ladrone, Philippine, Marian, and Caroline groups; of Australia, Van Diemen's Land, New Guinea, New Zealand, and of all the islands of the South Sea.

Cuvier distinguished only three principal divisions—the Caucasian, the Mongolian, and the Ethiopian; remaining doubtful as to the Malay and American varieties. Dr. Prichard, on the other hand, divides the species into seven principal varieties:—1, the Iranians, who in the form of their skulls and other physical characters resemble Europeans, in which are included, as before detailed, all the Caucasian variety. 2, the Turanian, who are nearly the same with the Mongolians of other writers. 3, the native Americans, except the Esquimaux and some others resembling them. 4, the Hottentots and Bushmen. 5, the Negroes. 6, the Papuas, or woolly-haired nations of Polynesia. 7, the Alfouron and Australian races.

The following is the arrangement, with the definitions given by Dr. Pickering, an American traveller and writer, in his work 'On the Races of Men:'—

a. White.

1. *Arabian.*—The nose prominent, the lips thin, the beard abundant, and the hair straight or flowing.

2. *Abyssinian.*—The complexion hardly becoming florid, the nose prominent, and the hair crisped.

b. Brown.

3. *Mongolian.*—Beardless, with the hair perfectly straight and very long.

4. *Hottentot.*—Negro features, and close woolly hair; and the stature diminutive.

5. *Malay.*—Features not prominent in the profile, the complexion darker than in the preceding races, and the hair straight or flowing.

c. Blackish-Brown.

6. *Papuan.*—Features not prominent in profile, the beard abundant, the skin harsh to the touch, and the hair crisped or frizzled.

7. *Negrillo.*—Apparently beardless, the stature diminutive, the features approaching those of the negro, and the hair woolly.

8. *Indian*, or *Telingan.*—The features approaching those of the Arabian, and the hair, in like manner, straight or flowing.

9. *Ethiopian.*—The complexion and features intermediate between the Telingan and Negro, and the hair crisped.

d. Black.

10. *Australian.*—Negro features, but combined with straight or flowing hair.

11. *Negro.*—Close woolly hair, the nose much flattened, and the lips very thick.

The most recent writer and greatest authority on the races of men is Dr. R. G. Latham, who, in his work on the 'Varieties of Man,' proposes the following arrangement. In the first place, like Cuvier and other previous writers, he adopts but three primary varieties of the human species:—

I. *Mongolidæ.* II. *Atlantidæ.* III. *Japetidæ.*

The termination in 'idæ' employed here seems preferable to the use of terms such as class, order, family, tribe, or other words which have another use, either in this or other departments of natural history. It must not however be supposed that by using these terms any of the varieties of man can be traced up to a common ancestry, so that we could say all the *Mongolidæ* originated with this man, or all the *Atlantidæ* with that man. In tracing back races we have no evidence so conclusive that any particular variety originated with a particular pair of human beings, as we have that all the families of mankind have originated in a single pair. The terms *Mongolidæ*, *Atlantidæ*, and *Japetidæ* are not derived from a community of meaning in the things they express. Thus, the first comes from a nation, the Mongols, who occupied a portion of eastern Asia, and were at one time the conquerors of the world, and are regarded as typical of a large portion of the human race. The *Atlantidæ* are entirely found in Africa; hence their name. The *Japetidæ* include the races of men in Europe, who are traditionally descended from Japheth; hence the name selected to express them.

I. Mongolidæ.—The people comprised under this variety have the following physical conformation:—The face is broad and flat, which either arises from the great development of the zygomatic arches, or from the distance between the parietal bones on each side of the head. There is often also a great depression of the nasal bones, which contributes to give a flat appearance to the face. The profile of the forehead is retiring or depressed, seldom found perpendicular. The profile of the jaws is prognathic or projecting, seldom found on a level with the forehead. The eyes frequently present the peculiarity called oblique. The skin is of a mixed character, never truly white, and very rarely of a jet-black; still it often presents what would be called a black or white colour. The eyes are generally of a dark colour. The hair, as a general rule, is straight, long, and black; in some instances it is curly—rarely woolly—and more rarely still light-coloured.

The languages of the people belonging to this variety are either characterised by the absence of cases (aptotic), or having inflections, they can be shown to have arisen out of the union of different words (agglutinate). They are very rarely amalgamate.

The distribution of this variety is very wide over the surface of the earth. It finds its greatest development on the continent of Asia; although even there it is found not to be entire possessor of the earth. The Persians of northern and western Persia, the Kurds, the Beluchi, the Afghans, the Tajiks of Bokhara, and the Siaposh must all be regarded as belonging to the *Japetidæ*. On the other hand, although we shall find the *Japetidæ* the principal occupants of Europe, there seems to be little doubt that the Lapps and Finns of Scandinavia, the Magyars of Hungary, the Turks of Turkey, the Basques or Euskaldunes of Biscay and Navarre, and probably even the Albanians or mountaineers of ancient Illyria and Epirus, all belong to the *Mongolidæ*.

From the analogy of language this variety is made by Dr. Latham to include the whole of the inhabitants of the Polynesian Islands, as well as those of America. Although at first sight the physical differences between the Asiatic *Mongolidæ* and the inhabitants of the islands of the South Seas and the continent of America might look as great as that between many of the *Mongolidæ* and *Japetidæ*, yet it has been found that even physical characters fail to afford a line of demarcation. Thus, the late Dr. Morton, of America, thought that "the squared or rounded head, the flattened and vertical occiput, the high cheek-bones, the ponderous maxillæ, the large quadrangular orbits, and the low receding forehead," were characters that would distinguish the American from all other varieties. When however we examine the languages of the American continent we shall find that the Esquimaux present so strong a relation to that of the other races that we cannot deny their affinity to the American races; and it is amongst the Esquimaux that we find a departure from the physical type of a peculiar American form, and a strong relationship with the Asiatic *Mongolidæ*. It is considerations such as this which have induced recent ethnologists to regard the American Indian as a form of the variety of mankind to which the followers of Genghis-Khan belong.

The influence of the races included under the variety of *Mongolidæ* must be regarded as rather material than moral. They undoubtedly form by far the larger portion of the human race, and occupy a considerable space in the history of the world. They have, by the sword, established some of the largest empires that the world has seen. China is at this moment an example. Their empires have however crumbled to pieces, and left no deep impression on the world. Such is not the history of the *Atlantidæ* and *Japetidæ*, the first of which includes the Jews and the Mohammedans, and the last the Greeks, Romans, and modern European races.

The *Mongolidæ* are divided by Dr. Latham into groups as follows:—

A. Altaic Mongolidæ.—The term Altaic is taken from the Altai Mountains in Central Asia, these being a convenient geographical centre for the different nations and tribes comprising this division. It embraces two stocks, the Seriform, and the Turanian.

The Seriform stock has the physical conformation of the Mongol, and its languages are either wholly aptotic or with only the rudiments of an inflexion. The area inhabited by these people is China, Tibet, and the Indo-Chinese or Trans-Gangetic Peninsula as far as Malaya; the Himalayan and parts of the Sub-Himalayan range of mountains.

In this stock the chief people are Chinese, Tibetans, Anamese, Siamese, Kambogians, Burmese, the Indu; and several unplaced tribes are added by Dr. Latham.

The Turanian stock has the physical conformation of the Mongols, the languages are not monosyllabic. They are found from Kamtchatka to Norway, and from the Arctic Ocean to the frontiers of Tibet and Persia. The countries included are the northern parts of the Chinese empire, the greater part of Siberia, Mongolia, Tartary, Eastern Turkistan, Asia Minor, Turkey, Hungary, Esthonia, and Lapland. They are divided into four groups:—

1. The Mongolian branch, including the Mongols proper, the Buriats, the Kalmuks of Russia, and the Eimak of Persia.

2. The Tungusian branch including the Tshapojirs on the Lena, the Lamuts on the Sea of Okhotsk, and the Mantshu rulers of China.

3. The Turk branch: this includes the Uighurs, the Turks of the Sandy Desert, Turks of Khoten, &c., the Kirghis, Uzbeks, Turkomans, Osmanli, Nogays, Turks of the Russian empire, and the isolated Yakuts of the Lena.

4. The Ugrian branch includes the Voguls, the Permians, Tcheremiss, Finlanders, Esthonians, Laplanders, and Hungarians.

B. Dioscurian Mongolidæ. — The term Dioscurian is taken from the ancient sea-port Dioscurias. The tribes included in it have a modified Mongol organisation, the languages are (paucosyllabic) few-syllabled and agglutinate. Of all the languages not belonging to the Seriform stock of the last section they approach nearest to the aptotic state. They embrace—1, the Georgians; 2, the Lesgians; 3, the Mizjeji; 4, the Irôn; and 5, the Circassians.

Of this group, Dr. Latham observes, "To have used the word 'Caucasian' would have been correct, but inconvenient. It is already misapplied in another sense, that is, for the sake of denoting the so-called Causasian race, consisting or said to consist of Jews, Greeks, Circassians, Scotchmen, ancient Romans, and other heterogeneous elements. In this sense it has been used in more than one celebrated work of fiction. In such and in such only, it is otherwise than out of place."

C. Oceanic Mongolidæ. — The epithet Oceanic is applied to this group, because, with the exception of the peninsula of Malacca, the tribes belonging to it are the inhabitants of islands exclusively. With the exception of Mauritius, the Isle of Bourbon, Ceylon, the Seychelles, the Maldives, and the Laccadives in the Indian Ocean, and the Japanese empire, with the islands to the north thereof in the Chinese Sea, every inhabited spot of land in the Indian and Pacific Oceans is inhabited by tribes of one and the same race which are embraced by this division. Not only is this race to be found spread over these islands, but apparently nowhere else. "In the peninsula of Malacca," says Dr. Latham, "and on no other part of the mainland of Asia, is an oceanic tribe to be detected." Although united by Dr. Latham, oceanic races exhibit two types. One class is yellow, olive, brunette, or brown, with long, black, and straight hair. Another class is black rather than yellow; the hair is sometimes long and straight, but in other cases crisp, curly, frizzy, or even woolly, The social, moral, and intellectual difference between these two classes is not less than their physical. The black division inhabits New Guinea, Australia, Tasmania, New Ireland, and the islands between it and New Caledonia. The brown division occupies all the rest of the oceanic area, Sumatra, Borneo, Java, the Moluccas, the Philippines, the South Sea Islands, the Carolinas, &c. The names given to these divisions are as follows:—

1. For the lighter-complexioned straight-haired type—Malay.

2. For the type that partakes of the character of the African negro inhabiting New Guinea, Australia, and what may be called the continuous localities for the unmixed black—Negrito.

3. The tribes with any or all of the Negrito characters, dwelling side by side with Malays in Malay localities, or in localities disconnected with the true Negrito area—the blacks of the Malayan area.

D. Hyperborean Mongolidæ. — The physical conformation of this section is that of undersized Mongolians. Their languages are agglutinate, neither monosyllabic, nor paucosyllabic. They are all subject to either Russia or China. Their religion is either Shamanism or an imperfect Christianity. They are found on the coasts of the Arctic Ocean, and the courses of the Yenisei and Kolima. The principal divisions are the Samoides, the Yeniseians, and the Yukahiri.

E. Peninsular Mongolidæ. — This section comprises races very widely distributed. Some of these lie within the arctic circle, others as far south as 26° N. lat. Their physical conformation is Mongol. Their languages are agglutinate, and in some cases excessively monosyllabic. The area occupied by these races are the islands and peninsulas of the north-eastern coast of Asia. The people embraced in it are the Koreans, the Japanese, the Aino, the Koriaks, and the Kamtchatdales.

F. American Mongolidæ. — This section embraces the original inhabitants of the whole continent of America. By most writers on ethnology, the races of America are regarded as a distinct family. Their connection with *Mongolidæ* seems however to be established by the Eskimo, who are physically Mongol and Asiatic, but philologically American. Of the Eskimo Dr. Latham remarks:—

"Unimportant as are the Eskimo in a political and historical view, their peculiar geographical position gives them an importance in all questions of ethnology; since one of the highest problems turns upon the affinities of this family.

"It has long been known that the nation which inhabits Greenland and Labrador is the nation which inhabits the north-western parts of Russian America as well. It is found on the American side of Behring's Straits, and it is found on the Asiatic side also. So that the Eskimo is the only family common to the Old and New World; an important fact in itself, and one made more important still by the Eskimo localities being the only localities where the two continents come into proximity. Now if these facts had stood alone, unmodified by any phenomena that detracted from their significance, the peopling of America would have been no more a mystery than the peopling of Europe. Such however is not the case. They neither stand alone, nor stand unmodified. The reasons that lie against what is at the first blush the common sense answer to the question 'How was America peopled?' are chiefly as follows:—

"1. The distance of the north-eastern parts of Asia from any probable centre of population—cradle of the human race, so called. For these parts to have been the passage, Kamtchatka must have been full to overflowing before the Mississippi had been trodden by the foot of a human being.

"2. The physical differences between the Eskimo and the American Indians.

"3. The difficulties presented by the Eskimo language.

"It is only these two last reasons to which I attribute much validity. The first of the three I put low in the way of an objection; that is, not much higher than I put the systems founded upon the Icelandic and Welsh traditions, the drifting of Japanese junks, and the effects of winds and currents upon Polynesian canoes. Without at present doubting whether the occurrences here alluded to have happened since America was peopled by the present race, I limit myself to an expression of dissent from the doctrine that by any such unsatisfactory processes the original population found its way; in other words, I believe that our only choice lies between the doctrine that makes the American nations to have originated from one or more separate pairs of progenitors, and the doctrine that either Behring's Straits or the line of islands between Kamtchatka and the peninsula of Aliaska, was the highway between the two worlds—from Asia to America, or vice versâ. I say vice versâ, since it by no means follows that because Asia and America shall have been peopled by the same race, the original of that race must necessarily have arisen in Asia; inasmuch as the statement, that the descendants of the same pair peopled two continents, taken alone, proves nothing as to the particular continent in which that pair first appeared. Against America, and in favour of Asia, being the birth-place of the human race—its unity being assumed—I know many valid reasons; reasons valid enough and numerous enough to have made the notion of the New World being the oldest of two a paradox. Nevertheless I know no absolutely conclusive ones. Omitting however this question, the chief prima-facie objections to the view that America was peopled from north-eastern Asia lie in the—

"1. Physical Differences between the Eskimo and the American Indian.—Stunted as he is in stature, the Eskimo is essentially a Mongol in physiognomy. His nose is flattened, his cheek bones project, his eyes are often oblique, and his skin is more yellow and brown than red or copper-coloured. On the other hand, in his most typical form, the American Indian is not Mongol in physiognomy. With the same black straight hair, he has an aquiline nose, a prominent profile, and a skin more red or copper-coloured than either yellow or brown. Putting this along with other marked characteristics, moral as well as physical, it is not surprising that the American should have been taken as the type and sample of a variety in contrast with the Mongolian.

"2. Philological Arguments.—Few languages, equally destitute of literature, have been better or longer known than the Eskimo. For this we have to thank the Danish missionaries of Greenland—Egede most especially. From the grammar of Fabricius the Eskimo was soon known to be a language of long compound words, and of regular though remarkable inflections. It was known too to be very unlike the better known languages of Europe and Asia. Finally, it has been admitted to be, in respect to its grammatical structure at least, American."

We need not here enumerate the various tribes embraced in this section, as it includes the whole of the original races found on the American continent.

G. Indian Mongolidæ. — The races belonging to this section are found in Hindustan, Cashmere, Ceylon, the Maldives and Laccadives, and part of Beloochistan. They are found mixed or contiguous to the Japetidæ of Beloochistan and Cabul, and various Seriform tribes. They present two extreme forms of physical conformation, one with the skin dark or even black, the other of a brunette colour, with a skin of great delicacy and clearness. The social condition of caste prevails among them. The principal religions are Brahminism and Buddhism, with a variety of intermediate creeds. Their ancient literature is in the Sanscrit, and their alphabets are derived from that language. They embrace the following divisions:—1, the Tamul; 2, the Paliuda; 3, the Brahúi; 4, the Indo-Gangetic; 5, the Purbutti; 6, the Cashmirian; 7, the Cingalese; and 8, the Maldivian.

II. The ATLANTIDÆ.—In their physical character the face is not so broad and flat as in the *Mongolidæ.* The jaws project, are prognathic, whilst the nose is generally flat; the forehead is retiring; the cranium dolikocephalic, that is, there is less space between the parietal bones of the skull, whilst its length remains the same, than there is in the last variety; the eyes only rarely open obliquely; the skin is mostly jet-black, presenting however lighter shades, and very rarely approaching a pure white; the hair is crisp, woolly, very rarely straight, and still more rarely light-coloured. The languages amongst the Atlantidæ belong to the agglutinate class. They are seldom or ever found with a truly amalgamate inflection.

The great district of the development of the natives which are brought together under the above definition, is Africa. Perhaps there is no quarter of the globe that presents a greater diversity of inhabitants than Africa, or races of men who at first sight appear so evidently distinct. All previous ethnologists have placed the Hottentot, the Negro, and the Bushman in a very different position to the Assyrian, the Babylonian, the Mohammedan, and the Jew; but in Dr. Latham's classification we find these brought together under the common variety *Atlantidæ*. The analogy of language has led to this conclusion; and the transition from the lowest to the highest of these races is so gradual, that no investigation of their physical structure with which we are at present acquainted, would be sufficient to break down the affinity discovered in their languages. No part of Africa seems to be inhabited by any races but those of the Atlantidæ. The Syro-Arabian or Semitic nations, however, which are now classed amongst the Atlantidæ, are found occupying a considerable area in the south-western part of Asia. The people of these races are far removed from the Negro and the Hottentot, and present great symmetry of form, and considerable cerebral development.

However small may have been the influence of the lower types of this race on the world, there can be no doubt of the vast impression produced by the Semitic nations. We may pass over the early civilisation indicated by the Assyrian and Babylonian empires, and fix attention on the religious history of the Jews. Here, amidst the surrounding Paganism, we find the worship of the one true God maintained by this small race amongst the Semitic nations; and through them the religion of Christ, which is destined to react on all the other races of mankind. It is also among these races that that compound of Judaism and Christianity, Mohammedanism, has sprung up; and however inferior it may be to the Christian religion, there can be little doubt of the beneficial influence it has exerted on the races who have embraced it.

The following is Dr. Latham's division of this group:—

A. Negro Atlantidæ.—The negroes have a black, unctuous, and soft skin; the hair woolly; lips thick; maxillary profile prognathic, frontal profile retiring; nasal depressed. They inhabit the low lands, sea-coasts, and the deltas and courses of rivers, chiefly the Senegal, Gambia, Niger, and Upper Nile. They are nearly limited to the tropic of Cancer. They are divided into Western Negroes, Central Negroes, and Eastern Negroes.

B. Kaffre Atlantidæ.—The language of the Kaffir supplies a broad distinction between them and other African races. They are prefixional and alliterational. Their physical comformation is modified negro. They occupy a district in Africa (east and west) from the north of the equator to the south of the tropic of Capricorn. The chief divisions are, 1, Western, 2, Southern, 3, Eastern.

C. Hottentot Atlantidæ.—"The Hottentot stock," says Dr. Latham, "has a better claim to be considered as forming a second species of the genus *Homo* than any other section of mankind. It can be shown however that the language is no more different from those of the world in general than they are from each other." The Hottentots occupy the southern extremity of Africa. They are of low stature; limbs slight; colour more brown or yellow than black; cheek-bones prominent; nasal profile depressed; hair in tufts rather than equally distributed over the head. They are divided into the Hottentots proper and the Saabs. The latter are found between the Roggeveld and the middle portion of the Orange River.

D. Nilotic Atlantidæ.—These people have a modified negro conformation, and inhabit the water-system of the Upper and Middle Nile. Their chief divisions are, 1, Gallas; 2, Agous; 3, Nubians; 4, Bishari.

E. Amazirgh Atlantidæ.—Amazirgh is a term equivalent to Berber. These people are found on the coasts of the Mediterranean and the whole north-western quarter of Africa. They present modifications of both the negro and Arab types. Their chief divisions are, 1, the Siwahs of the Oasis of Siwah, the ancient Ammonium; 2, Cabyles of the range of Atlas; 3, Tuaricks of the Sahara; 4, Guanches of the Canary Islands.

F. Ægyptian Atlantidæ.—This section includes the ancient Egyptians, the subjects of the Pharaohs and the Ptolemies, and the modern Copts as far as they are of unmixed blood. They dwell in the valley and delta of the Nile, from Essouan to the Mediterranean. The physical conformation of the ancient Egyptians is gathered from their mummies. The modern Copts have the hair black and crisp or curled; the cheek-bones projecting; lips thick; nose depressed; nostrils wide; complexion from a yellowish to a dark-brown; eyes oblique; frame tall and fleshy.

G. Semitic Atlantidæ.—This section embraces the most highly developed forms of the *Atlantidæ*. The Semitic races are found in Abyssinia, Arabia, Palestine, Syria, Mesopotamia, and parts of Kurdistan. They are light-complexioned, and referrible to three types—the Arab, the Jew, and the Kaldani. Their influence on the world has been pre-eminently moral, spiritually as well as intellectually. Their religions are pre-eminently monotheistic in the later parts of their history. Their alphabet is the earliest in the world, and, with the exception of the Ethiopic, is written from right to left. The chief divisions, which are more or less artificial, are Syrians, Assyrians, Babylonians, Phœnicians, Beni-Terah, Arabs, Æthiopians, Solymi Cappadocians, Elamites, Cyprians, Philistines, Canaanites.

With the Beni-Terah (sons of Terah), father of Abraham, are found the Jews, who are remarkable amongst the nations of the earth for their early intellectual culture, and for the moral and religious influence their writings have produced on the world.

III. Japetidæ.—This variety includes most of the nations of modern Europe. Physically, they present characters superior to the two other varieties. Their face is not flat, and is moderately broad. The jaws project but little, the nose is often very prominent, and the frontal profile is not unfrequently nearly vertical. The skull is shaped generally as the last variety; the opening of the eyelids is straight, and very rarely oblique; the skin is white, or brunette: the hair is never woolly, varying much in colour, frequently very light; the eyes are black, blue, or gray.

The languages of the great European races are never aptotic. They are mostly anaptotic, or having amalgamate inflections. In a few instances they are agglutinate.

Athough the *Japetidæ* form the principal part of the nations of Europe, they do not exclusively occupy this district of the earth, nor are they confined to it. We have before mentioned the Lapps and Finns of Scandinavia, the Euskaldunes of the Basque Provinces, the Magyars, and Turks. It appears not to be improbable that the former were the original inhabitants of Europe, and are the remnants of a race driven away successively by the Celts and the Indo-Germanic races that now occupy this part of the world. As also we find evidence of the origin of the *Japetidæ* in the east, so we find traces of their existence in various parts of Asia: as in the Persians, Kurds, Beloochi, Affghans, Tajiks, and Siaposh. It is not improbable, also, that the Armenians ought to be classed with the Japetidæ.

The influence of this variety of mankind on the history of the world, has been much greater than that of the other two. If we are indebted to the Semitic races for the truth of Christianity, its adoption and propagation in a pure form has been mainly due to European nations. It became early identified with the civilisation of Greece and Rome; and passing from the nations where it obtained its early triumphs, it has become, in later times, the religion of the great Anglo-Saxon race, which on both sides of the Atlantic is increasing with extraordinary rapidity.

Dr. Latham divides the *Japetidæ* into two divisions—Occidental and Indo-Germanic.

A. Occidental Japetidæ include the races called Celts or Kelts. The Keltic languages were separated from the common mother-tongue subsequent to the evolution of the persons of verbs, but anterior to the evolution of the cases of nouns. These languages are evidently agglutinate. The present area of this race is Brittany, Wales, the Highlands of Scotland, the Isle of Man, and Ireland. The original area occupied by the Kelts, which have been constantly removed, is the Scottish Lowlands, England, Gaul north of the Loire, and part of Switzerland. It is probable also that they occupied parts of Baden, Bavaria, and northern Italy. The Taurisci of the Tyrol, the Scordisci, of Illyria, the Galatians of Asia Minor, the Celt-Iberians of Spain, and the Cimbri of Jutland are generally regarded as Kelts. They have two types of complexion in the British Islands: the Silurian type having eyes and hair black, complexion dark with a ruddy tinge, and chiefly found in South Wales; the Hibernian type with gray eyes, yellowish, red, or sandy hair, and light complexion; they are found in Ireland. Dr. Latham gives the following as their chief divisions:—

1. Kelts of Gaul, falling into—*a.* the proper Celtæ; *b.* the Belgæ. Both extinct or incorporate.

2. British Kelts, falling into—*a.* the Cambrians; *b.* the Picts, which are extinct or incorporate.

3. Gaels. *a.* Scotch Gaels; *b.* Irish Gaels; *c.* Manxmen, or Gaelic Kelts of the Isle of Man.

4. The Cisalpine Kelts of northern Italy.

5. The Ligurians, extending from the Etruscan to the Iberian frontier.

Their line of population seems to have been from Calais and Dunkirk to England, from England to Scotland, and from Scotland to Ireland.

B. Indo-Germanic Japetidæ.—The languages of this group were separated from the common mother-tongue subsequent to the evolution of the cases of nouns. They are less evidently agglutinate than the Keltic. This and the previous group are sometimes called Indo-European, and thus embracing all the Japetidæ. The Indo-Germanic *Japetidæ* are divided into two classes:—

I. European Indo-Germans.—These are divided into—1. Gothic 2. Sarmatian; 3. Mediterranean.

1. The Goths embrace—

a. The Teutons, which are again divided into—

α. Mesogoths.

β. High Germans, including Hessians, Thuringians, Franks.
γ. Low Germans, including—
1. Batavians.
2. Saxons, embracing—
* Saxons of Hanover, and Anglo-Saxons of England.
** Saxons of Osnaburg and Westphalia.
*** Nordalbingians. Extinct.
3. Frisians.
b. Scandinavians, embracing—
1. Icelanders.
2. Faroe Islanders.
3. Norwegians.
4. Swedes.
5. Danes.

2. Sarmatians. This comprises the Lithuanic and Slavonic divisions, and these are its primary sections.

Of the Lithuanians Dr. Latham says—
1. Of all the Japetidæ they preserved their original paganism longest.
2. Of all the Japetidæ they have had the least influence on mankind.
3. Of all the Japetidæ they speak a language nearest in structure to the Sanscrit.

The Slavonic division includes—
α. Russians.
β. Servians.
γ. Illyrians
δ. Tcheks.
ε. Poles.
ζ. Serbs.
η. Polabic Slavonians.

3. Mediterranean Indo-Germans. These include the Greeks and Romans of antiquity, and their modern descendants.

II. Iranian Indo-Germans.—Dr. Latham says "the whole of this class is hypothetical." It includes the Persians, who embrace the Kurds, the Beloochi, the Affghans, the Siaposh, and other contiguous races in Asia. The unplaced stocks are the Armenians and Iberians.

(Dr. R. G. Latham, *Varieties of Man;* Lawrence, *Lectures on Man;* Dr. Lankester, *On the Physical History of Man*, in *Family Tutor;* Nott and Gliddon, *Types of Mankind;* Dr. Latham, *Ethnology of British Colonies, Ethnology of British Islands, Migrations of Man, Ethnology of Europe;* Dr. Pickering, *Races of Men;* Dr. Prichard, *Physical History of Mankind;* Cuvier, *Règne Animal.*)

MAN, FOSSIL. [ANTHROPOLITES.]

MANAKINS, the name of a group of small birds remarkable for the rich tints of their plumage (*Pipra* of authors). Mr. Swainson makes them a sub-family of the *Ampelidæ*, under the name of *Piprinæ.* [PIPRA.]

MANATEE. [CETACEA.]

MANCHINEEL-TREE. [HIPPOMANE.]

MANDARIN DUCK. [DUCKS.]

MANDIOC, the Brazilian name of the Cassava Plant, *Jatropha Manihot.* [JATROPHA.]

MANDRAGORA. [ATROPA.]

MANDRAKE. [ATROPA.]

MANDRILL. [BABOON.]

MANETTIA, a genus of Plants belonging to the natural order *Cinchonaceæ.* The limb of the calyx is 4- or 5-lobed, often with secondary lobes interposed between the principal ones; the corolla is funnel-shaped, with a terete or quadrangular tube, a hairy throat, and a 4- or 5-lobed limb; anthers sessile, in the throat of the corolla; capsule ovate, compressed, crowned with the lobes of the calyx. Seeds peltate, girded by a usually toothed border. The species are herbaceous plants or shrubs, with slender twining stems and axillary leaves, many-flowered peduncles.

M. cordifolia is a native of Buenos Ayres and of the province of Minas Geraes in Brazil. The whole plant is glabrous; the stem suffruticose, much branched, very slender, round, twining; bark gray, and exfoliating on the young shoots, green, glabrous, and shining. The leaves are opposite, petioled, cordate, acuminate, glabrous on both sides, shining, pale, with prominent veins, and obscure minute articulations, below dark, and the veins slightly channeled above; stipules small, subulate, and at length often reflexed in their upper half, bases broad, and connate within the petioles, so as to form a small cup, which is occasionally toothed round the branch; peduncles elongated, solitary, glabrous, filiform, shining, and single-flowered at the extremities of the branches, which are subsequently elongated, rendering the peduncle axillary; calyx green, glabrous, 4-parted, with minute divided intervening teeth; segments acute, at length reflexed, and nerved; corolla very handsome, shining on the outer surface, and glabrous everywhere except a little above its base on the inside, where for some distance it is densely clothed with inverted white hairs; tube clavate, funnel-shaped, with 4 flat sides, nectariferous, and only colourless at the base, every other part of the corolla vermilion orange-coloured, deepest on the inner side of the limb, green in the young buds; throat dilated and naked; limb 4-parted; segments deltoid, revolute. The seeds are brown, round, flattened, and surrounded by a membranous wing. The bark of the root is esteemed in Brazil a most valuable remedy in dropsy and dysentery. It is given in powder of half a drachm to a drachm and a half. It acts as an emetic.

(Lindley, *Flora Medica.*)

MANGABEY, a name for two species of Monkeys belonging to the group of *Guenons.* [GUENONS.]

MANGANESE, a Metal of which the black oxide, or binoxide, was first described by Scheele in 1774, and was afterwards determined by him and Gahn to contain a peculiar metal, which has so powerful an affinity for oxygen, that this circumstance alone would prevent its occurrence in nature in its metallic state. The natural compounds of manganese, and especially its oxides, are numerous, and are found abundantly in many parts of the earth. Like oxide of iron, it frequently occurs in minerals in such small quantity as to show that it exists in them rather in mixture than combination.

Manganese may be procured by mixing any of its oxides with oil, and heating it strongly in a well-covered crucible. Its properties are, that it has a grayish-white colour and resembles white cast-iron in appearance; it is hard, brittle, and has a fasciculated crystalline structure; its specific gravity, according to Berthier, is 7·05; it is inodorous and tasteless, but when breathed upon emits a smell of hydrogen gas. By exposure to the air manganese readily tarnishes by oxidisement, and even in a very short time attracts sufficient oxygen to lose its metallic lustre, and falls to a reddish-brown powder; hence the necessity for preserving it immersed in naphtha. Even at common temperatures it slowly decomposes water; and at a red heat the decomposition is rapidly effected, and in both cases hydrogen gas is evolved and oxide of manganese formed. It requires an extremely high temperature for its fusion, and it is fixed in the fire.

The ores of manganese are chiefly oxides: they are the following:—

Haussmannite—Occurs crystallised in octohedrons and massive. Primary form a square prism. Cleavage parallel to the base of the primary form. Fracture uneven. Hardness rather greater than that of phosphate of lime. Colour brownish-black. Powder reddish-brown. Lustre imperfect metallic. Opaque. Specific gravity 4·722.

Before the blow-pipe with borax fuses into an amethystine-coloured glass. It is found at Ilmenau in Thuringia, at Framont, and in Pennsylvania, &c.

Dr. Turner's analysis gives very nearly—

Manganese	70·98
Oxygen	27·33
Silica	0·34
Barytes	0·11
Water	0·43
	——99·19

The equivalent of manganese being 28, this ore is essentially a compound of 3 equivalents of metal 84 + 4 equivalents of oxygen 32 = 116. It contains less oxygen than any other oxide except the protoxide, which does not occur in nature except in combination.

Braunite—Occurs crystallised and massive. Primary form a square prism. Cleavage distinct, parallel to the faces of an octohedron. Fracture uneven. Hardness 6·0 to 6·5. Brittle. Colour brownish-black. Streak the same. Lustre imperfect metallic. Opaque. Specific gravity 4·818. The massive varieties are divergingly fibrous.

Before the blow-pipe melts and effervesces slightly with borax. It is found at Elgenberg, Wursindel, Piedmont, and in Cornwall.

According to Dr. Turner, it consists very nearly of—

Manganese	67·76
Oxygen	29·03
Barytes	2·26
Water	0·95
	——100

It is essentially an anhydrous sesquioxide of manganese, consisting of 1 equivalent of metal 28 + 1½ equivalent of oxygen 12 = 40.

Manganite—Occurs crystallised and massive. Primary form a right rhombic prism. Cleavage parellel to the lateral faces. Fracture uneven. Hardness 4·0 to 4·25. Scratches glass slightly. Colour iron and steel and blackish gray. Streak reddish-brown. Lustre metallic. Opaque. Specific gravity 4·328. Massive varieties amorphous. Structure crystalline, granular, large fibrous.

Before the blow-pipe, with borax, fuses into a transparent amethystine glass; heated in a tube, water is expelled. It occurs at Hartshill near Coventry, in Devonshire, Ilfeld in the Harz, &c.

Dr. Turner's analysis gives very nearly—

Manganese	62·93
Oxygen	26·97
Water	10·10
	——100

It is therefore hydrated sesquioxide of manganese.

Varvicite—Occurs massive and in pseudo-crystals. Composed of thin plates and fibres. Hardness 2·5. Colour gray. Powder black. Lustre metallic. Opaque. Specific gravity 4·531. When strongly heated yields oxygen gas and water.

It occurs massive at Hartshill in the county of Warwick, and the pseudo-crystals at Ilfeld.
Analysis according to Phillips :—

Manganese	63·1
Oxygen	31·5
Water	5·4
	100

It is a compound of 4 equivalents of metal 112 + 7 equivalents of oxygen 56 and 1 equivalent of water 9.

Pyrolusite, Binoxide of Manganese—Occurs crystallised and massive. Primary form a right rhombic prism. Cleavage parallel to the lateral planes and short diagonal; indistinct. Fracture uneven. Hardness 2·0 to 2·5. Colour blackish-gray and black. Streak black. Lustre imperfect metallic. Opaque. Specific gravity 4·94.

Massive varieties amorphous, reniform, and botryoidal. Structure granular, fibrous.

It is the most abundant ore of manganese, occuring in large quantity in Devonshire, Warwickshire, Thuringia, Brazil, and many other places.

Dr. Turner's analysis gives very nearly—

Manganese	61·86
Oxygen	35·36
Silica	0·56
Barytes	0·66
Water	1·56
	100

It is a compound of 1 equivalent of metal 28 + 2 equivalents of oxygen 16 = 44, and is the per- or bin-oxide.

Hydrated Binoxide of Manganese has long been known by the name of Black Wad.—It occurs of various shades of brown, and is massive, botryoidal, amorphous, and sometimes pulverulent. It is frequently soft enough to soil the fingers. It occurs largely in Devonshire, and is also met with in Cornwall, the Harz, Piedmont, and many other places.

Analysis of a specimen from the Harz by Klaproth :—

Peroxide of Manganese	68·0
Oxide of Iron	6·5
Water	17·5
Silica and Barytes	9·0
Carbon	1·0
	102

Psilomelane is an ore of manganese which contains a considerable quantity of barytes. It occurs reniform, botryoidal, and stalactitic. Structure granular, compact, and indistinctly fibrous. Fracture conchoidal, even. Hardness 5·0 to 6·0. Colour dark-gray and grayish-black. Streak brownish-black. Lustre imperfect metallic. Opaque. Specific gravity 4·0 to 4·15. It occurs in Devonshire, Cornwall, in the Harz, and most manganese mines.

Dr. Turner's analysis gives—

Red Oxide of Manganese	69·795
Oxygen	7·364
Barytes	16·365
Water	6·216
Silica	0·260
	100

Sulphur is also found in combination with manganese. The compound is called

Kobellite, Manganese-Blende, &c.—It occurs crystallised and massive. Primary form a cube. Cleavage parallel to its faces. Fracture uneven, conchoidal. Hardness 3·5 to 4·0. Colour brownish-black; when fresh fractured, steel-gray. Streak dark-green. Lustre imperfect metallic. Opaque. Specific gravity 4·014.

Fuses with difficulty, and only the edges with the blow-pipe; gives sulphuretted hydrogen when dissolved in an acid. It is found at Nagyag in Transylvania, and in Mexico.

Analysis by Arfwedson :—

Manganese	62·0
Sulphur	37·6
	99·6

Manganese occurs also in combination with some metals and oxides.

Arseniuret of Manganese—Occurs massive. Fracture in one direction granular and shining, in the other dull. Structure foliated. Hard. Brittle. Specific gravity 5·55. Found in Saxony. Colour whitish-gray. Blackens by exposure to the air.

Dr. Kane found it to consist of—

Manganese	45·5
Arsenic, with a trace of Iron	51·8
	97·3

Cupreous Manganese—Occurs massive, reniform, and botryoidal. Structure compact. Fracture imperfect conchoidal. Hardness about 1·5. Colour bluish-black. Streak the same. Lustre resinous. Opaque. Specific gravity about 3·2. Occurs in Bohemia and Chili.

Analysis by Kersten :—

Oxide of Manganese	74·10
Oxide of Copper	4·80
Water	20·10
Sulphate of Lime	1·05
Silica	0·30
	100·35

Carbonic acid and silica also occur in combination with oxide of manganese, and the latter also with oxide of manganese and iron.

Carbonate of Manganese: Kohlerite—Occurs crystallised and massive. Primary form a rhomboid. Cleavage parallel to the primary planes. Fracture uneven, conchoidal. Hardness 3·5. Colour rose-red, brownish. Streak white. Translucent. Lustre vitreous, pearly. Specific gravity 3·3 to 3·6. Massive varieties globular, botryoidal. Structure compact, fibrous, granular. Colour yellowish-white. Opaque. It is found at Hartshill in Warwickshire, Nagyag, Freyberg, &c.

Analysis of the carbonate from Nagyag by Berthier :—

Carbonic Acid	38·6
Protoxide of Manganese	56·0
Lime	5·4
	100

Silicate of Manganese—Occurs crystallised and massive. Primary form an oblique rhombic prism. Cleavage parallel to the lateral faces of the primary crystal. Fracture uneven and conchoidal. Scratches glass. Colour rose-red. Translucent on the edges. Lustre between pearly and resinous. Specific gravity 3·538 to 3·685. It occurs in Sweden, the Harz, Devonshire, Cornwall, &c.

Analysis by Berzelius :—

Silica	48·00
Oxide of Manganese	49·04
Lime and Magnesia	3·34
	100·38

Leonhard has described some silicates of manganese under the names of *Allagite, Photizite, Rhodonite*, &c., which contain admixtures of various other substances.

Silicate of Manganese and Iron: Knebelite.—The locality of this is not known. It occurs massive. Externally cellular and uneven. Fracture imperfect conchoidal. Lustre glistening. Colour gray, spotted dirty-white, red, brown, and green. It is opaque, hard, and brittle. Specific gravity 3·714.

Analysis by Döbereiner :—

Silica	32·5
Protoxide of Manganese	35·0
Protoxide of Iron	32·0
	99·5

Marceline (Anhydrous Silicate of Deutoxide of Manganese)—Occurs crystallised in octohedrons with a square base. Colour grayish-black. Lustre slightly metallic or vitreous. It is found at St. Marcel in Piedmont. Analysis by Berzelius :—

Silica	15·17
Oxide of Manganese	75·80
Oxide of Iron	4·14
Alumina	2·80
	97·91

The analysis by Berthier gives considerably more silica and less oxide of manganese.

Heteroeline is a silicate of manganese belonging to this group.

Phosphate of Manganese and Iron; Ullmannite—Occurs massive. Fracture conchoidal. Hardness 5·0 to 5·5. Colour reddish-brown, or blackish. Lustre resinous. Opaque. Specific gravity 3·439 to 3·775. Occurs at Limoges in France.

Analysis by Berzelius :—

Phosphoric Acid	32·8
Oxide of Manganese	32·6
Oxide of Iron	31·9
Phosphate of Lime	3·2
	100·5

Two other varieties have been described under the name of *Heteposite* and *Huraulite*.

MANGEL-WURZEL. [BETA.]

MANGIFERA, a genus of Plants belonging to the natural order *Anacardiaceæ*. Three or four species of this genus are enumerated—as *M. fœtida* of Loureiro, a native of Cochin China and the Moluccas; *M. laxiflora*, indigenous in Mauritius; and *M. sylvatica*, of Roxburgh, a native of the hilly districts bordering on Silhet, where it grows to a great size, and is called Lukshmee-Am. It bears a fruit which ripens in February and March, and is eaten by the natives, though not so palatable as even a bad mango. It is also dried and kept by them for medicinal purposes. *M. oppositifolia*, Roxburgh, a native of Rangoon, is proposed by Messrs. Wight and Arnott to be formed into a distinct genus.

M. Indica, the Mango-Tree, is alone of any consequence, and this as forming one of the most grateful fruits of the tropical parts of Asia; it extends also as far north as 30°, and has been successfully introduced into the West Indies. The tree grows to a great size, with an erect trunk, and dark-coloured cracked bark. The wood is of a whitish or dull-gray colour, porous, yet pretty durable if kept dry. The leaves are alternate, petioled, lanceolar, entire, often a little waved at the margins, firm, smooth, shining, and having, when bruised, a pleasant resinous smell. The flowers are yellow-coloured and small, but produced in great numbers, on large terminal erect panicles. Many perfect male flowers are often found intermixed with the hermaphrodite ones. Calyx 5-leaved; petals 5, lanceolate, twice the length of the calyx, furnished in the inside with a lobed granular scale or crust; stamen, a single fertile one, with three or four filament-like bodies, which represent the abortive stamens; ovary with its base immersed in the torus, obliquely oval, 1-celled, with a single ovule attached to the side of the cell; style one, from the upper edge of the ovary, curved downwards; drupe oblong, or somewhat kidney-formed, also a little compressed like a kidney, fleshy, with a smooth rind, yellow or reddish when ripe, size various, but in general about as large as a goose's egg; nut conformable to the drupe, but more compressed, woody, 1-celled, 2-valved, covered on the outside with many fibrous filaments, particularly in the worst sorts; the kernels are large. Embryo between erect and transverse; cotyledons thick, fleshy; radicle opposite to hilum.

The Mango is so well known as one of the most highly esteemed fruits of the East, that one is surprised to find it sometimes described as like nothing so much as a mixture of tow and turpentine. The latter is a secretion abounding in the family to which the Mango belongs, and may be secreted in larger quantities in neglected varieties, where also the filaments of the nut will likewise abound. But in well-cultivated varieties the fruit is sweet and rich-flavoured, juicy, and nearly as free of fibres as a melon. The kernels contain much nourishment, but are never used for food except in famines, when they are cooked in the steam of water, and used as an article of diet. From wounds made in the bark of the tree there issues a soft reddish-brown resin, which age hardens. Burnt in a candle, it emits a smell like that of a Cashue nut when roasting. It softens in the mouth, and adheres to the teeth. The taste is slightly bitter, with some degree of pungency. It dissolves almost entirely in spirits, and to some degree in water.

The tree is generally raised from seeds, which should be sown soon after they are gathered, but this is a very uncertain way of getting the finer varieties. Propagating by layers, and grafting by approach, are the only modes of certainly continuing fine sorts, as well as of improving them. These have the advantages also of bearing when small in size, that is, only a few feet in height, and therefore well suited to culture in the hothouses of Europe. Sweet states "that the Mango ripens in this country when the plants are of a good size. Sandy loam, or a mixture of loam and peat, is most suitable to it; and the pits should be well drained, as the plants are apt to get sodden with too much water. Fresh seeds from the West Indies vegetate freely. The plant may also be increased from cuttings, which root best in sand under a hand-glass." It would be advisable also to imitate its native climate as much as possible, that is, after winter, giving it dry heat with watering for some months, and then removing it into an orchideous house in the season of ripening its fruit.

MANGLETIA, a genus of Plants belonging to the natural order *Magnoliaceæ*, one of the species of which, *M. glauca*, has a white solid wood, which is largely employed in Java, and supposed to prevent the decay of corpses put into coffins made of it.

MANGO-GINGER. [CURCUMA.]

MANGO-TREE. [MANGIFERA.]

MANGOSTEEN. [CLUSIACEÆ; GARCINIA.]

MANGOUSTE. [HERPESTES.]

MANGROVE. [RHIZOPHORA.]

MANIHOT. [JATROPHA.]

MANIOC. [CASSAVA.]

MANIS. [EDENTATA.]

MANNA. The concrete juice of the *Ornus Europæus*, a species of Ash, native of the south of Europe. Other sweetish secretions exuded by some other plants are usually considered to be kinds of Manna. These appear to be all produced in warm and dry parts of the world. The kind which is most abundant is by the Arabs called Toorunjbeen, which is often translated 'Persian Manna,' and is produced by a thorny plant, called by botanists *Alhagi Maurorum*. The genus *Alhagi* (a name compounded of 'haj' and the article 'al') of botanists contains two species, *A. Maurorum* and *A. desertorum*, found in India, Egypt, Arabia, the north of Persia, and Syria. Both species are also called Ooshturkhar, or Camel's Thorn. *A. Maurorum* is alone remarkable for yielding a kind of Manna, which by some authors has been supposed to be the Manna of the Wilderness; hence the plant itself was called *Manna Hebraica* by Mr. Don. The climate of Persia and Bokhara seems alone suited for the secretion of this Manna, which in the latter country is employed as a substitute for sugar, and is imported into India from Cabul and Khorassan. A second kind, which, though less abundant, is more esteemed than the former, is called Sheer Khisht, and is mentioned by Garcias under this name, and described as produced in the country of the Uzbecs. A Cabul merchant reported to Dr. Royle that it was produced by a tree called Gundeleh, which was about 12 feet high, had a jointed stem, and grew in Candahar. A third kind of Manna is called Guzunjbeen, the produce of a species of Tamarisk, called Guz, which is considered by Ehrenberg to be only a variety of *Tamariscus gallica*, growing on Mount Sinai, but which has been called *T. mannifera*: by some authors this is supposed to be the Manna of the Wilderness. It is said to be produced also in Laristan and in Irak Ajemi. A fourth kind of Manna is produced on *Calotropis procera*, called Ashur, and its sweet exudation or sugar Shukur-al-Ashur, under which name it is described by Avicenna; Zuccarum-al-Husar in the Latin translation, ch. 758. A fifth kind, called Bed-Khisht, is described in Persian works as being produced on a species of willow in Persian Khorassan. Besides these comparatively little known kinds of Manna, a sweetish exudation is produced on the Larch (*Larix Europæa*), which forms the *Manna Brigantiaca*, or Briançon Manna of some Pharmacopœias. [ORNUS; ALHAGI; TAMARISCUS; LARIX.]

MANNA-ASH. [FRAXINUS.]

MANON, a genus of *Zoophyta*, proposed by Schweigger, adopted by Goldfuss, and ranked by De Blainville among the *Amorphozoa*, with *Spongia*, *Alcyonium*, &c. It is an attached mass, full of lacunæ, composed of reticulated fibres, with its surface pierced by many distinct holes. Goldfuss gives nine species, of which five are from the Chalk, two in Jura Kalk, and one in Transition Rocks.

MANTELLIA (in memory of the late Dr. Mantell, the geologist), a generic name proposed by Parkinson for certain Alcyoniform Fossils of the Chalk. M. Brongniart has also established the use of this word for certain Cycadiform Plants, to which Dr. Buckland has applied the title of *Cycadeoidea*. The specimens are chiefly found in the Oolite of the Isle of Portland, but one (*M. cylindrica*) occurs in the Lias of Luneville, according to M. Voltz. The stem of these plants is cylindrical or sphæroidal, and covered with transverse impressions of leaf-bases. The internal structure resembles *Cycas*. (Buckland, in 'Geological Transactions,' 1828.)

The following is an account of the locality in the Isle of Portland in which these fossils occur:—"Immediately upon the uppermost bed of limestone, which is a coarse rock, full of cavities and imprints left by the decay of the usual species of marine, univalve, and bivalve shells of the oolite, are layers of calcareous shell a few feet in thickness, in which no vestiges of marine fossils have been observed; and whose laminated structure and the presence of horizontal seams of carbonaceous earthy matter, with interspersions of vegetable remains, indicate a fluviatile or freshwater origin.

"Upon these deposits is a layer, from one to two feet thick, of a dark-brown friable loam abounding in lignite, and so similar in appearance to common vegetable earth or mould, as to have acquired the name of dirt-bed from the quarrymen. In and upon this bed are numerous petrified stems and branches of coniferous trees and plants allied to the *Zamiæ*. Many of the trees and plants are standing erect, as if petrified while growing on the spot; the trunks of the trees extending upwards into the limestone above, and vestiges of the roots being traceable into the dirt-bed. The upright stems are in general a few feet apart, and but 3 or 4 feet in diameter; portions of prostrate trunks have been collected, indicating a total height of the originals of 30 or 40 feet. In many instances fragments of branches remain attached to the stem. The cycadeous plants occur in the intervals between the upright trees, and the dirt-bed is so little consolidated, that specimens evidently standing in the position in which they originally grew, may be dug up with a spade.

"The strata above the dirt-bed consists of finely laminated cream-coloured shaly limestone, in which casts of the freshwater crustaceans (*Cyprides*) so abundant in the Wealden, are the only organic remains hitherto noticed. These deposits are covered by the modern vegetable soil, which but little exceeds in depth the ancient one above described, and instead of supporting *Cycadeæ* and pine forests, barely maintains a scanty vegetation. Here then we have the remains of a petrified forest of the ancient world, the trees and plants like the inhabitants of the city in Arabian fable turned into stone, yet still retaining the places they occupied when alive."

Specimens of *Mantellia nidiformis* and *M. cylindrica* from the Isle of Portland, are to be seen in the British Museum.

MA'NTIDÆ, a family of Orthopterous Insects, the species of which may be distinguished by the following characters:—Head exposed (not hidden by the thorax), furnished with three ocelli, or simple eyes, besides the ordinary pair of compound eyes; palpi short, slender, and cylindrical; antennæ generally setaceous, but sometimes pectinated; short in the females and long in the males; body elongated; the thorax usually very long, often dilated at the sides and dentate; abdomen long, and with the terminal segment small in the male sex, more or less dilated, and with this terminal segment large in the females; the apex furnished with two small appendages; legs long; the four posterior legs slender, the anterior legs with the coxæ very large and elongated; the femora also very large, dilated, and furnished with a double series of spines on the under side, between which (when the animal is in a state of repose) the tibiæ are placed: the tibiæ are rather short, armed with spines, and having a strong spine at the apex, which is recurved; tarsi usually 5-jointed, but in some species the posterior tarsi have only three joints; wings horizontally folded when at rest.

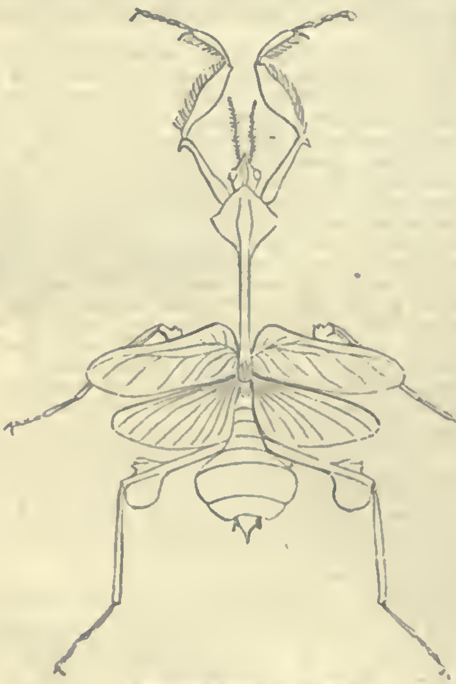
The principal genera contained in this family are:—*Heteromytarsus*

Eremiaphila, and *Mantis*. The species of the first of these three genera are readily distinguished by there being only three joints to the posterior tarsi, there being five joints to the tarsi in all the species comprised in the remaining two genera. In the genus *Eremiaphila*, the palpi are obtusely pointed, and the head is partially enveloped in the thorax; the two posterior pairs of legs are long and slender, and the thighs are sometimes terminated by a small spine; the penultimate segment of the abdomen is furnished with two spines in the females. The elytra and wings are always very short. The genus *Mantis* (as now restricted) is distinguished from the last by the head being free, the palpi very slender and almost pointed, and the wings as long as the body, or nearly so; the penultimate segment of the abdomen is never furnished with spines.

The *Mantidæ* are found in all warm countries, are exceedingly numerous, and remarkable for the grotesque forms which they usually assume. Their resemblance to a portion of a plant is often so great, that it is only by their motions they can be discovered. The names *M. religiosa*, *M. precaria*, *M. sancta*, Praying Mantis, &c. have been applied to certain species on account of a peculiarity in their habits—that of erecting the thorax at an angle with the body, and placing together the large fore legs, like the hands of a person when at prayer; in this position they will sometimes remain perfectly motionless for several hours. Their food consists of flies and other insects, which they are exceedingly dexterous in catching by means of their fore legs; the prey is held by the fore leg by bending back the tibia against the femur; the opposing surfaces of these two portions of the legs being covered with spines, enables them to retain their prey in this manner, and to convey it to the mouth.

The eggs are deposited by the female *Mantis* upon plants, and are covered by a glutinous substance, which soon becomes hard and forms a kind of case, in which they are arranged in a symmetrical manner. The form of the case varies according to the species. The young, when hatched, resemble the parents, except in size and in being destitute of wings.

Mantis gongylodes has been selected to illustrate a common form of the insects of the present family. This species inhabits the East Indies, and when alive is most probably of a green colour. The female is about 4 inches, and the male is about 3½ inches in length.



Mantis gongylodes. Linnæus.

MANTIS. [MANTIDÆ.]
MANUCODE. [BIRDS OF PARADISE.]
MAPLE. [ACER.]
MARABOU. [CICONIA.]

MARANTA, a genus of Plants belonging to the natural order *Marantaceæ*. The root-stock is white, horizontal, annulated, from which proceed root-fibres, some of which swell into tubers and become jointed stocks, similar to the rhizoma, but covered with scales. These often elongate, curve upwards, and rising out of the ground become new plants. The stem is 2 or 3 feet high, much branched, slender, finely hairy, tumid at the joints; leaves alternate, with long leafy hairy sheaths, ovate-lanceolate; panicles terminal, lax, spreading, with long linear sheathing bracts at the ramifications; calyx green and smooth; corolla white, small, unequal, one of the inner segments in the form of a lip; anther attached to the petal-like filament; style hooded, petal-shaped; ovary 3-celled, smooth; stigma 3-sided; fruit even, dry, 1-seeded.

M. arundinacea yields the arrow-root of commerce, but it is also procured in large quantities from a variety of closely-allied, and even many distinct, plants. Thus the Surinam and Bermuda arrow-root is the produce of the *M. arundinacea*, while the Jamaica arrow-root is obtained from the *M. Indica* (Tussac); which plant, along with several Curcumas, yields also the East Indian arrow-root. The West Indian arrow-root has mostly a pure white colour, the East Indian a yellow tinge.

The tubers, root-stocks, or offsets, are grated or brused, and repeatedly washed with water, which is passed through a fine hair-sieve, so long as it runs off with a milky appearance. It is allowed to subside, the supernatant water drained off, and the powder dried: 100 parts of the fresh plant yield 10 parts of arrow-root; but Benzon states 100 parts to yield 23 or 26 parts.

According to the analysis of this chemist it consists of—

Volatile Oil	0·07
Starch	26·00
Vegetable Albumen	1·58
Gummy Extract	0·60
Chloride of Calcium, insoluble fibre	6·00
Water	65·60
	——99·85

The volatile oil imparts a slight odour to the solution in warm water, which helps to distinguish genuine arrow-root from several of the articles substituted for it. Arrow-root has scarcely any taste, being bland and insipid; the powder, when pressed in the hand, emits a crackling noise, and retains the impression of the fingers, which common starch from wheat does not. Cassava (Manioc, from *Jatropha*, or *Janipha Manihot*) also retains the impression of the fingers, but it has more odour and a somewhat acrid taste.

1 *Canna Indica.* 2

1, a flower with the calyx and petals cut off, the petaloid, stamen, and style alone remaining. 2, a capsule.

The meals of any cereal grain may easily be distinguished from arrow-root by the nitrogen which they contain, and the ammoniacal products which they yield by distillation. Potato-starch is however most frequently used to adulterate arrow-root, or as a substitute for it. Microscopic observation of the form and size of the grains will point out the difference, as first indicated by Raspail ('Annales des Sciences Nat.,' t. vi.), those of arrow-root being smaller; the different habitudes of the starch with reagents will also do this. (See

Messrs. Payen et Chevalier, 'Traité de la Pomme de Terre,' p. 126; also 'Journal de Pharmacie,' Août, 1833.) Potato-starch is not soluble in cold water, which is the case with arrow-root. Dissolved in absolute alcohol, arrow-root separates into two distinct portions, which neither wheat nor potato-starch does. In equal proportions dissolved in warm water, arrow-root yields a thinner solution, with a more slimy aspect than wheat-starch.

Arrow-root dissolved in water, milk, or any other appropriate vehicle, constitutes, from its easy digestibility, a most excellent article of diet for delicate persons and young children. It may be given plain, or with wine or spices, according to circumstances. The valuable property just mentioned does not belong to either wheat- or potato-starch. The latter, if prepared from potatoes in spring, is very liable to disturb the stomach; but less so if prepared in October or November. Potato-starch may be prepared at a very cheap rate, and kept for a long period unchanged, thus affording a protection against times of scarcity.

(Sir John Sinclair, *On the Culture and Uses of Potatoes*, Edinb., 1828.)

MARANTA'CEÆ, *Marants*, a natural order of Endogenous Plants, which have either no stems or annual ones only, whose leaves have diverging veins, and whose flowers are constructed with an inferior ovary surmounted by a 3-leaved calyculus; very irregular flowers, white, red, or yellow; and a single stamen, whose anther has but one lobe.

With the exception of the genus *Calathea*, and of *Canna*, which is commonly cultivated under the name of Indian Shot, because of its beautiful flowers, the species included in this order are of small size, and by no means attractive, but the fleshy tubers of some of them abound in starchy matter, which renders them nutritious. Arrow-root of the finest quality is obtained from *Maranta arundinacea*, and a similar product is yielded by *Canna edulis* and others. The order is known from *Zingiberaceæ* by the anther having but one lobe instead of two.

All the species are found wild in tropical countries only.

The species are natives of the tropics of America, Africa, and Asia. Amylaceous qualities prevail in this order, and starch is prepared from many of the species. The fleshy corms of some species of the *Canna* are eaten in Peru, and a sort of arrow-root, called Tous le Mois, is extracted from some of the species. The seeds of others, called Indian Shot, have been used as a substitute for coffee, and yield a purple dye.

(Lindley, *Vegetable Kingdom.*)

MARBLE. A strict definition of this term is perhaps impracticable, unless, with Da Costa, we limit it to the calcareous rocks "of very lively colours, and of a constitution so fine that they will readily take a good polish." In a vague sense other ornamental stones, as granite and porphyry, may be ranked among marbles, but the catalogue of the typical or calcareous marbles is long enough without these somewhat inconvenient additions. A limestone which will admit of being worked easily and equally in all directions is properly called 'freestone,' as the Bath or Ketton freestone; a rock of similar chemical composition, generally capable of being worked equally in all directions, and also of taking a good polish, deserves the title of marble; when it is granular and of a white colour, it may be useful in statuary.

Da Costa, in his 'Natural History of Fossils,' gives a large catalogue of marbles, disposed in methodical order, which we shall follow in the subsequent brief notices of this extensive subject.

Division I. Marbles of one plain Colour.

Section 1. Black Marbles. Most of these contain bitumen, and are fetid when bruised.

Examples. The Namur marble, the marble of Ashford in Derbyshire, Dent in Yorkshire, near Crickbowell, Tenby, Kilkenny, &c. The marble, anciently called Marmor Luculleum, and now Nero Antico.

Section 2. White Marbles.

Examples. The marble of Paros, in which the Laocoon and Antinous are executed; the Carrara marble, of finer grain, much used in modern sculpture; the Skye marble, noticed by Dr. M'Culloch; that of Inverary, Assynt, Blair Athol, &c.

Section 3. Ash and Gray Marbles.

Examples. A beautiful marble, of compact oolitic texture, at Orelton, near the Clee Hills in Shropshire, deserves mention.

Section 4. Brown and Red Marbles.

Examples. The Rosso Antico; a rival to which, at least in colour, has been found on the estate of the Duke of Devonshire, near Buxton. The mottled brown marble of Beetham Fell, near Milnthorp, is of good quality.

Section 5. Yellow Marbles.

Example. The Giallo Antico. Siena marble, also dug at Mafra, near Lisbon. That used in ancient Rome is said to be from Numidia.

Section 6. Blue Marbles.

Example near St. Pons in Languedoc.

Section 7. Green Marbles.

Example. The Marmor Lacedæmonicum of Pliny. It is dug near Verona.

Division II. Marbles of two Colours.

Section 1. Black Marbles variegated with other colours.

Example. Near Ashburton in Devonshire, Torbay in the same county, Bianco e Nero Antico, the African Breccia of the ancients, Giallo e Nero Antico.

Section 2. White Marbles variegated with other colours.

Example. Marble imported from Italy. Marbles of this general character occur in Siberia, at Plymouth, at Killarney, in Sweden, &c.

Section 3. Ash and Gray Marbles variegated with other colours. These are very numerous, and occur in various parts of Europe.

Section 4. Brown and Red Marbles variegated with other colours.

Section 5. Yellow Marbles variegated with other colours.

Section 6. Green Marbles variegated with other colours.

Examples. Egyptian Marbles—the Marmor Tiberium and Augustum of Pliny; some Verde Antico, as that dug near Susa in Piedmont, the beautiful marble of Anglesey (called Mona marble), the marble of Kolmerden in Sweden.

Division III. Marbles variegated with many Colours.

Example. Some of the Plymouth marble, the beautiful Brocatello or Brocade marble of Italy and Spain.

Division IV. Marbles containing Shells, Corals, and other extraneous bodies.

In this division of marbles the British Islands are rich. Some of the Plymouth, Ashburton, and other Devonian limestones are extremely beautiful, from the abundance of fine corals exquisitely preserved in them; the crinoidal marbles of Flintshire, Derbyshire, and Garsdale in Yorkshire, are elegant examples of the carboniferous limestone; the shell marbles of Rance (Northamptonshire), Buckingham, Whichwood Forest, Stamford, Yeovil, may be noticed from the Oolitic rocks; that of Petworth and Purbeck, from the Wealden strata, has been extensively used by the architects of the middle ages. In general the working of the English marbles is costly, and their use limited.

Dana gives the following account of marbles in his 'Manual of Mineralogy,' with especial references to the American sources of this substance:—

"The finest and purest white crystalline limestones are used for statuary and the best carving, and are called Statuary Marble. A variety less fine in texture is employed as a building material. Its colours are white and clouded of various shades. It often contains scales of mica disseminated, and occasionally other impurities, from which the cloudings arise. The finest statuary marble comes from the Italian quarry at Carrara, from the island of Paros, whence the name Parian; from Athens, Greece; and from Ornofrio, Corsica. Of these the Parian is the most pure, consisting almost entirely of carbonate of lime; whilst that of Carrara is frequently intermixed with granular quartz, which renders it more durable. The Medicean Venus, and most of the fine Grecian statues, are made of the Parian marble. These quarries, and also those of the islands of Scio, Samos, and Lesbos, afforded marble for the ancient temples of Greece and Rome. The Parthenon at Atheus was constructed of marble from Pentelicus.

"Statuary marble has been obtained in the United States, but not of a quality equal to the foreign. Fine building material is abundant along the western part of Vermont, and south through Massachusetts to western Connecticut and eastern New York. In Berkshire county, Massachusetts, marble is quarried annually to the value of 200,000 dollars. The principal quarries are at Sheffield, West Stockbridge, New Ashford, New Marlborough, Great Barrington, and Lanesborough. The columns of the Girard College are from Sheffield, where blocks 50 feet long are sometimes blasted out; the material of the City Hall, New York, came from West Stockbridge; that of the Capitol at Albany from Lanesborough. At Stoneham is a fine statuary-marble quarry, but it is difficult to obtain large blocks. The variety from Great Barrington is a handsome clouded marble. Some of the West Stockbridge marble is flexible in thin pieces when first taken out. There are Vermont localities at Dorset, Rutland, Brandon, and Pittsford. Extensive quarries are opened at New York, at Sing Sing; also at Patterson, Putnam county; at Dover, in Dutchess county, New York. In Connecticut there are marble-quarries at New Preston; in Maine, at Thomastown. In Rhode Island, at Smithfield, a fine statuary marble is found; in Maryland, a few miles east of Hagerstown, 20 miles from Philadelphia, a fine clouded variety is found. A fine dun-coloured marble is found at New Ashford and Sheffield, Massachusetts; and at Pittsford, Vermont.

"The granular limestone, when coarse, usually crumbles easily, and is not a good material for building; but the finer varieties are not exceeded in durability by any other architectural rocks, not even by granite.

"The impurities are sometimes so abundant as to render it useless. For statuary it is essential that it should be uniform in tint, and without seams or fissures.

"The common minerals in this rock are tremolite, asbestus, scapolite, chrondrodite, pyroxolite, apatite, besides sphene, spinel, graphite, idocrase, and mica.

"Verde Antique Marble, or Verde-Antico, is a clouded green marble consisting of a mixture of serpentine and limestone, found at Genoa and Tuscany, and is much valued for its beauty. A variety is called Polzinera di Genoa, and Vert d'Egypte.

"A marble of this kind is found also in America, at Millford, near New Haven, Connecticut, of fine quality; also in Essex county, New York; at Moria, near Port Henry, on Lake Champlain.

"The Cipolin Marbles of Italy are white, or nearly so, with shadings or zones of green talc.

"The Bardiglio is a gray variety, found at Corsica, also at Carrara.

"Compact Limestone usually breaks out into thick slabs, and is a convenient and durable stone for building. It is not possessed of much beauty in the rough state. When polished it constitutes a variety of marbles, according to colour; the shades are very numerous, from white, cream, and yellow shades, through gray, dove-coloured, slate-blue, or brown, to black.

"The Nero-Antico Marble is an ancient deep-black marble; the Paragone is a modern one, of a fine black colour, from Bergamo; and Panno di Morte is another black marble, with a few white fossil shells.

"The Rosso-Antico is deep blood-red, sprinkled with minute white dots.

"The Giallo-Antico, or Yellow Antique Marble, is deep yellow, with black or yellow rings.

"A beautiful marble from Sienna, called Brocatello di Siena, has a yellow colour, with large irregular spots and veins of bluish-red or purplish.

"The Mandelato of the Italians is a light-red marble with yellowish-white spots. It is found at Luggezana.

"At Verona there is a red marble inclining to yellow; and another with large white spots in a reddish and greenish paste.

"The Bristol Marble, of England, is a black marble, containing a few white shells, and the Kilkenny is another, similar. There is also a black marble found in America at Shoreham, New York, and in other places in that state near Lake Champlain. There are several quarries at Isle la Motte.

"The Porto is a Genoese marble very highly esteemed. It is deep black, with elegant veinings of yellow. The most beautiful comes from Porto-Venese, and under Louis XIV. a great deal of it was worked up for decorations at Versailles.

"The Bird's-Eye Marble of western New York is a compact limestone with crystalline points scattered through it.

"Ruin Marble is a yellowish marble, with brownish shadings or lines arranged so as to represent castles, towers, or cities in ruins. These markings proceed from infiltrated iron. It is an indurated calcareous marl.

"Oolitic Marble has usually a grayish tint, and is speckled with rounded dots, looking like the roe of fish.

"Shell Marble contains scattered fossils, and is of different colours, as the Petworth and Bethersden marbles. It is abundant in the United States. Crenoidean or Encrinital Marble differs only in the fossils being mostly encrinites, resembling thin discs. Large quantities are found in Onondaga and Madison counties, New York, and the polished slabs are much used.

"Madreporic Marble consists largely of corals, and the surface consists of delicate stars. It is called by the Italians Pietra Stellaria. It is also common in some of the states on the Ohio.

"Fire Marble, or Lumachelle, is a dark-brown shell marble, having brilliant fire or chatoyant reflections from within.

"Breccian Marbles, and Pudding-Stone Marbles, are the polished calcareous breccia- or pudding-stone.

"Stalagmites and stalactites are frequently polished, and the variety of shades is often highly beautiful. The Gibraltar Stone, so well known, is of this kind. It comes from a cavern in the Gibraltar rock, and was deposited from dripping water. It is made into ink-stands, letter-holders, and various small articles.

"Wood is often petrified by carbonate of lime, and occasionally whole trunks are changed into stone. The specimens show well the grain of the wood, and some are very handsome when polished.

"Marble is sawn by means of a thin iron plate and sand and water, either by hand or machinery. In polishing the slabs are first worn down by the sharpest sand, either by rubbing two slabs together, or by means of a plate of iron; finer sand is afterwards used, and then a still finer. Next emery is applied of increasing fineness by means of a plate of lead; and, finally, the last polish is given by means of putty powder, rubbed on with a piece of felt about a third of an inch in thickness fastened on to a block of wood made for the purpose. More or less water is used throughout the process."

MARCASITE, a name for Iron Pyrites. [IRON.]

MARCELINE. [MANGANESE.]

MARCGRAA'VIACEÆ, *Marcgraviads*, a natural order of Polypetalous Exogens, having an imbricated calyx, numerous hypogynous stamens, and a superior ovary with a discoid stigma and many polyspermous cells. They are all inhabitants of the tropical parts of America, and are usually scrambling shrubs, which are sometimes true parasites. The order is of no known use, and of but little interest, except in a systematical point of view; unless for the sake of its very curious bracts, which vary in form in different species, but which are usually more or less pitcher-shaped. The stem, root, and leaves of *Marcgraavia umbellata* are regarded in the West Indies as diuretic and antiseptic.

Marcgravia umbellata.

1, a pitcher-shaped inverted bract adhering to the peduncle of an unexpanded flower; 2, a ripe fruit seated in the persistent imbricated calyx; 3, a transverse section of the same.

MARCHANTIA'CEÆ, *Liverworts*, a small natural order of Acrogens, or Cryptogamic Plants, forming part of the old group called *Hepaticæ*. They are plants of a low organisation, in most instances having no distinction of leaves and stem, but a thin leafy lobed thallus in their room, in which respect they resemble lichens, but are furnished with breathing pores and an approach to spiral vessels in the form of elaters, which latter circumstances elevate them to the level of *Lycopodiaceæ* and *Marsileaceæ*.

Marchantia polymorpha.

1, a vertical section of an involucrum, with the young capsules imbedded in the receptacle.

Marchantiaceæ differ from *Jungermanniaceæ*, with which they were formerly combined under the old name of *Hepaticæ*, in not having a distinct stem, and in their fruit not being 4-valved. *Marchantia* itself, a common plant under the north side of old walls and hedges, upon damp ground, forms deep green patches with a lobed lichenoid thallus, and has reproductive organs of two kinds arranged separately below mushroom-shaped heads; one of them appears to be male and the other female. None of the species are of any known use.

Endlicher separates the order into four, with the following distinctive characters:—

1. *Ricciaceæ.* Frondose. Involucre none. Capsules bursting irregularly. Elaters none. Aquatics.

2. *Anthoceroteæ.* Frondose or leafy. Involucre none. Capsules 1-2-valved, with a central columella. Elaters.

3. *Targioniaceæ.* Frondose. Involucre heterogeneous. Capsules opening by teeth. Elaters.

4. *Marchantiaceæ.* Frondose. Both involucre and involucel. Capsules various, opening irregularly by teeth. Elaters. Flowers capitate.

MARE. [EQUIDÆ.]

MARE'S-TAIL. [HALORAGACEÆ; HIPPURIS.]

MARECA. [DUCKS.]

MAREKANITE. [OBSIDIAN.]

MARGARIN, a peculiar fatty matter contained in vegetable oils, and also in animal fats, as mutton-suet and hog's-lard: when these have been treated with ether, for the purpose of obtaining stearin from them, the ethereal liquors, by spontaneous evaporation, deposit a portion of the solid matter which they contain, and this is to be collected on a linen cloth, strongly pressed, and then exposed for a long time to the heat of a salt-water bath. This substance is very soluble in cold ether, which distinguishes it from stearin. It appears probable however that by boiling in alkaline solutions it is converted into stearic acid; but additional experiments are required to determine its nature with precision. [OIL; ADIPOSE TISSUE.]

MARGARI'TA, Dr. Leach's name for the *Concha margaritifera*, or *Matrix Perlarum*, *Mytilus margaritiferus* of Linnæus, *Meleagrina margaritifera* of Lamarck. [AVICULA.]

MARGARITA'CEA, M. De Blainville's name for his third family of *Lamellibranchiata.* This family comprises the genera *Vulsella, Malleus, Perna, Crenatula, Inoceramus, Catellus, Pulvinites, Gervillia,* and *Avicula.* [AVICULA; MALLEACEA.]

MARGARITE. [MICA.]

MARGARODITE. [MICA.]

MARGINELLA. [VOLUTIDÆ.]

MARGINOPORA. [MILLEPORIDÆ.]

MARIGOLD. [CALENDULA.]

MARIGOLD, MARSH. [CALTHA.]

MARIMONDA. [ATELES.]

MARJORAM, an aromatic potherb used in cookery, especially among the French. It is the *Origanum Majorana* of Linnæus, or *Majorana hortensis* of Mœnch, a native of Barbary and the Himalaya Mountains. In gardens it is little better than an annual; in a wild state it is a suffruticose perennial. [ORIGANUM.]

MARL. A mixture of calcareous and argillaceous earth is commonly called Marl; in Norfolk soft chalk used on the lands is called Marl; in Worcestershire and Somersetshire red clays are termed Marls. In geology we have the Red Marl, the Black Marl at the base of the lias, the Chalk Marl, the Fresh-Water Marls of Headon Hill in the Isle of Wight. The term is too vague for scientific descriptions. It is a useful substance in agriculture. [MARL, in ARTS AND SC. DIV.]

MARLSTONE. Sandy, calcareous, and irony strata, which divide the upper from the lower Lias Clays, are thus designated. [GEOLOGY.] This mass of rocks is nowhere so well developed as in Yorkshire and Leicestershire.

MARMATITE, a name for Blende. [ZINC.]

MARMOLITE, a Mineral consisting of Silicate of Magnesia, occurs massive. Its structure is columnar, irregularly intersecting. Columnar portions foliated, having a cleavage in two directions intersecting each other. Colour grayish and greenish. Hardness 3·5. Lustre pearly. Translucent, opaque. Specific gravity 2·47. Found at Hoboken, New Jersey, and the Bare Hills, near Baltimore, United States. Analysis by Nuttall:—

Silica	36
Magnesia	46
Lime	2
Water	15
	—99

MARMOSET. [QUADRUMANA.]

MARMOT. [RODENTIA.]

MARRAM. [PSAMMA.]

MARROW, or MEDULLA, is the fat contained in the osseous tubes and cells of the bones. [BONE.] It consists of an oily fluid, contained in minute vesicles, which are usually collected into bunches and inclosed in spaces surrounded by bony walls. It is most abundant in the cavities of the long bones, and in the spongy tissue of their articular extremities, and of the short rounded bones.

Spinal Marrow and Medulla Spinalis are names sometimes applied to the spinal chord. [NERVES.]

MARRU'BIUM, a genus of Plants belonging to the natural order *Lamiaceæ*, or *Labiatæ*. It has a tubular calyx 5- to 10-nerved, equal, with 5 or 10 acute spiny teeth; corolla with the upper lip erect, the lower spreading and trifid, with the middle lobe broader and generally emarginate; stamens didynamous, inclosed; anthers with divaricating somewhat confluent lobes, all nearly of the same form; style with short obtuse lobes.

M. vulgare, White Horehound, is a biennial or perennial herbaceous plant, common by roadsides. The stem is bushy, branching from the bottom, bluntly quadrangular; leaves ovate and attenuated into a petiole, or roundish, cordate, crenate, hoary, rough; whorls many, flowered; calyx-teeth 10, subulate, recurved, patent, woolly below, their upper half glabrous; the flowers are white, in dense convex whorls. The officinal part is the leaves; these are to be collected without the stalks. They are of a whitish-gray woolly appearance, possessed of a faint odour, which becomes less by drying, and a bitter sharp taste. Ten pounds of leaves yield four pounds of extract. Their chief constituents are a bitter extractive, with a volatile oil, and probably some astringent matter.

White Horehound, when young, is apt to be confounded with many other labiate plants, particularly the *Ballota nigra*, or Black Horehound, which possesses a disagreeable odour. The medicinial properties of Horehound are very insignificant, being demulcent, slightly tonic, and astringent. As a popular remedy it enjoys great favour in many pulmonary complaints; but the preparations vended under the name of Horehound often contain more efficient ingredients, to which they owe their success.

MARSH-MALLOW. [ALTHÆA.]

MARSH-MARIGOLD. [CALTHA.]

MARSILEACEÆ, or RHIZOCARPEÆ, *Pepperworts* or *Rhizocarps*, a natural order of Aquatic Plants, with creeping stems bearing leaves, which are usually divided into three or more cuneate portions, and have a circinate vernation. The fructification is produced at the base of the leaf-stalks, and consists of sporocarps and involucres inclosing clustered organs, which consist of antheridian and pistillidian cells. The germinating body has an oval form, and occasionally a mammilla on one side, whence roots and leaves proceed. The species are all inhabitants of ditches or inundated places. They do not appear to be affected so much by climate as by situation; thus they have been detected in various parts of Europe, Asia, Africa, and America, chiefly however in temperate latitudes. Their position is between *Lycopodiaceæ* and *Jungermanniaceæ*. The species number about 20, the principal of which are—*Pilularia, Marsilea, Azolla,* and *Salvinia.* (Balfour, *Class-Book of Botany.*)

MARSUPIA'TA, or MARSUPIA'LIA (*marsupium*, a purse or bag), an extensive group of *Mammalia*, differing essentially from all the others in their organisation, and comprehending genera fed by every variety of nourishment. Their structure is, as a necessary consequence, modified accordingly; and we find among them an adaptation of the organs of progression, prehension, and digestion, to their several wants and habits, so that we may trace in them analogies to the carnivorous insectivorous, herbivorous, and rodent forms of the other *Mammalia.*

The first species belonging to this abnormal or aberrant group brought under the notice of zoologists were those of America, and they received from Scaliger the appropriate name of *Animalia crumenata*, or Purse-bearing Animals; for the leading peculiarity in these Marsupials is, so to speak, the premature birth of their young, which are born in a state of development not much beyond that of the fœtus in the other groups at a very early stage of pregnancy, and attach themselves by the mouth to the teats, which are situated in the marsupium, or pouch, of the mother; and in this nidus, or, as it may be termed, second uterus, the almost embryotic young one is nourished till the little knobs that marked the place of the extremities shoot out into limbs, and till the whole framework of the animal is completed, and it is able to go alone. Long after this period it flies to the pouch upon the approach of danger, or enters it when fatigued, and may often be seen peeping out to ascertain whether it is safe to venture abroad again.

Linnæus, who appears only to have known the American species, or Opossums, arranges them under the generic appellation of *Didelphis*, in his order *Feræ*, placing them between the Bears, Badgers, Racoons, &c., and the Moles (*Talpa*).

Cuvier, who had the advantage of knowing the great quantity of species and variety of forms discovered in Australia, arranged the copious materials which that extraordinary country afforded in addition to the few American forms, as the fourth order of his Mammifères, dividing the now numerous group into several subdivisions, and placing the order between his Carnassiers and his *Rodentia.*

Illiger makes the *Marsupialia* the sixth family of his second order, *Pollicata;* and his third order, *Salientia*, consists of the Kangaroos and Potoroos.

M. De Blainville divides the Mammifères into two sub-classes; the first being the Monadelphes and the second the Didelphes, which last consists of the *Marsupialia* and Monotremes, properly so called; we say properly so called, because, strictly speaking, every Marsupial female is a Monotreme.

Dr. J. E. Gray collects all the forms under the family *Didelphidæ.* [MAMMALOGY.]

Storr congregates all *Mammalia* with opposeable thumbs into one great group, which he divides into three sections: the first consisting of the genus *Homo*; the second of the genera *Simia*, *Prosimia*, *Procebus*, *Tarsius*, *Lemur*; and the third of the genera *Didelphis* and *Phalanger*.

Mr. Ogilby separates his Cheiropeds (Mammals with opposeable thumbs) into the three groups, *Bimana*, *Quadrumana*, and *Pedimana*, which last are characterised as having opposeable thumbs on the hind hands only. The *Pedimana* consist of the families *Simiadæ* (with anthropoid teeth) and the *Didelphidæ* (with abnormal teeth). These last consist of the genera *Phascolarctos*, *Phalangista*, *Petaurus*, *Didelphys*, *Cheironectes*, *Dasyurus*, and *Phascogale*. ('Nat. Hist. of Monkeys, Opossums, and Lemurs,' Menageries.)

Before we proceed to notice the classification proposed by Professor Owen, it will be better to give an outline of the organisation of these animals.

The *Marsupiata* differ considerably from each other in the osseous part of their structure, as might be expected in a group whose food and habits vary so much. Our limits do not permit of a detailed inquiry into these differences; but the examples given in the skeletons, skulls, and teeth represented in this article will convey a general notion of the formation of the bony parts, and the modifications to which they are subject. There is however one peculiarity common to all, which is even found in the true Monotremes, and presents a marked discrepancy from the osseous systems of the other *Mammalia*—we allude to the Marsupial bones. These are attached to the pubis, and imbedded in the muscles of the abdomen, where they afford support to the marsupium, or pouch, in the females. They exist also in the males, to whom their presence seems to be necessary for the purposes of reproduction. These bones and their situation are shown in the skeletons of the Kangaroo and Opossum. (Owen, 'On the Osteology of the *Marsupialia*.' 'Zool. Proc.,' Oct., 1838.)

The organs of digestion, as might be expected, vary greatly. The teeth are appropriated to the food or prey to be taken, whether it be flesh, insects, fruits, herbs, or roots; and in conformity with the same law, we have a simple or a complex stomach, and a corresponding structure in the viscera; the flesh-eating tribes being entirely without a cæcum, and the others possessing that appendage in a greater or less degree according to circumstances.

But it is in the organs of generation and mode of reproduction that the great and striking difference exists between the Marsupials and all other known Mammals.

Professor Owen, in his paper 'On the Generation of the Marsupial Animals, with a Description of the Impregnated Uterus of the Kangaroo' ('Phil. Trans.,' 1834), observes that in all the genera of this group the uterus is double, and the introductory passage is separated either wholly or for a considerable extent into two lateral canals. Both the digestive and generative tubes terminate within a common cloacal outlet, and the term *Monotremata* therefore, he remarks, though confined to the Edentate *Marsupiata*, is so far applicable to the whole of this aberrant division. As the females approach the Oviparous *Vertebrata* in their separate genital tubes, so also the males resemble them in the peculiar structure and connections of the reproductive organs. "Both sexes," says Professor Owen, "in the Marsupial genera manifest also their affinity to the oviparous classes in possessing two superior venæ cavæ, and in the want of the inferior mesenteric artery; and the marsupial bones, so common in the skeletons of reptiles, are limited in the mammiferous class to this division, in which alone, from the peculiarly brief period of uterine gestation, and the consequent non-enlargement of the abdomen, their presence might be expected. But these bones serve important purposes in relation to the generative economy of the *Marsupiata*. In the female they assist in producing a compression of the mammary gland necessary for the alimentation of a peculiarly feeble offspring, and they defend the abdominal viscera from the pressure of the young as these increase in size during their mammary or marsupial existence, and still more when they return to the pouch for temporary shelter." In the males, with the exception of the edentate genera, the marsupial bones, from their relation to the cremaster muscles, which wind round them like pulleys, assist in the acts of compression and retraction. The minute size of the young of the American Opossum when found in the marsupium, their pendulous attachment to the nipples, and perhaps the mode in which the latter are developed, gave rise among the earlier observers to a supposition that they were originally formed from those parts; and the gemmiparous theory, which has subsequently been often revived, appears to have been prevalent at the time when Tyson first devoted his attention to the subject.

Professor Owen, after concluding, from data stated in his paper, that it may be inferred that the ovum in the Kangaroo quits the ovisac in a condition corresponding to that in the ordinary *Mammalia*, and increases in a similar manner as it descends in the uterus, goes on to describe in minute and most interesting detail the fœtus and membranes of a Kangaroo (*Macropus major*) at apparently the middle period of gestation, which in that animal continues for thirty-eight days. The membranes consisted of an amnios, a very large vitelline sac, rendered highly vascular by ramifications of omphalo-mesenteric vessels, and a thin unvascular chorion. There was no placenta, nor any adhesion between the exterior membrane of the fœtus and the internal surface of the mother by the opposition and interlacement of villi, or vessels, as in those *Mammalia*, in which the placenta is replaced by a uniform villous and vascular chorion; the condition of the fœtus was such as occurs in the viper and other ovoviviparous reptiles, except that there was no trace of the existence of an allantois in that stage of the fœtal development. The dissection of very young mammary fœtuses of the Kangaroo, *Phalangista*, and *Petaurus*, exhibited the remains of a urachus and umbilical vessels, whence Professor Owen concluded that at a more advanced stage of the fœtus an allantois was developed. Professor Owen remarked that as the growth of the fœtus advanced, the circulating fluids became necessarily more charged with decomposed particles of the organised substance; and that although the extended surface of minutely subdivided blood-vessels afforded by the vitelline sac might serve both for respiration and nutrition at the earliest stages, yet that at a late period, and as the embryo acquired additional bulk and strength and parts, an accessory apparatus for that end appeared to be necessary. In all the *Reptilia*, he observed, in which the respiratory function of the fœtus is not performed by the extension of vascular filaments from the sides of the neck, an allantois or cæcal process, organised by umbilical or hypogastric vessels, is produced from the terminal portion of the intestinal tube. In the placental *Mammalia*, where the vitelline sac and vitellus are relatively smaller, the allantois makes its appearance much earlier, but is developed in different proportions in the different orders. It is subservient in all the placental *Mammalia* to the important function of the transference of the hypogastric or umbilical arteries to the exterior enveloping membrane or chorion; and in these *Mammalia*, Professor Owen further remarked, the umbilical vessels co-extended with the allantoic cæcum seek a more intimate contact with the vascular surface of the womb, and proceed to organise the chorion shooting out into villi, either extended over the whole surface, as in the mare, or disposed in circumscribed tufts, as in the ruminants, or limited to one place and forming a single placenta, as in the human subject, and in all unguiculate mammals.

As connected with this subject Professor Owen subsequently exhibited a preparation ('Magazine of Natural History,' vol. i. N. S.) to the Zoological Society of London, and took occasion to observe that in the bird and reptile the umbilical vessels are limited to the allantois, and do not extend beyond that membrane to the chorion; the allantois therefore plays a primary part in the respiration of the fœtus. In the placental *Mammalia*, on the other hand, its office as a temporary respiratory organ is secondary, but it is essential as a means of transference of the umbilical vessels to the chorion; it has therefore a pre-existence to the placenta, and without it the placenta could not be formed; for if it be considered that the embryo is formed within the bag of the chorion, and is originally free from any connection with that membrane, there must of necessity be some support for the umbilical vessels during their passage to the chorion; but no other is known except the allantois, or urinary bladder, and urachus, as its remains are termed. The existence of a placenta, in Professor Owen's mind, therefore infers the pre-existence of an allantois, but the reverse of the proposition does not therefore hold good. In birds and scaled reptiles the allantois itself performs the functions of the placenta or vascular chorion; and the question to be resolved relatively to the Kangaroo and other Marsupials was whether, the allantois being developed, it would serve as a medium for the organisation of the chorion, or remain, as in the Oviparous *Vertebrata*, an independent vascular bag or cæcum. The examination of the preparation alluded to, a uterine fœtus of a Kangaroo placed at Professor Owen's disposal by Dr. Sweatman, contributed to the solution of that question. This fœtus was further advanced than that described by Professor Owen in 'Phil. Trans.' The digits of the hinder extremities were, in this, completely formed. The umbilical chord extended nearly three lines from the abdominal surface of the fœtus; the amnios was reflected from this point to form the usual immediately investing tunic of the fœtus; and beyond the point of reflection, the chord divided into a very large superior vascular sac, organised by the omphalo-mesenteric vessels, corresponding in all respects with the vitelline sac described and figured in Professor Owen's paper in 'Phil. Trans.': but below the neck of this sac there extended a second pyriform sac, about one-sixth the size of the vitelline sac, having numerous ramifications of the umbilical vessels, and constituting a true allantois. This sac was suspended freely from the end of the umbilical chord; it had no connection at any part of its circumference with the chorion, and was equally free from attachment to the parieties of the uterus, in which the fœtus was developed.

The period of gestation (thirty-nine days) was determined in 1833, in the vivarium of the Zoological Society of London, by Professor Owen, whose account of this obscure and interesting portion of the natural history of the animal we here give from his paper in the 'Phil. Trans.':—

"In order to inure the female to the examinations of the pouch when they should become indispensable, they were commenced six days after the copulation, which took place on the 27th of August, and were repeated every morning and evening until the 5th of October, when, at 7 A.M., the fœtus was discovered in the pouch attached to the left superior nipple. On the preceding day at the same hour a great quantity of the moist brown secretion peculiar to the pouch was noticed, indicating a commencing determination of blood to that part, and at different periods during the day the female was observed to put her head into the pouch and lick off the secretion. When she was again examined, at six o'clock in the evening, a slight increase of the secretion was the only perceptible change in the state of the pouch, but there was no appearance in the nipples indicative of the event so soon about to take place. The nipple in use by the young one of the previous year was the right superior or anterior one; it was nearly two inches in length, and one-third of an inch in diameter, while the other three were about half an inch in length, and about a line in diameter. I took notes of the appearance of the marsupium on the 6th, the 10th, 15th, 21st, 30th, and 38th days of uterine gestation; no material alteration was however observable till after the death of the young Kangaroo of the previous year, which took place on the twenty-fifth day, when the brown secretion first began to appear, and the nipple that had been in use to diminish. As parturition took place in the night, the mode of transmission to the pouch was not observed. No blood or albuminous discharge could be detected on the litter, nor any trace of it on the fur between the vagina and orifice of the pouch; but these might have been removed by the mother. The appearances presented by the little one thus detected within twelve hours after being deposited in the pouch were as follows:—It resembled an earth-worm in the colour and semitransparency of its integument, adhered firmly to the point of the nipple, breathed strongly but slowly, and moved its fore legs when disturbed. Its body was bent upon the abdomen, its short tail tucked in between the hind legs, which were one-third shorter than the fore legs, but with the three divisions of the toes now distinct. The whole length from the nose to the end of the tail, when stretched out, did not exceed one inch and two lines. On the 9th of October I again examined the pouch; the young one was evidently grown and respired vigorously. I determined to detach it from the nipple for the following reasons:—1st, to decide the nature of the connection between the fœtus and the nipple; 2nd, to ascertain, if possible the nature of the mammary secretion at this period; 3rd, to try whether so small a fœtus would manifest the powers of a voluntary agent in regaining the nipple; and lastly, to observe the actions of the mother to effect the same purpose, which one might presume would be instinctively analogous to those by means of which the fœtus was originally applied to the nipple. With respect to the first point, I was aware that the Hunterian dissections, as exhibited in the preparations in the museum of the college, and the observations of Mr. Morgan and Mr. Collie, concurred in disproving the theory of a vascular mode of connection between the mammary fœtus and the nipple; nevertheless as a discharge of blood had been stated by Geoffroy St. Hilaire to accompany marsupial birth, or the spontaneous detachment of the fœtus from the nipple, and even the anastomoses and distribution of the continuous vessels in the neck of the fœtus had been speculated on by him, it became desirable to have ocular demonstration of the facts.

"The fœtus retained a firm hold of the nipple; when it was detached, a minute drop of whitish fluid, a serous milk, appeared on the point of the nipple. About half a line of the extremity of the nipple had entered the mouth, which extremity was of smaller diameter than the rest of the nipple, not being as yet so compressed by the contracted orifice of the mouth as to form a clavate extremity, such as it afterwards presents. The young one moved its extremities vigorously after being detached, but did not make any apparent effort to apply its legs to the integument of the mother, so as to creep along, but seemed, in regard to progressive motion, to be perfectly helpless. It was deposited at the bottom of the pouch, and the mother was liberated and carefully watched for an hour. She immediately showed symptoms of uneasiness, stooping down to lick the orifice of the vagina, and scratching the exterior of the pouch. At length she grasped the sides of the orifice of the pouch with her fore paws, and drawing them apart, as in the act of opening a bag, she thrust her head into the cavity as far as the eyes, and could be seen moving it about in different directions. During this act she rested on the tripod formed by the tarsi and tail. She never meddled with the pouch while in the recumbent posture; but when stimulated by uneasy sensations, she immediately rose and repeated the process of drawing open the bag and inserting her muzzle, sometimes keeping it there for half a minute at a time. I never observed that she put her fore-legs into the pouch; they were invariably employed to widen the orifice. When she withdrew her head, she generally concluded by licking the orifice of the pouch, and swallowing the secretion. After repeating the above act about a dozen times, she lay down, and seemed to be at ease.

"The freedom with which the mother reached with her mouth the orifices both of the genital passage and pouch suggested at once a means adequate to the removal of the young from the one to the other; while at the same time her employment of the fore paws indicated that their assistance in the transmission of the fœtus need not extend beyond the keeping open the entrance of the pouch while the fœtus was being introduced by the mouth, when it is thus probably conducted to, and held over, a nipple, until the mother feels that it has grasped the sensitive extremity of the part from which it is to derive its sustenance. This mode of transmission is consistent with analogy, the mouth being always employed by the ordinary quadrupeds, as dogs, cats, and mice, for the purpose of removing their helpless offspring. It accords also with the phenomena better than those which have been previously proposed; for it is now ascertained, by repeated dissections both of the Kangaroo and Opossum, that there is no internal passage from the uterus to the marsupium: and if the genital outlet can be brought into contact with the orifice of the pouch in the dead Kangaroo by means of great stretching of the relaxed parts, yet such an action has never been witnessed in the living animal;* the tender embryo would be more liable to receive injury from the fore paws; and these, from the absence of a thumb, could not so effectually insure its passage as the lips, which can be opposed to each other. Lastly, the young one did not by any of its actions encourage the idea of its possessing the power of instinctively creeping up to the nipple. When the female had rested quiet for about half an hour we again examined her, and found the young one not at the bottom of the pouch, but within two inches of the nipple; it was breathing strongly, and moving its extremities irregularly as before. I made an attempt to replace it on the nipple, but without success, and the mother was then released. On an examination two days afterwards the marsupium was found empty. Every portion of the litter was carefully searched, in the hopes of finding the fœtus, but without success. The mother therefore, owing to the disturbance of the young one, had probably destroyed it. This was a result I had not expected, for the head keeper at the Zoological Farm had twice taken a mammary fœtus from the nipple and pouch of the mother, soon after it had been deposited there, and when it did not exceed an inch in length, and it had each time again become attached to the nipple. I afterwards saw this fœtus attached to the nipple; and it continued to grow, without having sustained any apparent injury from the separation, until the death of the mother, when it was nearly ready to leave the pouch. A similar result occurred to Mr. Collie."

Outline of the Kangaroo about twelve hours after uterine birth, showing its natural size and external development at this period. The elongation of the jaws has reduced the mouth to a simple round anterior orifice, which subsequently becomes even more contracted before the lateral fissures begin to extend backwards. The eye is concealed by the completely formed eyelids. Three divisions are now seen at the posterior extremity. A longitudinal line indicates the separation of the umbilical pedicle. *a*, the upper nipple of the left side, to which the above fœtus was attached; *b*, the lower nipple of the same side.

The young one observed by Mr. Collie ('Zoological Journal,' vol. v.) was of nearly the size of the last and half the middle joint of one's little finger; and the flesh-coloured integuments were so transparent as to permit the higher coloured vessels and viscera to be seen through them. The extremities seemed completely formed, and its muscular power was testified by its efforts in sucking, during which it put every part of its body in motion. "According to the testimony of the person," continues Mr. Collie, "who preserved the mother with this little one for me, the latter by no means passes the whole of its time with the lacteal papilla in its mouth, but has been remarked, more than once, without having hold of it. It has even been wholly removed from the sac to the person's hand, and has always attached itself anew to the teat. Yesterday, on again looking at it, I gently pressed with the tip of my finger the head of the little one away from the teat of which it had hold, and continued pressing a little more strongly for the space of a minute altogether, when the teat, that had been stretched to more than an inch, came out of the young one's mouth, and showed a small circular enlargement at its tip, well adapting it for being retained by the mouth of the sucker. The opening of the mouth seemed closed in on both sides, and only sufficiently open in front to admit the slender papilla. After this I placed the extremity of the teat close to the mouth of the young, and held it there for a short time without perceiving any decided effort to get hold of it anew; when I allowed the sac to close, and put the mother into her place of security. An hour afterwards the young one was observed still unattached, but in about two hours it had hold of the teat and was actively employed in sucking."

Professor Owen then refers to a similar experiment tried with a mammary fœtus about the size of a Norway rat by Mr. Morgan. This fœtus, after two hours' separation from the nipple, regained its

* Professor Owen observes that this argument is not applicable to those *Marsupiata* which, like *Perameles* and the smaller South American Opossums, have the duplicatures of integument forming the pouch extended close to the cloaca.

hold, and sustained no injury from the interruption of the supply of nourishment. Professor Owen concludes therefore that the evidence adduced establishes the fact that the mammary fœtus at a very early period is at least capable of sustaining a separation from the nipple; and although it may not at this stage of growth possess the power of regaining its hold by its own unaided efforts, it is far from being the inert and formless embryo that it has been described to be, resembling on the contrary, in its vital powers, the new-born young of the smaller *Mammalia* rather than the uterine fœtus of a larger species at a period of development when such a fœtus corresponds in size to a new-born Kangaroo; and although the latter possesses greater powers of action than the same sized embryo of a sheep, and approximates more nearly in this respect to the new-born young of the rat, yet, Professor Owen observes, it is evidently inferior to the latter. For, though enabled by the muscular power of its lips to grasp and adhere firmly to the nipple, its own unaided efforts seem incapable of drawing sustenance therefrom. The peculiar adaptation of a muscle, analogous to the cremaster, to the mammary gland, for the purpose of injecting the milk from the nipple into the mouth of the adherent fœtus, has been demonstrated by Professor Geoffroy and Mr. Morgan; and Professor Owen remarks that it can scarcely be supposed that the fœtal efforts of suction should always be coincident with the maternal act of injection. If at any time this should not be the case, the consequences might be fatal from the forcible injection of milk into the larynx. To guard against this there is a special contrivance, first described by M. Geoffroy, the necessity for which appears to have been foreseen by Mr. John Hunter in his dissection of two small mammary fœtuses of the Kangaroo for the especial purpose of showing the relation of the larynx to the posterior nares (Nos. 3731, 3734, 3735, Mus. Coll. Reg. Chir., Physiological Series), in which, as Professor Owen states, there are evidences that Hunter had anticipated most of the anatomical discoveries which have subsequently been made upon the embryo of the Kangaroo. The epiglottis and arytenoid cartilages are elongated and approximated, and the rima glottidis is thus situated at the apex of a cone-shaped larynx, which projects, as in the *Cetacea*, into the posterior nares, where it is closely embraced by the muscles of the soft palate. The air-passage is thus completely separated from the fauces, and the injected milk passes in a divided stream on either side the larynx to the œsophagus.

1, the head of a mammary fœtus of a Kangaroo, about eight weeks old, dissected to show the relation of the larynx to the tongue and posterior nares. *a*, the epiglottis, drawn down out of the aperture in the soft palate; *b*, the cavity in the tongue for the reception of the nipple.

2, the elongated nipple, withdrawn from the mouth; the dotted line shows the extent to which it is grasped: it never extends into the œsophagus or stomach, as has been conjectured. Owen.

"Thus aided and protected by modifications of structure," continues Professor Owen, "both in the system of the mother and in its own, designed with especial reference to each other's peculiar condition, and affording therefore the most irrefragable evidence of creative foresight, the feeble offspring continues to increase from sustenance exclusively derived from the mother for a period of about eight months. The young kangaroo may then be seen frequently to protrude its head from the mouth of the pouch, and to crop the grass at the same time that the mother is browsing. Having thus acquired additional strength, it quits the pouch, and hops at first with a feeble and vacillating gait, but continues to return to the pouch for occasional shelter and supplies of food till it has attained the weight of 10 lbs. After this it will occasionally insert its head for the purpose of sucking, notwithstanding another fœtus may have been deposited in the pouch, for the latter, as we have seen, attaches itself to a different nipple from the one which had been previously in use."

For the observations made by Professor Owen on the structure of the female generative organs in the other Marsupials, as compared with those of Oviparous, Ovoviviparous, and Viviparous Animals, we must refer to his paper above quoted, our space not permitting us to do more than call the reader's attention to the fact that his inductions rest principally on the examination of those organs in *Didelphys dorsigera*, *Petaurus pygmæus*, *Petaurus Taguanoides*, *Dasypus viverrinus*, *Didelphys Virginiana*, *Hypsiprymnus Whitei*, and *Macropus major*. His remarks on the inferiority of the cerebral development of the Marsupials will be read with great interest as bearing on the structure and analogies of those organs, and other points of resemblance to the lower vertebrate classes, especially to the reptiles. "Those marsupial quadrupeds which I have had an opportunity of observing alive in the Zoological Gardens," says the Professor ("and there are at present (1834) species of *Dasyurus*, *Didelphys*, *Phalangista*, *Petaurus*, *Hypsiprymnus*, *Macropus*, and *Phascalomys*), are all characterised by a low degree of intelligence; nor can I learn that they ever manifest any sign of recognition of their keepers or feeders. Another character, no less uniformly belonging to them, is the want of a power of uttering vocalised sounds. When irritated they emit a wheezing or snarling guttural sound; that of the *Dasyurus ursinus* is the clearest, and is the nearest approach to a growl. Mr. Harris however states that in addition to this noise, the Ursine Opossum utters a kind of hollow barking. The *Thylacinus cynocephalus*, or large Dog-Faced Opossum, he observes, utters 'a short guttural cry, and appears exceedingly inactive and stupid, having, like the owl, an almost constant motion with the nictitating membrane of the eye.' The Wombat, when irritated, emits a loud hiss, which forcibly reminds one of that of the serpent. The noise emitted by the Kangaroo under similar circumstances is equally remote from a vocalised sound; the necessary apparatus for producing which, Cuvier long ago observed to be wanting in the larynx of this animal. It is interesting to find these analogies to the *Reptilia*, and more might be pointed out if it were not a comparison which merits a separate consideration." The reader who would pursue his inquiries as to the generative system of the *Marsupialia* may also consult the previous writings of Daubenton, Rengger, and Leuckart. The museum of the Royal College of Surgeons will afford ample materials for following out the organisation of this extraordinary group in the skeletons and preparations preserved in the Physiological Series of that noble institution. The following is the arrangement, based on the organisation of the animals, proposed by Professor Owen in a paper read to the Zoological Society of London on the 8th and 22nd of January, 1839:—

CLASSIFICATION OF THE MARSUPIATA.

Tribes.	Families.	Genera.	Sub-genera.
Sarcophaga. Three kinds of teeth; canines long in both jaws; a simple stomach; no intestinum cæcum	*Dasyuridæ*	*Thylacinus.* *Dasyurus.* *Phascogale.*	
. . . .	Extinct transitional forms	*Phascalotherium* *Thylacotherium* } fossil.	
Entomophaga. Three kinds of teeth in both jaws; a simple stomach; a moderately long intestinum cæcum	*Ambulatoria*	*Myrmecobius.*	
	Saltatoria	*Chœropus.* *Perameles.*	
	Scansoria	*Didelphys*	*Cheironectes.*
Carpophaga. Anterior incisors large and long in both jaws; canines inconstant; a simple stomach; a very long intestinum cæcum	*Phalangistidæ*	*Phalangista*	*Cuscus.* *Pseudocheirus.* *Tapoa* (Gray).
		Petaurus	*Ascobates.*
	Phascolarctidæ	*Phascolarctos.*	
Poephaga. Anterior incisors large and long in both jaws; canines present in the upper jaw only, or wanting; a complex stomach; a long intestinum cæcum	*Macropodidæ*	*Hypsiprymnus.*	
		Macropus	*Halmaturus.* *Macropus.*
*Rhizophaga.** Two scalpriform incisors in both jaws; no canines; stomach with a special gland; cæcum short, wide, with a vermiform appendage	*Phascolomyidæ*	*Phascolomys* *Diprotodon* (fossil).	

* The terms given to the tribes or primary groups of *Marsupiata* in the classification are not to be understood as strictly indicating the food of the species severally included therein, but only their general tendency to select for their support the substances implied by those designations.

We now proceed to give a succinct illustration of the genera and some of the sub-genera above mentioned.

Thylacinus (Temminck).—Dental Formula :—

$$\text{Incisors, } \frac{8}{6}\text{; Canines, } \frac{1-1}{1-1}\text{; Molars, } \frac{7-7}{7-7}=46.$$

The incisors are ranged in a semicircle, equal, and separated in the middle in each jaw by a vacant space; the external incisor on each side is the stoutest; the canines are of considerable size, curved and pointed like those of the cats and dogs; the last molars are armed with three obtuse tubercles, resembling those of the two groups of *Carnivora* last mentioned; toes five on each fore foot, and four on each hind foot.

T. cynocephalus (*Dasyurus cynocephalus* of Geoffroy, *T. Harrisii* of Temminck), the Tasmanian Wolf, Zebra Opossum, and Zebra Wolf. Size of a young wolf; the short smooth hair of a dusky yellowish-brown above, barred or zebraed on the lower part of the back and rump with about 16 jet-black transverse stripes, broadest on the back, and gradually tapering downwards, two of which extend a considerable way down the thighs; the ground-colour on the back inclines to blackish-gray; tail much compressed and tapering to a point.

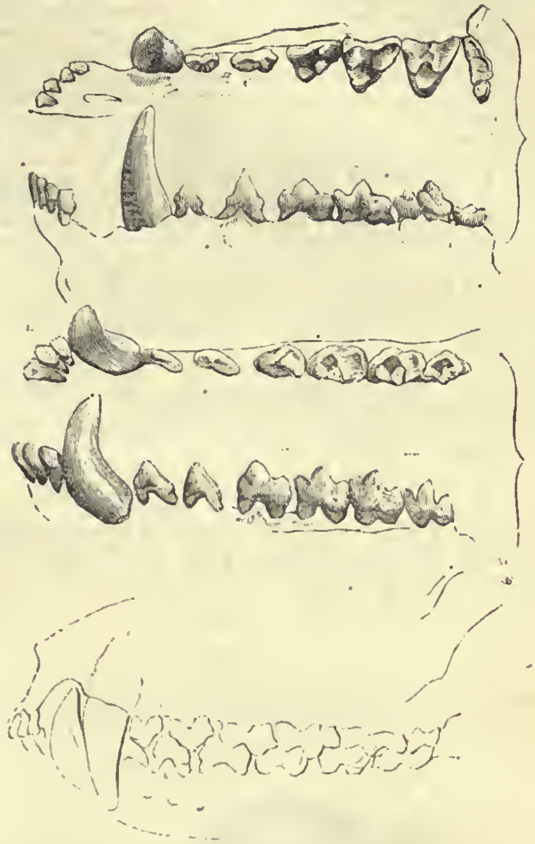
Tasmanian Wolf (*Thylacinus cynocephalus*).

Mr. Harris ('Linn. Trans.') states that this species, the largest of the Australian *Carnivora*, inhabits caverns and rocks in the deep and almost impenetrable glens in the neighbourhood of the highest mountainous parts of Van Diemen's Land, where it probably preys upon the brush (bush ?) Kangaroo and various small animals that abound in those places. The individual from which the description and drawing were taken was caught in a trap baited with kangaroo-flesh. It remained alive but a few hours, and during that period uttered the cry and presented the appearances quoted by Professor Owen. In its stomach were found the partly-digested remains of a Porcupine Ant-Eater (*Echidna aculeata*). Two of these animals are now alive in the Gardens of the Zoological Society, Regent's Park. The following account of this animal is given in the guide-book to the gardens :—

"The *Thylacinus*, or Tasmanian Wolf, is a carnivorous marsupial, which, in that great group of animals almost peculiar to Australia, has the same functions and relations as have the lion and the tiger among the larger quadrupeds of Africa and Asia. It is probable that these beasts formerly preyed for the most part on phalangers and kangaroos; for it appears, from the observations of Mr. Gunn, that they obstinately refuse the flesh of the wombat, although it is one of the commonest quadrupeds in the districts which they inhabit. But since the introduction of sheep, their favourite prey is mutton, and their ravages have been so extensive as to oblige the shepherds to destroy them by every possible means. They are rarely caught alive, or, if so caught, are killed whilst in the snares, so that it has only been with the greatest difficulty and by offering large rewards that Mr. Gunn and Dr. Grant have been able to secure the present interesting specimens for the society. They are animals of extreme activity, and capable of bounding upwards nearly to the height of the den in which they are exhibited. No other species of *Thylacinus* is now known to exist, and this is entirely confined to the island of Van Diemen's Land. In the fossil Fauna of the continent of Australia, Professor Owen has however discovered indication of a species very closely allied to it, among the remains collected by Sir Thomas Mitchell in the caverns of Wellington Valley, New South Wales."

Dasyurus (Geoffroy).—Head conical, very much pointed; gape very wide; ears moderate; toes five on the fore feet; on the hind feet the great toe is reduced to a tubercle or is entirely absent.

Dental Formula :—Incisors, $\frac{8}{6}$; Canines, $\frac{1-1}{1-1}$; Molars, $\frac{6-6}{6-6}=42$.



Teeth of Dasyurus (*Dasyurus macrurus*).

D. ursinus (*Didelphys ursina* of Harris). Head, body, legs, and upper part of the tail covered with long coarse black hair, irregularly marked with one or two blotches of white; in some specimens on the shoulders, in others on the throat or rump; tail slightly prehensile, its under part bare. (Harris.)

Ursine Opossum (*Dasyurus ursinus*). Harris.

This species, which is very voracious, and burrows in the ground in Van Diemen's Land, is of the size of a badger. "These animals," says Mr. Harris, "were very common on our first settling at Hobart Town, and were particularly destructive to poultry, &c. They however furnish the convicts with a fresh meal, and the taste was said to be not unlike veal. As the settlement increased, and the ground became cleared, they were driven from their haunts near the town to the deeper recesses of forests yet unexplored. They are however easily procured by setting a trap in the most unfrequented parts of the woods, baited with raw flesh, all kinds of which they eat indiscriminately and voraciously; they also, it is probable, prey on dead fish, blubber, &c., as their tracks are frequently found on the sands of the sea-shore. In a state of confinement they appear to be untameably savage; biting severely, and uttering at the same time a low yelling growl. A male and female, which I kept for a couple of months chained together in an empty cask, were continually fighting; their quarrels began as soon as it was dark (as they slept all day), and continued throughout the night almost without intermission, accompanied with a kind of hollow barking, not unlike a dog, and sometimes a sudden kind of snorting, as if the breath was retained a considerable time, and then suddenly expelled. The female generally conquered. They frequently sat on their hind parts, and used their fore paws to convey food to their mouths. The muscles of their jaws were very strong, as they cracked the largest bones with ease asunder; and many of their actions, as well as their gait, strikingly resembled those of the bear. Its vulgar name is the Native Devil."

A specimen in the Gardens of the Zoological Society was a snarling surly animal.

Professor Owen's account of the dissection of a *Dasyurus macrurus*, or Long-Tailed Dasyurus (Spotted Martin of Phillips's 'Voyage'), will be found in the 'Zoological Proceedings' for 1835.

Phascogale (Temminck).—Differing from *Dasyurus*, especially in its Dental Formula:—

$$\text{Incisors, } \frac{8}{6};\ \text{Canines, } \frac{1-1}{1-1};\ \text{Molars, } \frac{7-7}{7-7} = 46.$$

P. penicillata (*Didelphis penicillatus* of Shaw, *Dasyurus penicillatus* of Geoffroy). Size rather larger than that of the Brown Rat (*Mus decumanus*); tail very bushy; fur uniform, ash-colour, whitish beneath, short, woolly, and very thick.

This Phascogale lives on trees in Australia.

Phascogale (*Phascogale penicillata*).

Myrmecobius (Waterhouse).—Fore feet with five toes; hind feet with four toes, all free; head elongated, snout produced; ears moderate, narrower, and subacute at the apex; body slender; tail moderate. Dental Formula:—

$$\text{Incisors, } \frac{8}{6};\ \text{Canines, } \frac{1-1}{1-1};\ \text{Pseudo-Molars, } \frac{3-3}{3-3};\ \text{Molars, } \frac{5-5}{6-6} = 52.$$

Skull and lower jaw of *Myrmecobius*.

M. fasciatus. Fore part of the body reddish, gradually blended into the black, which is the prevailing colour of the posterior half, and which is adorned with nine white bands. Fur of two kinds: under hair scanty and whitish-gray; upper hair rather coarse, short, and adpressed on the anterior parts; long on the posterior and under parts; hairs on the anterior part of the back generally black at the base and fulvous at the apex; those on the head very short, brownish above, being composed of a mixture of black, fulvous, and a few white hairs; a few black hairs spring from the sides of the muzzle and under each eye; hair of the tail long and rather bushy; most of the hairs on the under part fulvous at the base and white at the tip; those on the under side of the tail generally black at the base and white at the apex. Length from nose to root of tail 10 inches; length of tail to the end of the hair 7 inches.

Myrmecobius fasciatus. Waterhouse.

Mr. Waterhouse, in his paper in the 'Transactions of the Zoological Society,' descriptive of this animal, gives the following account of the two specimens on which his description is founded. The first was procured by Lieutenant Dale, of Liverpool, whilst on an exploring party in the interior of the country at the Swan River Settlement, and was discovered about 90 miles to the south-east of the mouth of that river. Two of these animals, according to Lieutenant Dale, were seen within a few miles of each other; they were first observed on the ground, and on being pursued both directed their flight to some hollow trees which were near. The party succeeded in capturing one of them; the other was unfortunately burnt to death in their endeavour to dislodge it by fumigating the hollow tree in which it had taken refuge. The country in which they were found abounded in decayed trees and ant-hills. Mr. Waterhouse was informed that the second individual was found in Van Diemen's Land (but he suspects some mistake here), and that others similar to it had been seen in the act of burrowing or digging at the roots of trees in search after insects. Their favourite haunts are stated to be in those situations in which the Port Jackson willow abounds.

Mr. Waterhouse observes, that although in the structure of the skull *M. fasciatus* evinces an affinity to Phascogale, it differs from that genus in the want of a thumb to the hind feet, and in the strength and larger size of the claws of the fore feet, which are shaped somewhat like those in the genus *Herpestes*, and are evidently suited to burrowing. The fore legs are also stouter in proportion, and the feet are stronger. In their narrow and pointed shape, the ears, he remarks, resemble those of *Perameles nasutus*, and differ from those of Phascogale; they also differ in being tolerably well clothed with hairs. Mr. Waterhouse imagines that in the present animal he can perceive a slight approach to the Edentate *Marsupialia*, or *Monotremes*, and he thinks that analogically it may be compared to the genus *Tupaia* among the true *Insectivora*, bearing a somewhat similar connection with *Echidna* and *Ornithorhynchus* to that which exists between the last-mentioned genus and the genera *Erinaceus* and *Mygale*. In conclusion, he adds that it must be allowed that there is a greater dissimilarity in structure between the last-mentioned genus and the genera *Myrmecobius* and *Monotremes* than between *Tupaia* and *Mygale*; we are however prepared for this, by the comparatively sudden transitions from one form to another which we find in the *Marsupialia*, which group, it must be borne in mind, stands low in the grade of organisation among the *Mammalia*. ('Zoological Transactions,' vol. ii.)

Chœropus (Ogilby).—On March 13th, 1838, Mr. Ogilby exhibited to a meeting of the Zoological Society of London a drawing made by Sir Thomas Mitchell of a Marsupial animal found by that officer on the banks of the river Murray, during his journey in the interior of New South Wales. Mr. Ogilby stated his original belief that the animal in question belonged to the genus *Perameles*, under which impression he had proposed to name it *P. ecaudatus*, from its entire want of tail, a character found in no other species of the same group; but a drawing of the fore foot, afterwards found by Sir Thomas Mitchell, and likewise exhibited to the Society on the present occasion, had considerably shaken this first opinion, and induced Mr. Ogilby to suspect that the animal may eventually form the type of a new genus. According to Sir Thomas Mitchell's drawing, and the notes which he took at the time of examining the specimen, it would appear that there were only two toes on the fore feet, which were described as having been so perfectly similar to those of a pig as to have procured for the animal the name of the Pig-Footed Bandicoot among the persons of the expedition.

The drawing of the foot in fact very closely resembles that of the genus *Sus* in form and characters; two toes only are represented short and of equal length; but there is a swelling at the base of the first phalanges, which renders it probable that there may be two smaller ones behind. The *Perameles*, on the contrary, have three middle toes on the fore feet, all of equal length, and armed with very long powerful claws, besides a small rudimentary toe very distinctly marked on each side. The form and character of the hind feet were perfectly similar to those of the *Perameles*, as were also the teeth, as far as could be judged from the drawing, except that the canines did not appear to surpass the anterior molars in point of size. The ears were long, elliptical, and nearly naked; the head broad between the ears, and very much attenuated towards the muzzle; the body about the size of a small rabbit, and the fur very much of the same quality and colour as in that animal. Mr. Ogilby, after expressing his confidence in the fidelity of Sir Thomas Mitchell's drawings, and the care with which that gentleman assured him he had made the observation in question, expressed his belief that this animal would be found to constitute a new genus of Marsupials, and proposed for it the provisional name of *Chœropus*, in allusion to the described characters of the fore feet.

The following is the notice of this animal inserted by Sir Thomas Mitchell in his journal, on the occasion of first discovering it:—"June 16, 1836. The most remarkable incident of this day's journey was the discovery of an animal of which I had seen only a head in a fossil state in the limestone caves of Wellington Valley, where, from its very singular form, I supposed it to belong to some extinct species. The chief peculiarity then observed was the broad head and very long slender snout, which resembled the narrow neck of a wide bottle; but in the living animal the absence of a tail was still more remarkable. The feet, and especially the fore legs, were also singularly formed, the latter resembling those of a pig; and the marsupial opening was downwards, and not upwards, as in the Kangaroo and others of that class of animals. This quadruped was discovered by the natives on the ground; but on being chased it took refuge in a hollow tree, from which they took it alive, all of them declaring that they had never before seen an animal of the kind. This was where the party had commenced the journey up the left bank of the Murray, immediately after crossing that river." Such, Mr. Ogilby remarked, was all the information he possessed at present with regard to this singular animal; but Mr. Gould had promised to examine the original specimen on his arrival at Sydney, in the museum of which town it had been deposited; and Mr. Ogilby therefore hoped that, through the kindness of that gentleman, he should shortly have it in his power to communicate a more detailed description of its form and characters to the Society. ('Zool. Proc.,' 1838.)

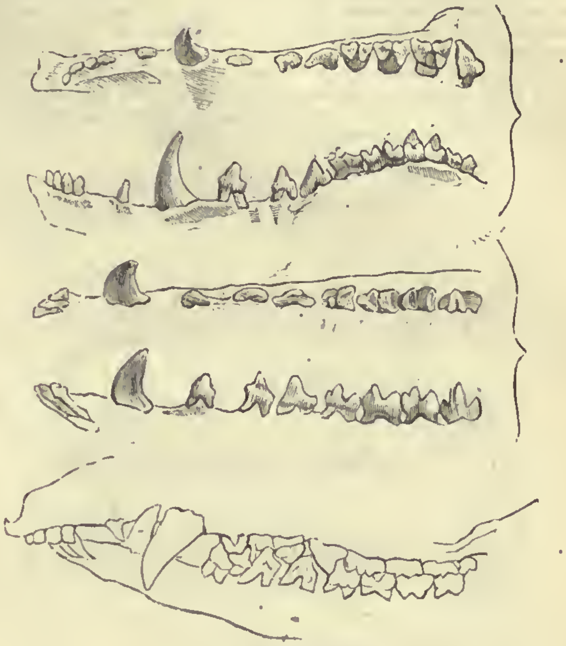
Dental Formula :—Incisors, $\frac{4-4}{3-3}$; Spurious Molars, $\frac{4-4^*}{4-4}$; Molars, $\frac{3-3}{3-3}$, or $\frac{4-4}{4-4}$, perhaps $\frac{5-5}{5-5}$.

Chœropus ecaudatus.

Perameles (Geoffroy).—Head elongated, pointed; ears moderate, hairy; posterior great toes rudimentary, and the two succeeding toes united by the skin up to the nails, great toe and little toe of the fore feet with the form of simple tubercles, so that they wear the appearance of having only three anterior toes.

* The anterior of these might be termed canines.

Dental Formula :—Incisors, $\frac{10}{6}$; Canines, $\frac{1-1}{1-1}$; Molars, $\frac{7-7}{7-7}$ = 48.



Teeth of *Perameles*. F. Cuvier.

P. nasutus. Head very long; muzzle produced; nose prolonged above the jaw; fur gray-brown above and white beneath.

Perameles nasutus.

Dr. J. E. Gray, in characterising a new species of *Perameles* (*P. Gunnii*), very closely agreeing with *P. nasutus*, but peculiar for its very short white tail, and in having several indistinct white bands over the haunches, stated that *P. Gunnii* inhabits Van Diemen's Land, where it frequents gardens, and commits great havoc amongst bulbous roots, which it is said to devour with avidity. ('Zool. Proc.,' 1838.) Specimens of *P. Lagotis*, or Rabbit Perameles, from Swan River, are to be seen in the Gardens of the Zoological Society in the Regent's Park.

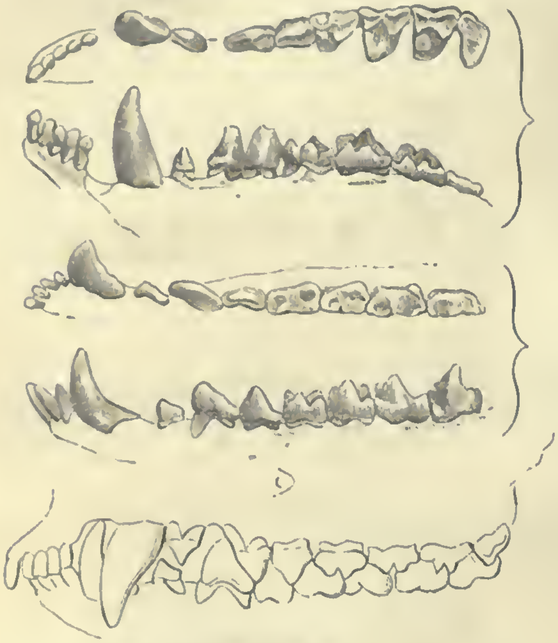
Didelphys (Linnæus).—Head very much pointed, gape wide, tongue rough with horny papillæ; ears large and naked; eyes small; tail long and tapering, flexible, and prehensile, with hair at the base only, the remaining part being covered with scales. Fore feet with five toes, all armed with strong sharp curved claws; thumb of the hind foot opposeable and destitute of nail or claw, the other toes or fingers armed with claws like those of the fore feet. Dental Formula :—

$$\text{Incisors, } \frac{10}{8};\ \text{Canines, } \frac{1-1}{1-1};\ \text{Molars, } \frac{7-7}{7-7} = 50.$$

This genus, in its geographical distribution, is confined to America.

D. Virginiana. Size that of a domestic cat. Colour dull white.

Hair of two kinds; that which is lowest, a long fine woolly down, white at the base, brownish at the tip, through this pass the long hairs of a pure white on the head, neck, and upper parts of the body; the hair is short and close. Round each eye a brownish circle. Ears generally black at the base and yellowish at the tip. Whiskers long, partly white, partly reddish. Extremity of the nose flesh-coloured, with a tinge of yellow. Legs deep chestnut-brown. Tail not so long as the body, covered at the base by long hairs, but only scantily furnished with bristles, which come out from between the whitish scales that protect it for the greater part of its length.



Teeth of *Didelphys Virginiana*. F. Cuvier.

The Virginian Opossum is an arboreal animal, as might be expected from the structure of its posterior feet or hands especially. It appears to be to a certain degree carnivorous, for it preys upon insects and birds, and feeds also on fruits; but there is reason for believing that animal food forms its principal support, for it sometimes invades the farmyards in its neighbourhood. According to Barton, the period of uterine gestation in this species is twenty-six days. It inhabits North America, and was, perhaps is, very abundant in the north of Mexico, and nearly throughout the United States, where it is called the Opossum. In the 'Perfect Description of Virginia' (1649), we find, in the catalogue of animals, "Passonnes: this beast hath a bagge under her belly, into which she takes her young ones, if at any time affrighted, and carries them away." Lawson says:—"The Possum is found nowhere but in America. She is the wonder of all the land animals, being the size of a badger, and near that colour. The female doubtless breeds her young at her teats, for I have seen them stick fast thereto when they have been no bigger than a small rasberry, and seemingly inanimate. She has a paunch, or false belly, wherein she carries her young, after they are from those teats, till they can shift for themselves. Their food is roots, poultry, or wild fruits. They have no hair on their tails, but a sort of a scale, or hard crust, as the beavers have. If a cat has nine lives, this creature surely has nineteen; for if you break every bone in their skin, and mash their skull, leaving them for dead, you may come an hour after, and they will be gone quite away, or perhaps you may meet them creeping away. They are a very stupid creature, utterly neglecting their safety. They are most like rats of anything. I have, for necessity in the wilderness, eaten of them. Their flesh is very white, and well tasted; but their ugly tails put me out of conceit with that fare. They climb trees as the racoons do. Their fur is not esteemed nor used, save that the Indians spin it into girdles and garters." The tail appears to be not alone of use as an organ of prehension to the adult animal; for it is stated that the little ones when advanced in growth leap upon their mother's back if they are frightened, and, twisting their tails round hers, escape with her assistance the threatened danger. In captivity the animal is sullen, snarling, and stupid.

Virginian Opossum (*Didelphys Virginiana*).

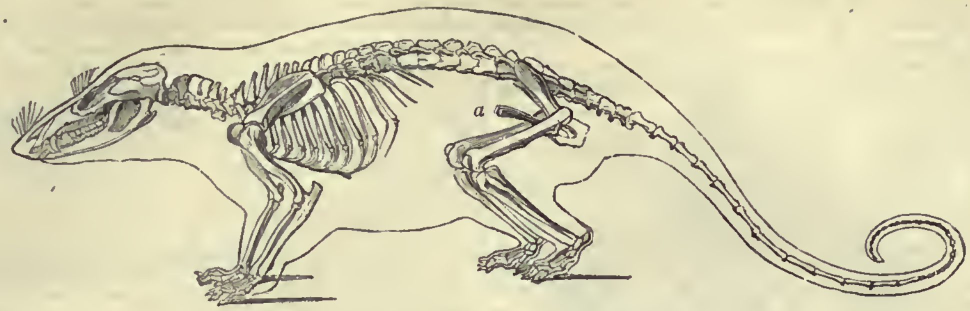
The French name Sarigue for the species of this genus is evidently a form of Carigueya, the Brazilian name for the genus. They are known in Paraguay under the name of Micouré; in the American Islands under that of Manicou; and in Mexico by the appellation of Tlaquatzin.

The species of *Didelphys* are numerous, and we subjoin a table of their distribution from Mr. Waterhouse's 'History of Mammalia:'—

Distribution of the Species of Didelphys.

United States.	California.	Mexico.	Peru.	Guyana.	Brazil.	Paraguay.	Banda Oriental.	Chili.
Virginiana.	*Californica.*		*Azaræ.*		*Azaræ.*	*Azaræ.*	*Azaræ.*	
	brevieeps.	*pruinosa.*		*cancrivora.*	*pœcilotus.*			
		Californica.	*nudicaudata.*	*Quica.*	*albiventris.*			
			Opossum.	*nudicaudata.*	*cancrivora.*			
				Philander.	*Quica.*			
					nudicaudata.			
			Derbiana.		*Opossum.*			
			noctivaga.		*dichura.*			
			Impavida.		*ochropus.*	*lanigera.*		
					cinerea.	*crassicaudata.*	*crassicaudata.*	
		murina.	*murina.*	*murina.*	*macrotarsus.*	*grisea.*		
					microtarsus.			
					domestica.			
				brachyura.	*glirina.*			*elegans.*
					murina.	*pusilla.*		
					pusilla.			
				variegata.	*velutina.*			
					unistriata.			
					tricolor.			
					brachyura.	*brachyura.*	*brachyura.*	
					tristriata.			
					variegata.			

The figure of the skeleton of the Virginian Opossum (*Didelphys Virginiana*) which is given on the next page, exhibits the peculiar formation of the marsupial bones as well as the prehensile tail of this animal.



Skeleton of *Didelphys Virginiana.* *a*, the marsupial bones.

Cheironectes (Illiger).—The complete dental formula of this sub-genus does not appear to be known. The number of incisors is stated at 10 above and 8 below. Head rather pointed; ears naked, rounded; tail scaly, prehensile; an opposeable thumb on the hind feet or hands, and the toes webbed.

C. palmatus (*Cheironectes Yapock* of Desmarest; *Didelphys palmata* of authors). Fur brown above, with three transverse bright-gray bands, interrupted in the middle; white below. Size larger than that of the brown rat. [DIDELPHINA.]

The river Yapock, or Oyapock (the boundary that separates the French settlements from Brazil), in Guyana, is the place where this species has been found. It swims with facility; indeed Buffon describes it under the name of Petite Loutre de la Guyane.

Cheironectes palmatus.

Phalangista (Cuvier).—Head rather short; ears hairy; fur woolly and short; no extensible membrane between the anterior and posterior limbs; tail long, prehensile, sometimes without hair on its extremity.

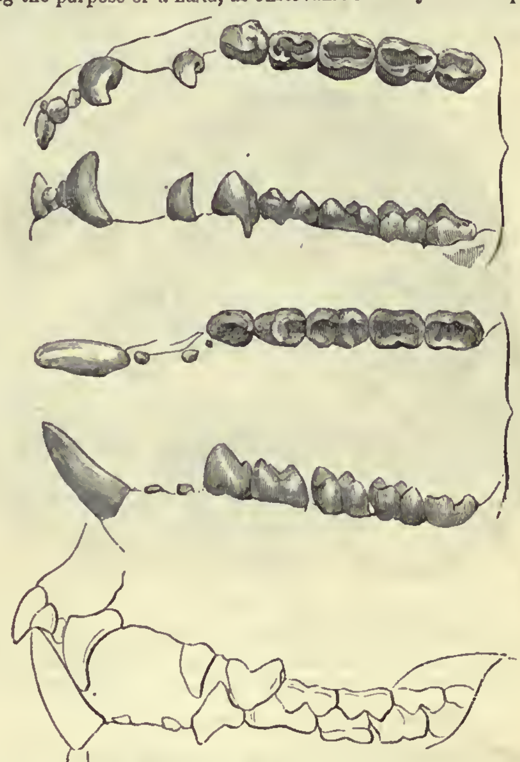
Sub-genus *Phalangista*, properly so called (*Balantia*, Illiger). Tail prehensile, but covered with hair; ears long and erect. Dental Formula:—

$$\text{Incisors, } \frac{6}{2}\text{; Canines, } \frac{2}{0}\text{; Pre-Molars, } \frac{4}{2}\text{; Molars, } \frac{8}{8} = 32.$$

Lesson gives the dentition of *Phalangista* as:—

$$\text{Incisors, } \frac{6}{2}\text{; Canines, } 0\text{; Molars, } \frac{8-8}{7-7} = 38.$$

P. vulpina (Vulpine Opossum). The following description of this species is given in Phillips's 'Voyage:'—"This is not unlike the common fox in shape, but considerably inferior to it in respect to size, being from the point of the nose to the setting on of the tail only 26 inches, the tail itself 15 inches: the upper parts of the body are of a grisly colour, arising from a mixture of dusky and white hairs, with rufous yellow tinge, the head and shoulders partaking most of this last colour; round the eyes blackish; above the nostrils 10 or 12 black whiskers, 4 inches or more in length; all the under parts of the body are of a tawny buff colour, deepest on the throat, where the bottom of the hairs are rust-colour; the tail is of the colour of the back for about one quarter of its length, thence to the end black; the toes on the fore feet are 5 in number, the inner one placed high up; on the hind feet 4 toes only, with a thumb, consisting of two joints without a claw, placed high up at the base of the inner toe; the whole foot serving the purpose of a hand, as observable in many of the Opossum



Teeth of *Phalangista*. F. Cuvier.

genus. The legs are much shorter in proportion than those of the common fox; the ears about one inch and a half in length." It is

Vulpine Opossum (*Phalangista vulpina*).

the Phalanger Renard of the French, Bruno of Vicq-d'Azyr, and Whatapooroo of the natives. It is found in Australia, in the neighbourhood of Port Jackson.

Sub-genus *Cuscus* (Lacépède).—Tail prehensile, but in great part naked, and covered with rugosities; ears very short. Dental Formula :—

$$\text{Incisors, } \frac{6}{6}\text{; Canines, 0; Molars, } \frac{6-6}{8-8} = 40. \quad \text{(Lesson.)}$$

This genus is peculiar to the Western Polynesia, or Malasia. (Lesson.)

C. maculatus (*Didelphys Orientalis* of Gmelin; *Cuscus Amboinensis* of Lacépède; *Phalangista maculata* of Geoffroy). This species, which is named Coescoes at the Moluccas, according to Valentyn, varies much in its colouring with reference to sex and age. M. Lesson, who found it at Wagiou, where the natives call it Scham-Scham, says that its fur, which is thick and woolly, is generally whitish, covered with isolated brown spots, sometimes running together. The same author states that its habits are slow and nocturnal, and that it lives on fruits in the equatorial forests of the great Mollucca and Papuan islands.

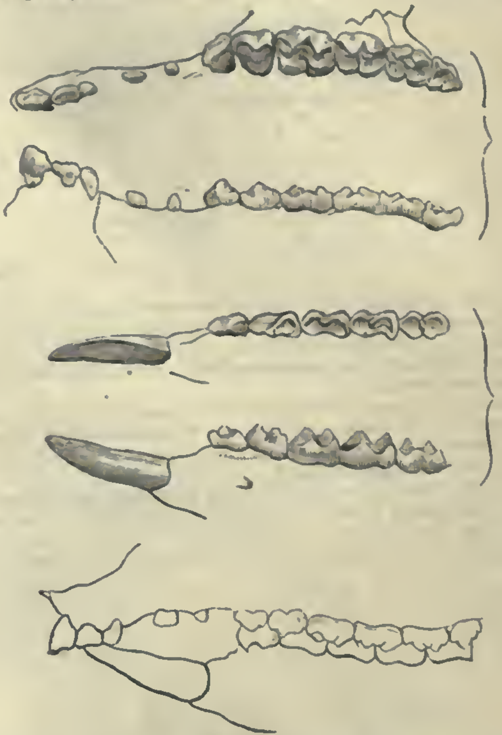
Cuscus maculatus.

Petaurus (Shaw).—Head rather short; ears small and hairy; skin of the flanks extended between the anterior and posterior limbs, and covered with hair; tail not strictly prehensile. Dental Formula :—

$$\text{Incisors, } \frac{6}{2}\text{; Canines, 0; Molars, } \frac{8-8}{7-7} = 38.$$

It will be observed that the number of lower molar teeth given in the cut amounts only to 5, and consequently does not correspond with the formula above given, or with that stated by F. Cuvier himself, who makes the total number of teeth 22 in the upper jaw and 16 in the lower, and the number of upper false molars 8, and of molars 8 also; the number of lower molars being 6 false and 8 true, 38 in all. He tells us that this form of dentition is taken from *Phalangista Cookii*, *Petaurus Taguanoides*, "Le Phalanger Didelphoide, or Le Macraure, of M. Geoffroy, and a species which has no name."

Mr. Bennett, who in common with Cuvier, Desmarest, and Lesson, has placed the interesting species which we have chosen as the example under the genus *Petaurus*, remarks that F. Cuvier, relying solely on the discrepancy or agreement of the dentary systems, and putting entirely out of question all consideration of other and essential points of structure, has reunited the old genus *Phalangista*, in order again to subdivide it into two incongruous and heterogeneous groups; in the one confounding two well marked species of flying *Petauri* not only with the climbing *Phalangistæ* of Australia, but with the naked-tailed and strictly prehensile Couscous of the Moluccas; repaying the other group, which he had so unnecessarily dismembered, by the addition of a true *Phalangista*, whose only pretensions to such an association are made to depend on a somewhat similar arrangement of the teeth. "By thus confining himself to a single character," continues Mr. Bennett, "he has broken up the regular series of affinities which connected together three marked but still closely allied gradations of form, to substitute an arrangement which has no other recommendation than the theoretic views of its author. In such a case we cannot hesitate in giving to the organs of locomotion, combined with the general habit, that precedence before those of mastication, which, under other circumstances, we are generally in the habit of conceding to the latter; and we feel the less repugnance to adopting this course, because it is admitted that the dentary formula is in these animals subject to some variation, and because zoologists are by no means agreed with respect to its exact definition. The teeth of the Squirrel-*Petaurus* agree generally, according to M. F. Cuvier, with those of the



Teeth of *Petaurus*. F. Cuvier.

Phalangistæ. They are consequently 38 in number, 20 occupying the upper jaw, and 18 the lower. The former are divided by the same eminent naturalist into 6 incisors, 4 canines, 2 false molars, and 8 true ones; the latter consisting of 2 incisors, and no canines, with 8 false and as many true molars. The dentary character of the orginal species of *Petaurus*, which he takes as the type of his other group, differs chiefly in the total want of canine teeth; but we may here be permitted to observe that it appears to us somewhat doubtful how far those which are above enumerated as such truly deserve the name which has been applied to them. In every other respect the little creature in question perfectly agrees with the group of animals to which we have restored it; and which are at once characterised by the broad expansion of their skin on each side of the body, extending between the anterior and posterior limbs, as in the Flying Squirrels, to which indeed they bear a close resemblance. In common with nearly the whole of the mammiferous quadrupeds of the country which they inhabit, they possess the abdominal pouch which fixes their place in the system among the marsupial animals; and, as in many of these, the thumbs of the hind-feet are long and distinctly opposeable to the sole. The other toes are four in number, and furnished with tolerably strong claws, of which the thumbs are destitute. The fore feet have long radiating toes, the middle one of which is the longest, all armed with similar claws to those of the hind feet. The tail is round, covered with loose hair, somewhat tapering towards the point, and not strictly prehensile, having no naked surface at its extremity beneath. In size the present species is about equal to the common squirrel, and its tail is rather longer than its body. Its colour is delicately gray above, somewhat darker on the head, and white beneath. A black line passes from the point of the nose along the back towards the tail; and the lateral folds of the skin are bounded in front and on the sides by a similar band, which confounds itself gradually in the inside with the gray of the body, and is bordered at the outer margin by a fringe of white. The eyes are each placed in a spot of black, and a faint blackish line extends along the upper surface of the hinder limbs. The tail is also of a darker hue, especially towards its extremity."

P. sciureus, Norfolk Island Flying Squirrel (the Sugar Squirrel), may be taken as an example of this genus. There are three other species, *P. Australis*. *P. breviceps*, and *P. Ariel*, all from Australia.

"During the day," says Mr. Bennett, speaking of the Sugar Squirrel, "the animal generally remains quietly nestled in the hollows of trees, but becomes animated as night advances, and skims through the air, supported by its lateral expansions, half leaping, half flying from branch to branch, feeding upon leaves and insects. This peculiar mode of locomotion can scarcely be considered as a true flight, inasmuch as the cutaneous folds which serve the purposes of wings seem rather destined for the mere support of the animal in its long and apparently desperate leaps, than for raising it in the air and directing its course towards any given object. For this latter purpose tbey are indeed but little fitted by their structure, tbe want of proper muscles in a great measure incapacitating tbem from performing such offices as are dependent on volitiou. It may be doubted however wbether tbese animals are entirely destitute of the power of exercising tbeir will in tbeir flight-like leaps. For the following anecdote bearing upon tbis subject we are indebted to our friend Mr. Broderip, wbo related it to us on unquestionable autbority. On board a vessel sailing off tbe coast of New Holland was a Squirrel-Petaurus, which was permitted to roam about tbe ship. On one occasion it reacbed the mast-head, and as the sailor wbo was despatcbed to bring it down approacbed, made a spring from aloft to avoid bim. At tbis moment tbe ship gave a heavy lurcb, wbicb, if tbe original direction of tbe little creature's course bad been continued, must bave plunged it into the sea. All who witnessed the scene were in pain for its safety; but it suddenly appeared to check itself, and so to modify its career that it aligbted safely on tbe deck." Tbose that we have seen in captivity are in a state of somnolency all day; one kept at the Gardens in tbe Regent's Park was formerly in the possession of the then Marchioness of Cleveland. At night it was lively and active, and was perfectly tame, but rather shy. Tho species inhabits New South Wales, and is said to be abundant at tbe foot of the Blue Mountains. There seems to be no authority for tbe locality of Norfolk Island as a habitat of this very pretty little animal, excepting the figure and description in Phillips's 'Voyage' above alluded to. The fur would be highly ornamental from its colour, softness, and beauty, as an article of dress.

Norfolk Island Flying Squirrel (*Petaurus sciureus*).

Phascolarctos, De Blainvillo (*Lipurus*, Gold.; *Amblotis*, Illig.).—Body stout; head short, ears shaggy; limbs ratber short, robust, and nearly equal in length; toes five on each fore foot; the anterior toes divided into two groups for prehensiou, the tbumb and tbe fore finger being in one group, and the remaining three fingers in tbe other, the thumb of tbe posterior foot very large, but without a nail, and tbe two inner fingers united; tail very sbort, almost null; Mr. Martin says that it differs from tbe Wombat in its dental formula, in which respect it closely resembles tbe Kangaroos. Dental Formula:—

$$\text{Incisors, } \frac{3-3}{1-1}; \text{ Canines, } \frac{1-1}{0-0}; \text{ Molars, } \frac{5-5}{5-5} = 30.$$

Tho canines are small, and in the intermaxillary suture. The false molars are compressed and trenchant, but thicker tban in *Hypsiprymnus*, the dentition of whicb, otherwise, that of tbe *Koala* resembles closely. The lower true grinders are narrower tban tbe upper ones, and both quadricuspid.

P. cinereus (*Lipurus cinereus* of Goldfuss; *P. fuscus* of Desmarest; *P. Flindersii* of Lesson), the Asby Koala. It is the only species.

It is as large as a dog of moderate size. Fur long, tbick, rather coarse, and ashy-brown, tufted ears rather lighter. It is said to have the gait and carriage of a yonng bear, to be arboreal in its habits, and to pass its life upon trees and in dens or holes whicb it hollows at their feet. Of its powers of climbing there can be no doubt; the structure of its extremities would lead to tbis inference, and actual observation has confirmed it. Its locality is Australia, and we are enabled to give figures of the parent and young, taken by tho kind permission of a friend, from a very accurate and beautiful drawing executed from tho living animals, tho first that were known in tbe colonies. They were brought in by natives to Colonel Paterson, then lieutonant-governor of the colony, from the Hat Hill district, to tho southward of Port Jackson, in 1803. Tho native name 'Koala' is said to signify 'Biter.'

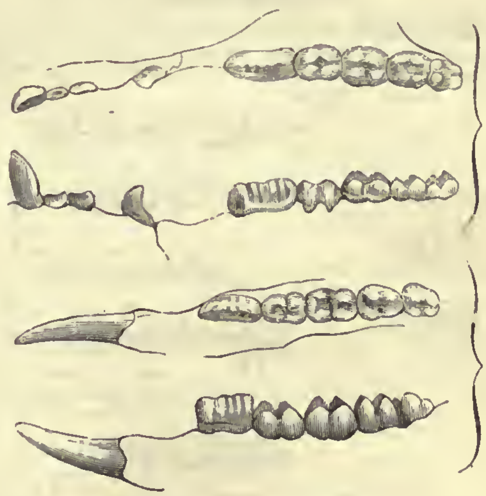
Ashy Koala (*Phascolarctos cinereus*).

There are old and young stuffed specimens in the Britisb Museum, and a stuffed specimen (Mr. Caley's) in the Museum of tbe Linnæan Society.

The visceral anatomy will be found in Mr. Martin's paper 'On tbe Anatomy of the Koala,' read to the Zoological Society in November, 1836 ('Zool. Proc.,' 1836). It is chiefly remarkable for tbe enormous size and length of the cæcum.

Hypsiprymnus (Illiger).—Head elongated; ears large; upper lip cleft. Tail moderate, scaly, covered scantily witb hairs. Two teats only in tbe ventral pouch of tbe female. Anterior feet five-toed, armed with obtuse nails; third toe of the hind feet very robust, and armed with a very strong nail. Dental Formula:—

$$\text{Incisors, } \frac{3-3}{1-1}; \text{ Canines, } \frac{1-1}{0-0}; \text{ Molars, } \frac{5-5}{5-5} = 30.$$



Teeth of *Hypsiprymnus*. F. Cuvier.

H. Potoroo (*Macropus minor* of Sbaw; *Potorous minimus* and *Kangurus Gaimardi* of Desmarest; *Hypsiprymnus Whitei* of Quoy and Gaimard; Potoroo of Wbite, and Kauguroo-Rat of Phillips's 'Voyage'). It is the size of a rabbit; general colour grayish, reddish-brown above, whitish below; bead triangular; ears large; tarsi very long; tail elongated, flexible, terminated by a pencil of hairs.

Tbe manners of the Kangaroo-Rat are mild and timid; its food consists of vegetables, and it is said to burrow in the ground. Australia is its locality, and Lesson says that it is not rare in the neighbourhood of Port Jackson, especially near the river Weragambla in the Blue Mountains.

Kangaroo-Rat (*Hypsiprymnus Potoroo*).

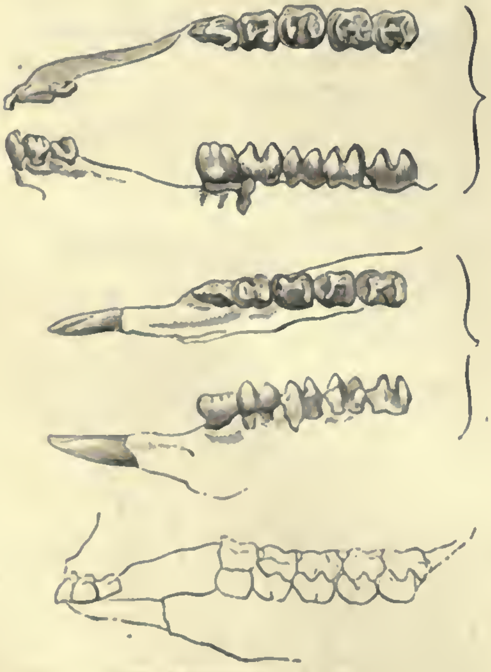
M. Lesson records two other species, and Mr. Ogilby described ('Zool. Proc.,' 1831) a fourth, *Hypsiprymnus setosus*, known in the colony of New South Wales by the native name of Bettong Kangaroo. The specimen described by Mr. Ogilby was believed to have been brought from Swan River. The last-named zoologist has also characterised six other new species. ('Zool. Proc.,' 1838.)

Skull of *Hypsiprymnus*.

A second species, *H. Gilbertii*, has been described by Mr. Gould.

Sub-genus *Halmaturus* (Illiger in part).—Differing from the true Kangaroos in having shorter ears, a tail nearly naked, or only with a few hairs. Dental Formula :—

$$\text{Incisors, } \frac{3-3}{1-1}; \text{ Canines, } \frac{0-0}{0-0}; \text{ Molars, } \frac{5-5}{5-5} = 28.$$



Teeth of *Halmaturus*. F. Cuvier.

H. elegans (*Kangurus fasciatus* of Péron and Lesueur). Colou mouse-gray, bounded transversely with reddish-brown on the back and loins. Size of a large hare.

It haunts the under thick bushes, and is said to form subterranean galleries in the island of St. Pierre.

Sub-genus *Macropus* (Shaw; *Halmaturus* of Illiger in part).—Head elongated; ears very large; upper lip cleft; whiskers very short and few. Posterior limbs like those of *Hypsiprymnus*, but much longer and more robust. Tail long, triangular, very muscular. Dental Formula :—Incisors, $\frac{6}{2}$; Canines, $\frac{0-0}{0-0}$; Molars, $\frac{4-4}{4-4} = 24$.

M. major and *M. giganteus* of Shaw (*Kangurus labiatus* of Geoffroy; *Didelphys gigantea* of Gmelin; the Kangaroo of Cook).

Great Kangaroo (*Macropus major*).

This extraordinary animal, discovered by Captain Cook, is now so well known, that a description, in addition to our illustrations and account of its animal economy at the beginning of this article, would be superfluous. Our countrymen pursued it in Australia with greyhounds, and the leaps which it took surprised those who beheld it clear obstacles 7 or 8 feet high. In size it equals a sheep, some of the largest weighing 140 lbs., and the flesh is represented by those who have tasted it as being a little like venison. The species breeds pretty freely in this country, and has been kept with success in our parks.

It inhabits New South Wales, Southern and Western Australia, and Van Diemen's Land. It is known to the colonists by the names of 'Boomer' and 'Forrester.' Mr. Gould describes two species, *M. ocydromus* and *M. melanops*, which Mr. Waterhouse regards as specifically identical with *M. giganteus*.

M. fuliginosus, Sooty Kangaroo (*Kangurus fuliginosus*, Desmarest; Kangaroo Giant, F. Cuvier). It is about the same size as the last species. Mr. Waterhouse thinks this species will turn out to be a variety of the last. He says "the name Sooty Kangaroo is most ill applied to the present animal, since its colouring is anything but sooty, being for the most part of a brownish-yellow, rather bright on the sides of the body, and somewhat suffused with dusky-brown on the middle of the back."

M. unguifer, the Nail-Tailed Kangaroo, first described by Mr. Gould, has a nail-like horny excrescence at the end of its tail. It is smaller than the foregoing species.

M. frænatus, the Bridled Kangaroo, is another nail-tailed species, discovered by Mr. Gould. Its weight varies from 10 lbs. to 15 lbs.

M. auratus, the Crescent-Marked Kangaroo, is about the size of a rabbit. It inhabits the Swan River district, Western Australia.

M. leporoides (*Lagorchestes leporoides*, Gould), the Hare-Kangaroo, is a pretty little Kangaroo, about the size of the common hare. Its powers of leaping are very extraordinary. "While out on the plains of South Australia," says Mr. Gould, "I started a Hare Kangaroo before two fleet dogs; after running to the distance of a quarter of a mile,

Skeleton of Great Kangaroo (*Macropus major*).
a, the marsupial bones.

it suddenly doubled and came back upon me, the dogs following close at its heels. I stood perfectly still, and the animal had arrived within 20 feet before it observed me, when, to my astonishment, instead of branching off to the right or the left, it bounded clear over my head, and on descending to the ground I was enabled to make a successful shot, by which it was procured."

M. conspicillatus (*Lagorchestes conspicillatus*, Gould) is distinguished from the last by its ears heing considerahly shorter, the more hrilliant rusty-red colouring round the eye, and the want of a black patch at the base of the fore leg; the muzzle likewise is more obtuse.

M. fasciatus, Banded Hare-Kangaroo (*Kangurus fasciatus*, Péron; *Bettongia fasciata*, Gould). It is about the size of the common hare, and has very long and soft brown-gray hair. It is very shy and timid, inhabiting the thick brush of Western Australia.

M. hirsutus, like the rest of the group called hy Mr. Gould *Lagorchestes*, is about the size of the common hare. It inhabits Western Australia, where it is known to the natives hy the name of 'Woo-rup.' It is distinguished from the others by the long reddish hairs which are mingled with those of the ordinary hair on the hinder parts of the back, and especially near the base of the tail.

M. antilopinus (*Halmaturus Antilopinus*, F. Cuvier), Antelopine Kangaroo, is a large species, nearly the size of *M. giganteus*. It is characterised by being clothed with short stiff hairs, and these lie close to the skin, as in many of the antelope tribe. It inhabits North Australia.

M. Isabellinus (the Yellow Wallaroo), Isabelline Kangaroo. This species has been described from a flat and imperfect skin procured hy Mr. Gould at Barrow Island.

M. robustus, Waterhouse (*Petrogale robusta*), the Great Rock Kangaroo. It is the Black Wallaroo of the colonists, and inhabits the mountain ranges in the interior of New South Wales. The male and female differ in size and colour. The male equals in weight the Great Kangaroo, and is of a black colour, whilst the female is a small delicate creature of a silvery-gray colour. This animal is living in the Gardens of the Zoological Society, Regent's Park.

M. rufus, Desmarest (*M. laniger*, Gould). The male is called the 'Red Buck' and the female the 'Blue Doe,' she is also called 'Flying Doe.' This species is as large as *M. giganteus*. Four specimens were procnred hy M. Gould in Australia, and are now in the British Museum. It frequents the banks of the Murrumbidgee and the Darling, and is probahly dispersed over the great hasin of the interior of Australia.

M. agilis, the Agile Kangaroo, inhabits the north coast of Australia. It is very agile, and eludes the dogs employed in hunting it by its extreme activity in leaping over the high crags. The colour of the fur is sandy-yellow, but the hack is pencilled with black.

M. Parryi, Bennett (*Halmaturus Parryi*). It inhabits New South Wales. It is of a silvery-gray ahove and white beneath. It is a large species.

M. Irma (*Halmaturus Irma*, Jourdan), the Black-Gloved Kangaroo, is a native of Western Australia. It runs very fast, is ahout 31 inches in length or half the size of *M. giganteus*, aud abounds in the Swan River district.

M. Greyi, named after the Hon. Captain G. Grey, who presented two specimens to the British Museum. It inhabits South Australia.

M. ruficollis, Desmarest (*Halmaturus elegans*, Gray), Kangaroo à Cou Roux, the Red-Necked Kangaroo. It inhabits New South Wales and King's Island. It was discovered hy Messrs. Péron and Lesueur in King's Island. Mr. Waterhouse regards the *M. Bennettii*, 'Brush Kangaroo,' as a variety of this species. This animal has hred freely in this country both in the Gardens of the Zoological Society and in the menagerie of the Earl of Derhy.

M. Ualabatus, the Black Wallahy of Gould, Black-Tailed Kangaroo of Waterhouse, is an inhabitant of New South Wales.

M. Eugenii, Waterhouse (*Halmaturus Eugenii; H. gracilis*, Gould), inhabits Western Australia.

M. Thetides, the Pademelon Kangaroo, Pademelon Wallaby of the colonists, inhabits New South Wales. It is a small species, about 20 inches in height when sitting. It is highly prized as an article of diet.

M. Parma, Parma Kangaroo, inhabits New South Wales.

M. dorsalis, Black-Striped Kangaroo. Like the last it is found in the scruhhy districts of New South Wales. This species is eaten, and its skin is used for clothing.

M. Derbianus, Derby's Kangaroo, inhabits Western and South Western Australia. It is ahout the size of the last, and is found in the interminahle forests of short *Eucalypti*, which characterise many districts of Australia.

M. Billardierii, Waterhouse (*Kangurus Billardierii*), Red-Bellied Kangaroo, is a native of Van Diemen's Land. It is a gregarious species, hundreds of them inhahiting the same locality. It is called by the colonists 'The Wallaby.'

M. brachyurus, the Short-Tailed Kangaroo, inhabits the region of King George's Sound.

M. penicillatus, Gray (*Heteropus albogularis*, Jourdan), the Brush-Tailed Rock-Kangaroo, inhabits New South Wales, and its flesh is said to he most excellent. It is a gregarious and nocturnal species, dwelling in rocky districts, and remarkable for its power of leaping from rock to rock.

M. lateralis, the Black-Flanked Rock-Kangaroo (*Petrogale lateralis*, Gould). It inhabits western Australia, the Swan River district, and is nocturnal in its hahits, and remarkably shy.

M. inornatus (*Petrogale inornata*, Gould), inhabits the north coast of Australia.

M. Brachiotis, the Short-Eared Rock-Kangaroo, inhabits the north-west coast of Australia.

M. concinnus is also found in the same districts.

M. Brunii, Le Brun's Kangaroo (Filander, Le Brun; *Didelphys Brunii*, Schreber; *Macropus vetema*, Lesson; *Hypsiprymnus Brunii*, Müller; *Halmaturus Asiaticus*, Gray; Javan Opposum, Pennant). Head narrow and very long; ears short; tail moderate; fore legs strong; fur very short, soft, and composed of hair almost entirely of one kind, radiating from a point on the mesial line of the hack a little behind the shoulders; general colour grayish-brown suffused with yellowish, especially on the sides of the hody; under parts pale dirty yellow; ears blackish externally.

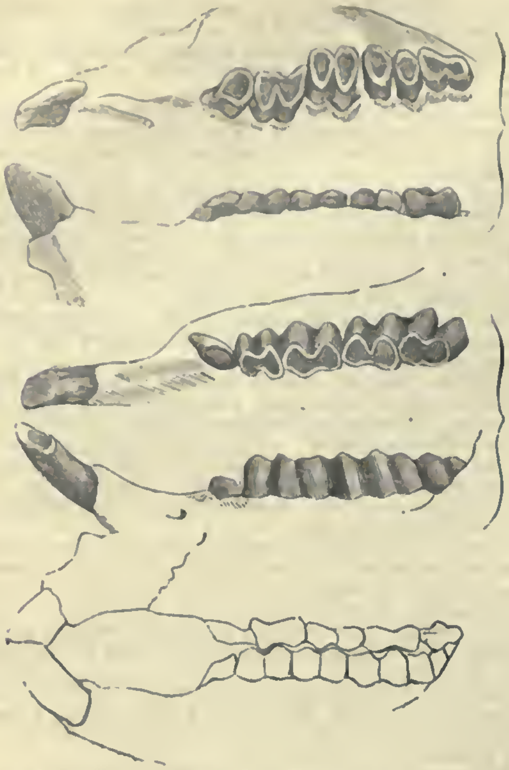
This animal was the first of the *Marsupiata* with which naturalists became acquaiuted, having been described by Le Brun as early as 1711. It is an inhabitant of New Guinea. Specimens were ohtained during the French expedition of the Astrolabe, and hy an expedition recently sent out by the Dutch government. Through the last expedition specimens have been obtained which are now in the British Museum.

Phascolomys (Geoffroy).—Body clumsy; head large and bluff; fore feet with five toes, armed with crooked nails; hind feet with four, and a little tubercle without a nail, in place of the great toe; indeed it may be said to have but four toes on the hind feet. Tail nearly null. Dental Formula:—

$$\text{Incisors, } \frac{1-1}{1-1}\text{; Canines, } \frac{0-0}{0-0}\text{; Molars, } \frac{5-5}{5-5} = 24.$$

P. Wombat, *Didelphys ursina* of Shaw; the Wombat of the natives, navigators, and naturalists, is the only species of this geuus known.

From Lieut.-Col. Collins's 'Account of the English Colony of New South Wales' (1802), we select the following part of a description of a Womhat found on Cape Barren Island, abstracted from Bass's 'Journal:'—"The Womhat, or, as it is called by the natives of Port Jackson, the Womback, is a squat, short, thick, short-legged, rather inactive quadruped, with great appearance of stumpy strength, and somewhat higger than a large turnspit dog. Its figure and movements, if they do not exactly resemhle those of the bear, at least strongly remind one of that animal. Its length, from the tip of the tail to the tip of the nose, is 31 inches, of which its body takes up 23



Teeth of *Phascolomys*, or Wombat (F. Cuvier), nearly of the natural size.

inches and 5-10ths. The head is 7 inches and the tail 5-10ths. Its circumference behind the fore legs 27 inches; across the thickest part of the belly 31 inches. Its weight by hand is somewhat between 25 and 30 lbs. The hair is coarse, and about one inch or one inch and five-tenths in length, thinly set upon the belly, thicker on the back and head, and thickest upon the loins and rump; the colour of it a light sandy brown of varying shades, but darkest along the back." The head is large, flattish, and nearly triangular when viewed in front; the ears are sharp and erect; the eyes small and rather sunken than prominent, but quick and lively.

Wombat (*Phascolomys Wombat*).

From the same work we take the following account of the habits, &c., of this species:—"This animal has not any claim to swiftness of foot, as most men could run it down. Its pace is hobbling or shuffling, something like the awkward gait of a bear. In disposition it is mild and gentle, as becomes a grass-eater; but it bites hard, and is furious when provoked. Mr. Bass never heard its voice but at that time; it was a low cry between a hissing and a whizzing, which could not be heard at a distance of more than thirty or forty yards. He chased one, and with his hands under his belly suddenly lifted him off the ground without hurting him, and laid him upon his back along his arm like a child. It made no noise, nor any effort to escape, not even a struggle. Its countenance was placid and undisturbed, and it seemed as contented as if it had been nursed by Mr. Bass from its infancy. He carried the beast upwards of a mile, and often shifted him from arm to arm, sometimes laying him upon his shoulder, all of which he took in good part; until, being obliged to secure his legs while he went into the brush to cut a specimen of a new wood, the creature's anger arose with the pinching of the twine; he whizzed with all his might, kicked and scratched most furiously, and snapped off a piece from the elbow of Mr. Bass's jacket with his grass-cutting teeth. Their friendship was here at an end, and the creature remained implacable all the way to the boat, ceasing to kick only when he was exhausted. This circumstance seems to indicate that with kind treatment the Wombat might soon be rendered extremely docile; but let his tutor beware of giving him provocation, at least if he should be full grown. Besides Furneaux's Islands, the Wombat inhabits, as has been seen, the mountains to the westward of Port Jackson. In both these places its habitation is underground, being admirably formed for burrowing; but to what depth it descends does not seem to be ascertained. According to the account given of it by the natives, the Wombat of the mountains is never seen during the day, but lives retired in his hole, feeding only in the night; but that of the islands is seen to feed in all parts of the day. His food is not yet well known; but it seems probable that he varies it according to the situation in which he may be placed. The stomachs of such as Mr. Bass examined were distended with the coarse wiry grass, and he as well as others had seen the animal scratching among the dry ricks of sea-weed thrown up upon the shores, but could never discover what it was in search of. Now the inhabitant of the mountains can have no recourse to the sea-shore for his food, nor can he find there any wiry grass of the islands, but must live upon the food that circumstances present to him."

A letter from James Hunter, Esq., Governor of the settlement, dated Sydney, New South Wales, August 5, 1798, and published in Bewick's 'Quadrupeds,' states that this animal, there called the Wombach, was found upon an island on the coast of New South Wales, in 40° 36' S. lat., where considerable numbers were caught by the company of a ship which had been wrecked there on her voyage from Bengal to Port Jackson. The same communication relates that it had "lately been discovered to be an inhabitant of the interior of this country also. The mountain natives call it the Wombach."

The specimen dissected by Sir Everard Home in 1808 was brought from one of the islands in Bass's Straits, and lived as a domestic pet in the house of Mr. Clift for two years.

The individual dissected by Professor Owen in May, 1836, had lived at the Gardens of the Zoological Society upwards of five years.

M. Lesson says that it lives in King's Island and the Furneaux Islands, but that it does not exist in the neighbourhood of Port Jackson.

The anatomy of the Wombat will be found in Cuvier's 'Leçons d'Anatomie Comparée,' in Sir Everard Home's paper, 'Phil. Trans.,' 1808, and in Professor Owen's memoir, 'Zool. Proc.,' 1836. The latter observes that the digestive organs in the abdominal cavity presented a development corresponding generally to that which characterises the same parts in the phytiphagous Rodents. It has a very short cæcum.

The flesh of the Wombat is said to be excellent. Mr. Hunter, the writer of the letter above quoted, terms it delicate meat, and some have remarked that the animal might be easily naturalised in this country.

The impression made upon us by Mr. Bass's account of the behaviour of the Wombat which he caught, and by one that we have seen in captivity, is, that the animal is of a low grade in point of intellect. In both cases, as long as there was no positive pain or disagreeable sensation, the animal was content, however new its situation might be. There was none of that anxiety and uneasiness which all animals of lively sense show when suddenly placed in new positions, or in strange places; and indeed the following note is appended to Mr. Bass's account of the capture of his Wombat:—"The Kangooroo and some other animals in New South Wales were remarkable for being domesticated as soon as taken." This may be one of the consequences of the low cerebral development generally to be observed in this group.

There are at present (1855) several specimens in the gardens of the Zoological Society, which are remarkably tame, and readily present themselves at the palisades of their inclosure to be caressed.

The following list, showing the distribution of the *Marsupiata* in Australia, will supply also the names of the species not already mentioned in the preceding account:—

South Australia.

Macropus giganteus.
M. lunatus.
M. leporoides.
M. fasciatus.
M. rufus.
Macropus Greyi.
M. Eugenii (Nuyt's Archipelago).
M. Derbianus (from islands off the coast).
Hypsiprymnus Grayi.

H. penicillatus.
H. Gaimardi.
H. campestris.
Phascolomys Wombat.
P. latifrons.
Phascolarctos cinereus.
Phalangista vulpina.
P. Cookii.
P. concinna.
Petaurus Australis.
Perameles obesula.
P. fasciata.
Chœropus castanotis.
Myrmecobius fasciatus.
Phascogale penicillata.
P. flavipes.
P. albipes.
P. crassicaudata.
Dasyurus Geoffroyi.

North Australia.

Macropus unguifer.
M. antilopinus.
M. agilis.
M. brachiotis.
M. inornatus.
Macropus concinnus.
Phalangista vulpina.
Petaurus breviceps, var. *Ariel.*
Perameles macroura.
Dasyurus hallucatus.

Western Australia.

Echidna aculeata.
Macropus giganteus.
M. (giganteus) ocydromus.
M. lunatus.
M. Isabellinus.
M. fasciatus.
M. hirsutus.
M. conspicillatus (Barrow Island).
M. Irma.
M. Derbianus.
M. brachyurus (King George's Sound).
M. lateralis.
Hypsiprymnus Grayi.
H. penicillatus.
H. Gilbertii (King George's Sound).
H. platyops.
Phalangista vulpina.
P. v. xanthopus.
P. Cookii.
P. concinna.
Phalangista Neillii (King George's Sound).
Tarsipes rostratus (Swan River and King George's Sound).
Perameles (Macrotis) lagotis (Swan River and King George's Sound).
P. Bougainvillii (Peron's Peninsula, Shark's Bay).
P. obesula.
P. myorsuros (Swan River and King George's Sound).
Chœropus castanotis (Swan River).
Myrmecobius fasciatus (Swan River and King George's Sound).
Phascogale penicillata.
P. calura.
P. apicalis.
P. leucogaster, var. *flavipes* (?).
P. albipes (?).
P. crassicaudata.
Dasyurus Geoffroyi.

Van Diemen's Land.

Ornithorhynchus paradoxus.
Echidna (aculeata) setosa.
Macropus giganteus.
M. ruficollis, var. *Bennettii.*
M. Billardierii.
Hypsiprymnus cuniculus.
H. murinus.
Phascolomys Wombat.
Phalangista vulpina.
P. Cookii.
P. nana.
Perameles obesula.
P. Gunnii.
Phascogale Swainsonii.
P. minima.
P. leucopus.
Dasyurus maculatus.
D. viverrinus.
D. ursinus.
Thylacinus cynocephalus (Bass's Strait).
Echidna.
Macropus ruficollis (King's Island).
Phascolomys Wombat.
Dasyurus maculatus.

New South Wales.

Ornithorhynchus paradoxus.
Echidna aculeata.
Macropus giganteus.
M. frœnatus (interior).
M. leporoides.
M. robustus (interior).
M. rufus.
M. Parryi.
M. Ualabatus.
M. Thetidis.
M. Parma.
M. dorsalis (interior).
M. penicillatus.
Hypsiprymnus rufescens.
H. penicillatus.
H. Gaimardi.
H. murinus.
Phascolomys Wombat.
Phascolarctus cinereus.
Phalangista vulpina.
P. canina (interior).
P. Cookii.
Petaurus taguanoides.
P. Australis.
P. sciureus.
P. breviceps.
P. (acrobata) pygmæus.
Perameles obesula.
P. nasuta.
P. fasciata.
Phascogale penicillata.
P. flavipes.
P. murina.
P. macroura.
Dasyurus Geoffroyi.
D. viverrinus.

Fossil Marsupiata.

Besides the Fossil Opossum (*Didelphys Cuvieri*) of the Montmartre Gypsum, figured and described by Cuvier in the 'Annales du Museum,' and in his 'Ossemens Fossiles,' and the fossil *Dasyurus*, *Hypsiprimnus*, *Halmaturus*, *Phascolomys*, and Kangaroo, described by Mr. Clift and Cuvier and Mr. Pentland, from the Australian bone-caverns and bone breccia, there are some fossil forms now generally considered as belonging to the *Marsupiata*, which it will be necessary, on account of the great interest which attaches to them both geologically and zoologically, to mention more at length. We commence with those fossil jaws originally described as belonging to the *Marsupiata* which were found at Stonesfield.

Thylacotherium, Owen (*Amphitherium*, De Blainville; *Didelphys*, Cuvier).—In consequence of strong doubts having been expressed by M. De Blainville, from inspection of casts, respecting the mammiferous nature of the fossil jaws found at Stonesfield, and assigned to the *Marsupiata* by Baron Cuvier, a paper 'On the Jaws of the Thylacotherium Prevostii from Stonesfield' was read before the Geological Society by Professor Owen, giving a detailed account of the fossils from a careful inspection of the originals. In this communication Professor Owen confined his description to the jaws discovered at Stonesfield, characterised by having 11 molars in each ramus of the lower jaw. He commenced by observing that the scientific world possesses ample experience of the truth and tact with which Cuvier formed his judgments of the affinities of an extinct animal from the inspection of a fossil fragment; and that it was only when so distinguished a comparative anatomist as M. De Blainville questioned the determinations, that it became the duty of those who possessed the means to investigate the nature of the doubts, and reassure the confidence of geologists in their great guide.

When Cuvier first hastily examined at Oxford, in 1818, one of the jaws described in Professor Owen's paper, and in the possession of Dr. Buckland, he decided that it was allied to the *Didelphys* ("me semblèrent de quelque Didelphe"*); and when doubts were raised by M. Constant Prevost, in 1824,† relative to the age of the Stonesfield slate, Cuvier, from an examination of a drawing made for the express purpose, was confirmed in his former determination; but he added that the jaw differs from that of all known carnivorous *Mammalia*, in having 10 molars in a series in the lower jaw. ("Il [the drawing] me confirme dans l'idée que la première inspection m'en avoit donnée. C'est celle d'un petit carnassier dont les mâchelières resemblant beaucoup à celles des sarigues; mais il y a dix de ces dents en série, nombro que ne montre aucun carnassier connu." 'Oss. Foss.,' v. 349, note.) It is to be regretted that the particular data, with the exception of the number of the teeth, on which Cuvier based his opinion, were not detailed; but he must have been well aware that the grounds of his belief would be obvious, on an inspection of the fossil, to every competent anatomist: it is also to be regretted that he did not assign to the fossil a generic name, and thereby prevent much of the reasoning founded on the supposition that he considered it as belonging to a true *Didelphys*.

Professor Owen then proceeded to describe the structure of the jaw; and he stated that having had in his possession two specimens of the *Thylacotherium Prevostii* belonging to Dr. Buckland, he had no hesitation in declaring that their condition is such as to enable any anatomist conversant with the established generalisations in comparative osteology, to pronounce therefrom not only the class but the more restricted group of animals to which they have belonged. The specimens plainly reveal, first, a convex articular condyle; secondly, a well-defined impression of what was once a broad, thin, high, and slightly recurved triangular coronoid process, rising immediately anterior to the condyle, having its basis extended over the whole of the interspace between the condyle and the commencement of the molar series, and having a vertical diameter equal to that of the horizontal ramus of the jaw itself: this impression also exhibits traces of the ridge leading forwards from the condyle and the depression above it, which characterises the coronoid process of the zoophagous marsupials; thirdly, tho angle of the jaw is continued to the same extent below the condyle as the coronoid process reaches above it, and its apex is continued backwards in the form of a process; fourthly, the parts above described form oue continuous portion with the horizontal ramus of the jaw, neither the articular condyle nor the coronoid being distinct pieces, as in reptiles. These are the characters, Professor Owen believes, on which Cuvier formed his opiniou of the nature of the fossil; and they have arrested the attention of M. Valeuciennes in his endeavours to dissipate the doubts of M. De Blainville.‡

From the examination of a cast, M. De Blaiuville however has been induced to infer that there is no trace of a convex condyle, but in place thereof an articular fissure, somewhat as in the jaws of fishes; that the teeth, instead of being imbedded in sockets, have their fangs confluent with, or anchylosed to, the substance of the jaws, and that the jaw itself presents evident traces of the composite structure.

In answer to the first of these positious, Professor Owen stated that the portion of the true condyle which remains in both the specimens of *Thylacotherium* examined by Cuvier and M. Valenciennes, clearly shows that the condyle was convex, and not concave. It is situated a little above the level of the grinding surface of the teeth, and projects beyond the vertical line dropped from the extremity of the coronoid process, but not to the same extent as in the true *Didelphys*. In the specimen examined by M. Valenciennes, the condyle corresponds in position with that of the jaw of the *Dasyurus* rather than the *Didelphys*; it is convex, as in mammiferous animals, and not coucave as in oviparous. The entire convex condyle exists in the specimen belonging to the other genus, *Phascolotherium*, now in the British Museum. Professor Oweu is of opinion that the entering angle or notch, either above or below the true articular condyle, has been mistaken for "une sorte d'échancrure articulaire, un peu comme daus les poissons."

* 'Ossemens Foss.,' tom. v., p. 349.

† 'Annales des Sciences Nat.,' Avril, 1825; also the papers of Mr. Broderip and Dr. Fitton, in the 'Zoological Journal,' 1828, vol. iii., p. 408.

‡ 'Comtes Rendus,' 1838, Second Semestre, No. 11, Sept. 10, p. 527, et seq.

The specimen of the half-jaw of the Thylacothere examined by M. Valenciennes, like that which was transmitted to Cuvier, presents the inner surface to the observer, and exhibits both the orifice of the dental canal and the symphysis in a perfect state. The foramen in the fossil is situated relatively more forward than in the recent Opossum and Dasyure, or in the Placental *Insectivora*, but has the same place as in the marsupial genus *Hypsiprymnus*. The symphysis is long and narrow, and is continued forward in the same line with the gently convex inferior margin of the jaw, which thus tapers gradually to a pointed anterior extremity, precisely as in the jaws of the Marsupial *Insectivora*. In the relative length of the symphysis, its form and position, the jaw of the *Thylacotherium* precisely corresponds with that of the *Didelphys*.

In addition however to these proofs of the mammiferous nature of the Stonesfield remains, and in part of their having belonged to *Marsupiata*, Professor Owen stated that the jaws exhibit a character hitherto unnoticed by the able anatomists who have written respecting them, but which, if co-existent with a convex condyle, would serve to prove the marsupial nature of a fossil, though all the teeth were wanting.

In recent marsupials the angle of the jaw is elongated and bent inwards in the form of a process, varying in shape and development in different genera. In looking therefore directly upon the inferior margin of the marsupial jaw, we see, in place of the edge of a vertical plate of bone, a more or less flattened triangular surface or plate of bone extended between the external ridge and the internal process or inflected angle. In the Opossum this process is triangular and trihedral, and directed inwards with the point slightly curved upwards and extended backwards, in which direction it is more produced in the small than in the large species of *Didelphys*.

Now, observed Professor Owen, if the process from the angle of the jaw in the Stonesfield fossil had been simply continued backwards, it would have resembled the jaw of an ordinary placental carnivorous or insectivorous mammal; but in both specimens of *Thylacotherium*, the half jaws of which exhibit their inner or mesial surfaces, this process presents a fractured outline, evidently proving that when entire it must have been produced inwards or mesially, as in the Opossum.

Professor Owen then described in great detail the structure of the teeth, and showed, in reply to M. De Blainville's second objection, that they are not confluent with the jaw, but are separated from it at their base by a layer of matter of a distinct colour from the teeth or the jaw, but evidently of the same nature as the matrix; and secondly, that the teeth cannot be considered as presenting an uniform compressed tricuspid structure, and being all of one kind, as M. De Blainville states, but must be divided into two series as regards their composition. Five if not six of the posterior teeth are quinquecuspidate, and are molares veri; some of the molares spurii are tricuspid, and some bicuspid, as in the Opossums. An interesting result of this examination is the observation that the five cusps of the tuberculate molars are not arranged, as had been supposed, in the same line, but in two pairs placed transversely to the axis of the jaw, with the fifth cusp anterior, exactly as in the *Didelphys*, and totally different from the structure of the molars in any of the *Phocæ*, to which these very small *Mammalia* have been compared: and in reference to this comparison Professor Owen again called attention to the value of the character of the process continued from the angle of the jaw, in the fossils, as strongly contradistinguishing them from the *Phocidæ*, in none of the species of which is the angle of the jaw so produced. The *Thylacotherium* differs from the genus *Didelphys* in the greater number of its molars, and from every ferine quadruped known at the time when Cuvier formed his opinion respecting the nature of the fossil. This difference in the number of the molar teeth, which Cuvier urged as evidence of the generic distinction of the Stonesfield mammiferous fossils, has since been regarded as one of the proofs of their Saurian nature; but the exceptions by excess to the number seven, assigned by M. De Blainville to the molar teeth in each ramus of the lower jaw of the insectivorous *Mammalia*, are well established, and have been long known. The insectivorous *Chrysochlore*, in the order *Feræ*, has eight molars in each ramus of the lower jaw; the insectivorous *Armadillos* have not fewer; and in one sub-genus (*Priodon*) there are more than twenty molar teeth on each side of the lower jaw. The dental formulæ of the carnivorous *Cetacea*, again, demonstrate the fallacy of the argument against the mammiferous character of the *Thylacotherium* founded upon the number of its molar teeth. From the occurrence of the above exceptions in recent placental *Mammalia*, the example of a like excess in the number of molar teeth in the marsupial fossil ought rather to have led to the expectation of the discovery of a similar case among existing Marsupials, and such an addition to our zoological catalogues has, in fact, been recently made. In the Australian quadruped described by Mr. Waterhouse under the name of *Myrmecobius* an approximation towards the dentition of the *Thylacotherium* is exemplified, not only in the number of the molar teeth, which is nine on each side of the lower jaw in the *Myrmecobius*, but also in their relative size, structure, and disposition. Lastly, with respect to the dentition, Professor Owen says it must be obvious to all who inspect the fossil and compare it with the jaw of a small *Didelphys*, that, contrary to the assertion of M. De Blainville, the teeth and their fangs are arranged with as much regularity in the one as in the other, and that no argument of the Saurian nature of the fossil can be founded on this part of its structure.

With respect to M. De Blainville's assertion that the jaw is compound, Professor Owen stated that the indication of this structure near the lower margin of the jaw of the *Thylacotherium* is not a true suture, but a vascular groove similar to that which characterises the lower jaw of *Didelphys, Opossum*, and some of the larger species of *Sorex*. ('Geol. Proc.')

Jaw of *Thylacotherium Prevostii*. Upper figure magnified.

Some discussion having ensued, in which Dr. Grant and Mr. Ogilby expressed opinions in support of M. De Blainville's views, Professor Owen, on the occasion of reading, on the 9th of December following, his paper on *Phascolotherium*, being the second part of the 'Description of the Remains of Marsupial *Mammalia* from the Stonesfield Slate,' gave a brief summary of the characters of the *Thylacotherium*, described in the first part of the memoir, and which he conceived fully proved the mammiferous nature of that fossil. He stated that the remains of the split condyles in the specimen demonstrate their original convex form, which is diametrically opposite to that which characterises the same part in all reptiles and all ovipara; that the size, figure, and position of the coronoid process are such as were never yet witnessed in any except a zoophagous mammal endowed with a temporal muscle sufficiently developed to demand so extensive an attachment for working a powerful carnivorous jaw; that the teeth, composed of dense ivory with crowns covered with a thick coat of enamel, are everywhere distinct from the substance of the jaw, but have two fangs deeply imbedded in it; that these teeth, which belong to the molar series, are of two kinds; the hinder being bristled with five cusps, four of which are placed in pairs transversely across the crown of the teeth, and the anterior or false molars, having a different form, and only two or three cusps—characters never yet found united in the teeth of any other than a zoophagous mammiferous quadruped; that the general form of the jaw corresponds with the preceding more essential indications of its mammiferous nature. Fully impressed with the value of these characters, as determining the class to which the fossils belonged, Professor Owen stated that he had sought in the next place for secondary characters which might reveal the group of *Mammalia* to which the remains could be assigned, and that he had found in the modification of the angle of the jaw, combined with the form, structure, and proportions of the teeth, sufficient evidence to induce him to believe that the *Thylacotherium* was a marsupial quadruped.

Professor Owen then recapitulated the objections against the mammiferous nature of the Thylacotherian jaws from their supposed imperfect state, and repeated his former assertion that they are in a condition to enable these characters to be fully ascertained: he next reviewed, first, the differences of opinion with respect to the actual structure of the jaw; and, secondly, with respect to the interpretation of admitted appearances.

1. As respects the structure.—It has been asserted that the jaws must belong to cold-blooded *Vertebrata*, because the articular surface is in the form of an entering angle: to which Professor Owen replied that the articular surface is supported on a convex condyle, which is met with in no other class of *Vertebrata* except in the *Mammalia*. Again, it is asserted that the teeth are all of an uniform structure, as in certain reptiles; but, on reference to the fossils, Professor Owen stated that it will be found that such is not the case, and that the actual difference in the structure of the teeth strongly supports the mammiferous theory of the fossils.

2. With respect to the argument founded on an interpretation of structure, which really exists, the author showed that the *Thylacotherium* having 11 molars on each side of the lower jaw is no objection to its mammiferous nature, because among the placental *Carnivora* the *Canis Megalotis* has constantly one more grinder on each side of the lower jaw than the usual number; because the *Chrysochlore*, among the *Insectivora*, has also 8 instead of 7 molars in each ramus of the lower jaw; and the *Myrmecobius*, among the *Marsupiata*, has 9 molars on each side of the lower jaw; and because some of the insectivorous *Armadillos* and zoophagous *Cetacea* offer still more numerous and reptile-like teeth, with all the true and essential characters of the mammiferous class. The objection to the false molars having two fangs, Professor Owen showed was futile, as the greater number of the

spurious molars in every genus of the placental *Feræ* have two fangs, and the whole of them in the Marsupialia. If the ascending ramus in the Stonesfield jaws had been absent, and with it the evidence of their mammiferous nature afforded by the condyloid, coronoid, and angular processes, Professor Owen stated that he conceived the teeth alone would have given sufficient proof, especially in their double fangs, that the fossils do belong to the highest class of animals.

In reply to the objections founded on the double fangs of the *Basilosaurus*, Professor Owen said that the characters of that fossil not having been fully given, it is doubtful to what class the animal belonged; and in answer to the opinion that certain sharks have double fangs, he explained that the widely bifurcate basis supporting the tooth of the shark is no part of the actual tooth, but true bone, and ossified parts of the jaw itself, to which the tooth is anchylosed at one part, and the ligaments of connection attached at the other. The form, depth, and position of the sockets of the teeth in the Thylacothere are precisely similar to those in the small Opossums. The colour of the fossils, Professor Owen said, could be no objection to those acquainted with the diversity in this respect, which obtains in the fossil remains of *Mammalia*. Lastly, with respect to the Thylacothere, the author stated that the only trace of compound structure is a mere vascular groove running along its lower margin, and that a similar structure is present in the corresponding part of the lower jaw of some species of Opossum, of the Wombat, of the *Balæna antarctica*, and of the *Myrmecobius*, though the groove does not reach so far forward in this animal; and that a similar groove is present near the lower margin, but on the outer side of the jaw, in the *Sorex Indicus.*

Phascolotherium, Owen, is another genus of fossil *Marsupiata.* Description of the half jaw of the *Phascolotherium.*—This fossil is a right ramus of the lower jaw, having its internal or mesial surface exposed. It once formed the chief ornament of the private collection of Mr. Broderip, by whom it has since been liberally presented to the British Museum. It was described and figured by Mr. Broderip (1828, with the provisiona name of *Didelphys Bucklandii*) in the 'Zoological Journal,' and its distinction from the *Thylacotherium* clearly pointed out. The condyle of the jaw is entire, standing in bold relief, and presents the same form and degree of convexity as in the genera *Didelphys* and *Dasyurus.* In its being on a level with the molar teeth, it corresponds with the marsupial genera *Dasyurus* and *Thylacynus*, as well as with the placental *Zoophaga.* The general form and proportions of the coronoid process closely resemble those in zoophagous Marsupials; but in the depth and form of the entering notch, between tha process and the condyle, it corresponds most closely with the *Thylacynus.* Judging from the fractured surface of the inwardly reflected angle, that part had an extended oblique base, similar to the inflected angle of the *Thylacynus.* In the *Phascolotherium* the flattened inferior surface of the jaw, external to the fractured inflected angle, inclines outwards at an obtuse angle with the plane of the ascending ramus, and not at an acute angle, as in the *Thylacynus* and *Dasyurus;* but this difference is not one which approximates the fossil in question to any of the placental *Zoophaga;* on the contrary, it is in the marsupial genus *Phascolomys*, where a precisely similar relation of the inferior flattened base to the elevated plate of the ascending ramus of the jaw is manifested. In the position of the dental foramen the Phascolothere, like the Thylacothere, differs from all zoophagous Marsupials and the placental *Feræ;* but in the *Hypsiprymnus* and *Phascolomys*, marsupial herbivora, the orifice of the dental canal is situated, as in the Stonesfield fossils, very near the vertical line dropped from the last molar teeth. The form of the symphysis, in the Phascolothere, cannot be truly determined: but Professor Owen stated his opinion that it resembles the symphysis of the *Didelphys* more than that of the *Dasyurus* or *Thylacynus.*

Professor Owen agrees with Mr. Broderip in assigning four incisors to each ramus of the lower jaw of the Phascolothere, as in the *Didelphys;* but in their scattered arrangement they resemble the incisors of the *Myrmecobius.* In the relative extent of the alveolar ridge occupied by the grinders, and in the proportions of the grinders to each other, especially the small size of the hindermost molar, the Phascolothere resembles the *Myrmecobius* more than it does the *Opossum, Dasyurus,* or *Thylacynus;* but in the form of the crown the molars of tha fossil resemble the *Thylacynus* more closely than any other genus of Marsupials. In the number of the grinders the Phascolothere resembles the *Opossum* and *Thylacinus*, having four true and three false in each maxillary ramus; but the molares veri of the fossil differ from those of the *Opossum* and Thylacothere in wanting a pointed tubercle on the inner side of the middle large tubercle, and in the same transverse line with it, the place being occupied by a ridge which extends along the inner side of the base of the crown of the true molars, and projects a little beyond the anterior and posterior smaller cusps, giving the quinquecuspid appearance to the crown of the tooth. This ridge, which in *Phascolotherium* represents the inner cusps of the true molars in *Didelphys* and *Thylacotherium*, is wanting in *Thylacynus*, in which the true molars are more simple than in the Phascolothere, though hardly less distinguishable from the false molars. In the second true molar of the Phascolothere the internal ridge is also obsolete at the base of the middle cusp, and this tooth presents a close resemblance to the corresponding tooth in the *Thylacinus;* but in the *Thylacinus* the two posterior molars increase in size, while in the Phascolothere they progressively diminish, as in the *Myrmecobius.* As the outer sides of the grinders in the jaw of the Phascolothere are imbedded in the matrix, we cannot be sure that there is not a smaller cuspidated ridge sloping down towards that side, as in the crowns of the teeth of the *Myrmecobius.* But assuming that all the cusps of the teeth of the Phascolothere are exhibited in the fossil, still the crowns of these teeth resemble those of the *Thylacinus* more than they do those of any placental *Insectivora* or *Phoca,* if even the form of the jaw permitted a comparison of it with that of any of the Seal tribe. Connecting then the close resemblance which the molar teeth of the *Phascolotherium* bear to those of the *Thylacynus* with the similarities of the ascending ramus of the jaw, Professor Owen is of opinion that the Stonesfield fossil was nearly allied to *Thylacynus*, and that its position in the marsupial series is between *Thylacynus* and *Didelphys.* With respect to the supposed compound structure of the jaw of the *Phascolotherium*, Professor Owen is of opinion that of the two linear impressions which have been mistaken for harmoniæ, or toothless sutures, one, a faint shallow linear impression continued from between the ante-penultimate and penultimate molars obliquely downwards and backwards to the foramen of the dental artery, is due to the pressure of a small artery, and he stated that he possessed the jaw of a *Didelphys Virginiana* which exhibits a similar groove in the same place. Moreover this groove in the Phascolothere does not occupy the same relative position as any of the costiguous margins of the opercular and dentary pieces of the reptile's jaw. The other impression in the jaw of the *Phascolotherium* is a deep groove continued from the anterior extremity of the fractured base of the inflected angle obliquely downwards to the broken surface of the anterior part of the jaw. Whether this line be due to a vascular impression or an accidental fracture is doubtful; but as the lower jaw of the Wombat presents an impression in the precisely corresponding situation, and which is undoubtedly due to the presence of an artery, Professor Owen conceives that this impression is also natural in the Phascolothere, but equally unconnected with a compound structure of the jaw; for there is not any suture in the compound jaw of a reptile which occupies a corresponding situation.

The most numerous, the most characteristic, and the best-marked sutures in the compound jaws of a reptile are those which define the limits of the coronoid, articular, angular, and surangular pieces, and which are chiefly conspicuous on the inner side of the posterior part of the jaw. Now the corresponding surface of the jaw of the Phascolothere is entire; yet the smallest trace of sutures, or of any indication that the coronoid or articular processes were distinct pieces, cannot be detected; these processes are clearly and indisputably continuous, and confluent with the rest of the ramus of the jaw. So that where sutures ought to be visible, if the jaw of the Phascolothere were composite, there are none; and the hypothetical sutures that are apparent do not agree in position with any of the real sutures of an oviparous compound jaw.

Lastly, with reference to the philosophy of pronouncing judgment on the Saurian nature of the Stonesfield fossils from the appearance of sutures, Professor Owen offered one remark, the justness of which, he said, would be obvious alike to those who were and to those who were not conversant with comparative anatomy. The accumulative evidence of the true nature of the Stonesfield fossils, afforded by the shape of the condyle, coronoid process, angle of the jaw, different kinds of teeth, shape of their crowns, double fangs, implantation in sockets—the appearance, he repeated, presented by these important particulars cannot be due to accident; while those which favour the evidence of the compound structure of the jaw may arise from accidental circumstances. ('Geol. Proc.,' 1838-39, vol. iii.)

Jaw of *Phascolotherium Bucklandii.* Upper figure magnified.

A paper was afterwards read, entitled 'Observations on the Structure and Relations of the presumed Marsupial Remains from the Stonesfield Oolite, by William Ogilby, Esq., F.G.S.'

These observations were intended by the author to embody only the most prominent characters of the fossils, and those essential points of structure in which they are necessarily related to the class of mammifers or of reptiles respectively. For the sake of putting the several points clearly and impartially, he arranged his observations under the two following heads :—

1. The relations of agreement which subsist between the fossils in question and the corresponding bones of recent Marsupials and *Insectivora*.

2. The characters in which the fossils differ from those families. Mr. Ogilby confined his remarks to *Marsupiata* and *Insectivora*, because it is to those families only of Mammifers that the fossils have been considered by anatomists to belong; and to the interior surface of the jaw, as the exterior is not exhibited in any of the fossil specimens.

1. In the general outline of the jaws, more especially in that of the *Didelphys* (*Phascolotherium*) *Bucklandii*, the author stated that there is a very close resemblance to the jaw in recent *Insectivora* and Insectivorous Marsupials; but he observed that with respect to the uniform curvature along the inferior margin, Cuvier has adduced the same structure as distinctive of the Monitors, Iguanas, and other true Saurian Reptiles; so that whatever support these modifications of structure may give to the question respecting the marsupial nature of the Stonesfield fossils, as compared with other groups of Mammals, they do not affect the previous question of their mammiferous nature, as compared with reptiles and fishes. The fossil jaws, Mr. Ogilby said, agree with those of Mammals, and differ from those of all recent reptiles, in not being prolonged backwards behind the articulating condyle; a character, in conjunction with the former relation, which would be, in this author's opinion, well-nigh incontrovertible, if it were absolutely exclusive; but the extinct Saurians, the *Pterodactyles*, *Ichthyosauri*, and *Plesiosauri*, cotemporaries of the Stonesfield fossils, differ from their recent congeners in this respect, and agree with Mammals. Mr. Ogilby is of opinion that the condyle is round both in *Didelphys Prevostii* and *D. Bucklandii*, and is therefore a very strong point in favour of the mammiferous nature of the jaws. The angular process, he said, is distinct in one specimen of *D. Prevostii*, and, though broken off in the other, has left a well-defined impression; but that it agrees in position with the *Insectivora*, and not the *Marsupiata*, being situated in the plane passing through the coronoid process and the ramus of the jaw. In *D. Bucklandii*, he conceived, the process is entirely wanting; but that there is a slight longitudinal ridge partially broken, which might be mistaken for it, though placed at a considerable distance up the jaw, or nearly on a level with the condyle, and not at the inferior angular rim of the jaw. He is therefore of opinion that *D. Bucklandii*, cannot be properly associated either with the Marsupial or Insectivorous Mammals. The composition of the teeth, he conceives, cannot be advanced successfully against the mammiferous nature of the fossils, because animal matter preponderates over mineral in the teeth of the great majority of the Insectivorous *Cheiroptera*, as well as in those of the *Myrmecobius* and other small Marsupials. In the jaw of *D. Prevostii*, Mr. Ogilby cannot perceive any appearance of a dentary canal, the fangs of the teeth, in his opinion, almost reaching the inferior margin of the jaw, and being implanted completely in the bone; but in *D. Bucklandii* he has observed, towards the anterior extremity of the jaw, a hollow space filled with foreign matter, and very like a dentary canal. The double fangs of the teeth of *D. Prevostii*, and probably of *D. Bucklandii*, he said, are strong points of agreement between the fossils and mammifers in general; but that double roots necessarily indicate, not the mammiferous nature of the animal, but the compound form of the crowns of the teeth.

2. With respect to the most prominent characters by which the Stonesfield fossils are distinguished from recent Mammals of the Insectivorous and Marsupial families, Mr. Ogilby mentioned, first, the position of the condyle, which is placed in the fossil jaws in a line rather below the level of the crowns of the teeth; and he stated that the condyle not being elevated above the line in the *Dasyurus Ursinus* and *Thylacinus Harrisii*, is not a valid argument, because those Marsupials are carnivorous. The second point urged by the author against the opinion that the fossils belonged to the Insectivorous or Marsupial Mammifers, is in the nature and arrangement of the teeth. The number of the molars, he conceives, is a secondary consideration; but he is convinced that they cannot be separated in the fossil jaws into true and false, as in *Mammalia;* the great length of the fangs, equal to at least three times the depth of the crowns, he conceives, is a strong objection to the fossils being placed in that class, as it is a character altogether peculiar and unexampled among Mammals; the form of the teeth also, he stated, cannot be justly compared to that of any known species of Marsupial or Insectivorous Mammifer, being, in the author's opinion, simply tricuspid, and without any appearance of interior lobes. As to the canines and incisors, Mr. Ogilby said that the tooth in *Dasyurus Bucklandii*, which has been called a canine, is not larger than some of the presumed incisors, and that all of them are so widely separated as to occupy full five-twelfths of the entire dental line; whilst in the *Dasyurus viverrinus* and other species of Insectivorous Marsupials they occupy one-fifth part of the same space. Their being arranged longitudinally in the same line with the molars, he conceives, is another objection; because, among all Mammals, the incisors occupy the front of the jaw, and stand at right angles to the line of the molars. With respect to the supposed compound structure of the jaw, Mr. Ogilby offered no formal opinion, but contented himself with simply stating the appearances: he nevertheless objected to the grooves being considered the impression of bloodvessels, though he admitted that the form of the jaws is altogether different from that of any known reptile or fish.

From a due consideration of the whole of the evidence, Mr. Ogilby stated, in conclusion, that the fossils present so many important and distinctive characters in common with Mammals on the one hand and cold-blooded animals on the other, that he does not think naturalists are justified at present in pronouncing definitively to which class the fossils really belong. ('Geol. Proc.,' 1838-39, vol. iii.)

On the 9th of January, 1839, Professor Owen proved, in a paper read to the Geological Society, that the so-called *Basilosaurus* of Dr. Harlan, upon which M. De Blainville and the other objectors, thinking it to be a fossil reptile with double-fanged teeth, had relied so strongly as an argument for the non-mammiferous nature of the Stonesfield jaws, is no Saurian at all, but a mammiferous animal forming a most interesting link between the carnivorous and herbivorous *Cetacea;* and in compliance with the suggestion of Dr. Harlan, who, having compared with Professor Owen the microscopic structure of the teeth of the *Basilosaurus* with those of the *Dugong* and other animals, admitted the correctness of the inference of its mammiferous nature, Professor Owen proposed to substitute for the name of *Basilosaurus* that of *Zeuglodon.* [CETACEA.]

Among the fossil remains collected by Sir Thomas Livingstone Mitchell in the Caves of Wellington Valley, Australia, and which are now deposited in the museum of the Geological Society of London, Professor Owen describes the following genera and species :—

Macropus.—M. Atlas, at least one-third larger than the *M. major*, the largest known existing species of Kangaroo, approaching in the great size of its permanent spurious molar to *Hypsiprymnus.*

M. Titan, as large as the preceding, but differing chiefly in the smaller size of the permanent spurious molar, which in this respect more nearly corresponds with the existing *M. major.*

Hypsiprymnus.—An undetermined species, rather larger than any of the three species with whose crania Professor Owen has had the opportunity of comparing them. There is no evidence, according to him, that it agrees with any existing species.

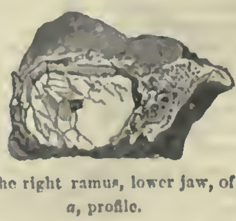
Phalangista.—A species differing from *P. vulpina* in having the spurious molar of relatively smaller size, and the second molar narrower; the symphysis of the lower jaw is also one line deeper in the fossil. Professor Owen states that there is no proof that it corresponds with any existing species; but, he adds, that a comparison of the fossils with the bones of these species (which are much wanted in our osteological collections) is obviously necessary to establish the important fact of the specific difference or otherwise of the extinct Phalanger.

Phascolomys.—P. Mitchellii, a little larger probably than the existing Wombat.

Diprotodon (Owen).—Professor Owen applies this name to the genus of *Mammalia* represented by the anterior extremity of the right ramus of the lower jaw, with a single large procumbent incisor, of which we give a reduced figure below (*a*, *b*). It had been formerly conjectured to belong to the Dugong, but the incisor resembles the corresponding tooth of the Wombat in its enamelled structure and position (*b*), and the section of the Wombat's teeth. It differs however in the quadrilateral figure of its transverse section, in which it corresponds with the inferior incisors of the Hippopotamus.

a

b



Anterior extremity of the right ramus, lower jaw, of *Diprotodon*. Owen. *a*, profile.

Dasyurus.—D. laniarius, closely resembling *Dasyurus Ursinus*, but differing from it in being one-third larger, and in having the canines or laniaries of proportionately larger size. Another specimen leads Professor Owen to doubt whether it is the lower jaw of the *Dasyurus laniarius*, or of some extinct Marsupial Carnivore of an allied but distinct species.

The general result of the examination of the remains found in the

Wellington Valley bone-caves are—1st, that the fossils are not referrible to any known extra-Australian genus of Mammals; 2nd, that the fossils are not referrible, from the present evidence, to any existing species of Australian Mammal; 3rd, that the greater number certainly belong to species either extinct or not yet discovered living in Australia; 4th, that the extinct species of *Macropus*, *Dasyurus*, and *Phascolomys*, especially *Macropus Atlas* and *M. Titan*, are larger than the largest known existing species; 5th, that the remains of the saltatory animals, as the *Macropi* and *Hypsiprymni*, are all of young individuals, while those of the Burrowing Wombat, the Climbing Phalanger, and the Ambulatory Dasyure, are the remains of adults. (Owen, in Mitchell's 'Three Expeditions into the Interior of Eastern Australia,' &c.)

Dr. Buckland observes, that the discovery of the *Marsupiata*, both in the secondary and tertiary formations, shows that this order, so far from being of more recent introduction than other orders of *Mammalia*, is in reality the first and most ancient condition under which animals of this class appeared upon our planet; that, as far as we know, it was their only form during the secondary period; that it was co-existent with many other orders in the early parts of the tertiary period; and that its geographical distribution in the present creation is limited to North and South America, and to Australia, with the adjacent islands. ('Bridgewater Treatise.')

The lower jaw of the *Phascolotherium* presented to the British Museum by Mr. Broderip will be found in the wall-case G of that Institution with the remains of Cavern Bears.

(Waterhouse, *A Natural History of Mammalia*, vol. i.; Dr. J. E. Gray, *British Museum Catalogue;* Owen, *British Fossil Mammals; Proceedings of Geological and Zoological Societies;* Buckland, *Bridgewater Treatise.*)

MARSUPIOCRINI'TES, a genus of *Crinoidea*, proposed by Professor Phillips for some remarkable fossils noticed by Sir Roderick Murchison in the strata of the Silurian system. ('The Silurian System,' pl. 18, fig. 3.) The arms are formed of two rows of calcareous plates. [ENCRINITES.]

MARSUPITES, a fossil genus of *Echinodermata*, established by Miller in his work on the *Crinoidea*. In many respects it resembles the *Crinoidea*, but has no stem. [ENCRINITES.] It belongs to the Chalk.

MARTAGON. [LILIUM.]

MARTEAU. [SQUALIDÆ.]

MARTEN, or MARTIN, the name of a Carnivorous Quadruped (*Mustela Martes*, Linn.), of the Weasel family. [MUSTELIDÆ.]

MARTES. [MUSTELIDÆ.]

MARTIN, the name for some of the Swallow Tribe, as the House Martin (*Hirundo urbica*, Linn.), the Bank or Sand Martin (*Hirundo riparia*), and the Black Martin or Swift. [HIRUNDINIDÆ; SWALLOWS.]

MARTINISITE, a Mineral composed of 91 per cent. of chloride of sodium and 9 per cent. of sulphate of magnesia. It comes from the salines of Hassfurth. (Dana, *Mineralogy.*)

MARYSOLE. [PLEURONECTIDÆ.]

MASARIS (Fabricius), a genus of Hymenopterous Insects, the type of the tribo *Masaridæ*, the first of the third family of the aculeated *Hymenoptera*—the *Diploptera*. [DIPLOPTERA.]

MASCAGNIN, a Mineral, a native Sulphate of Ammonia. It occurs stalactitic, pulverulent, or efflorescent. Colour yellow or grayish. Taste acrid, bitter. Translucent, opaque. Found in the fissures of the earth, and among the lavas of Ætna and Vesuvius, in the Solfatara, and near Sienna in Tuscany.

The following analysis is by Gmelin:—

Sulphuric Acid	53·29
Ammonia	22·80
Water	23·91
	——100

MASSA'RIUM, a provisional generic name of M. De Blainville for *Alcyonium Massa* of Müller.

MASSICOT. [LEAD.]

MASTERWORT, the old name of an Umbelliferous Plant with fleshy tuberous roots, growing in moist meadows and woods in the north of Europe and in Newfoundland. It has a stem from 1 to 2 feet high, broad twice-ternate leaves, flat large umbels of white or pink flowers, and thin orbicular straw-coloured fruit. Botanists calls this plant *Imperatoria Ostruthium;* it has acrid, bitter, somewhat aromatic roots, and formerly had a great reputation as a remedy for toothache, and as a cure for agues, whence no doubt its names have been derived. It retains a place in continental medical practice, but it is disused in England. [IMPERATORIA.]

MASTICH. [PISTACHIA.]

MASTIFF, the name of a variety of dog of a very old English breed, now seldom seen in its original state of purity. Manwood states that the word is derived from 'mase thefese,' because it is supposed to terrify thieves by its voice, which, when the animal is excited, is fearfully deep and loud. This is the Dogue de Forte Race of Buffon and the French, the *Mastivus* of Ray, the *Canis Molossus* of Linnæus, and the *Villaticus* or *Catenarius* of Dr. Caius.

A true-bred Mastiff is of considerable size, and very stoutly built. The head is well developed and large, the lips deep and pendulous on each side of the mouth, and the whole aspect noble.

It appears from Claudian and Gratius that the British dogs, mastiffs probably, were highly prized at Rome; and Camden notices the employment of a special officer, Procurator Cynegii, appointed in Britain for superintending the breed of these dogs and their transmission to that city, where they appeared in the combats of animals at the amphitheatre, and sometimes upon occasions even more cruel, for there can be little doubt that they were set to worry those unhappy Christians whom the tyrants of the time ordered to be sewed up in the skins of beasts and then exposed to the attacks of those powerful and savage dogs. Pennant quotes Strabo for the fact that the Gauls trained British Mastiffs for war, and used them in their battles. According to Dr. Caius, three were a match for a bear and four for a lion; but Stow mentions a lion-fight with three of these dogs, in which, though two were disabled, and afterwards died, the lion was so much harassed that he retreated, and refused to resume the battle.

The Mastiff is capable of great attachment, and when kept as a guard is of unfailing vigilance, giving the alarm by its powerful bark, and never ceasing till it has roused the family or secured the intruder. It is now comparatively little used as a watch-dog, especially in great towns, where an active police has almost entirely superseded it.

Mastiff (*Canis Molossus*).

MASTIGUS (Hoff.), a genus of Insects belonging to the fourth family (*Clavicornes*) of the *Pentamera*.

MA'STODON, the name of an extinct genus of gigantic Pachydermatous Proboscidian Mammals (*Mastotherium*, Fischer), whose remains are found abundantly in the third and fourth, or Pliocene, divisions of the tertiary fresh-water deposits, and also, but less frequently, in the deposits of the second, or Miocene, period.

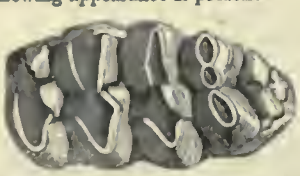
In the greater portion of their organisation the Mastodons must have closely resembled the elephants. [ELEPHANTIDÆ.] The tusks, the proboscis, the general conformation of the body and the limbs were very similar; and the principal distinction between the two genera was formed by the molar teeth. These indeed were gradually pushed forward from behind as they are in the Elephant, and displayed the same relative increase in proportion as the animal was advanced in life; but, unlike those of the Elephant, their crowns exhibited on cutting the gum large conical points of a mammiform structure, whence the animal derives its name. As these conical points were worn down by mastication, the tooth presented discs more or less large, according to the degree of attrition which it had undergone. The following cuts, which are very much reduced in size, as will be understood from what we have already stated, will explain this difference in the tooth more clearly than words. Before the tooth has suffered from detritus it presents the following appearance:—

Molar Tooth of Mastodon, not worn.

And after exposure to a comparatively small degree of detrition it has the aspect represented in the following cut:—

Molar Tooth of Mastodon, slightly worn.

But when from longer use the conical teat-like points are more deeply worn down, the following appearance is presented :—



Molar Tooth of Mastodon, a good deal worn, seen from above.

The way in which these teeth are set in the upper jaw will be seen from the following cut :—

Molar Teeth and Palate of Mastodon.

And the mode in which those of the lower jaw are arranged will be perceived from the figures given below.

Portions of Lower Jaw of Mastodon.

The general contour of the lower jaw as viewed from above may be collected from the following figure.

Portion of Lower Jaw of Mastodon.

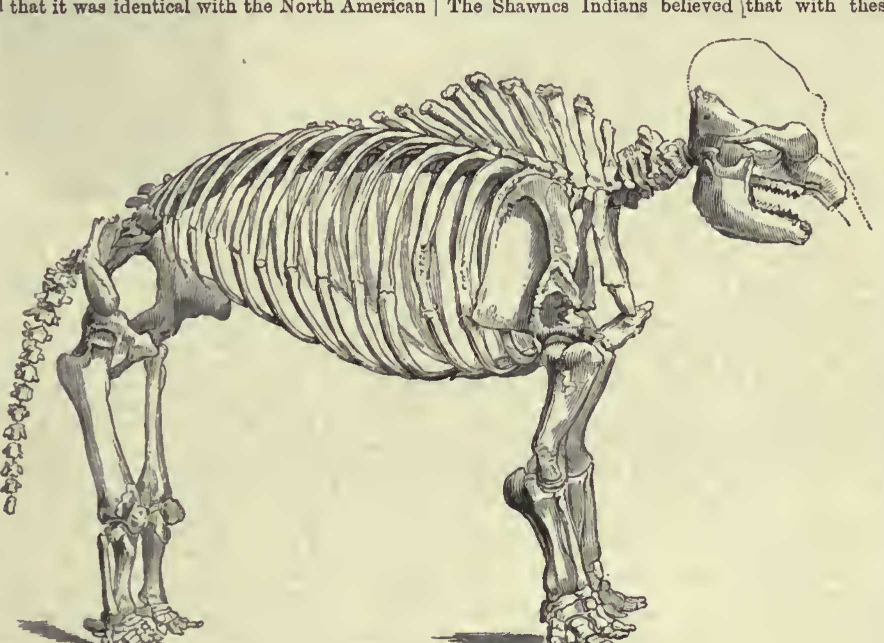
In his 'British Fossil Mammals' Professor Owen makes the following prefatory remarks to his description of these teeth :—

"Naturalists are most familiar with that gigantic type of quadrupeds called, from the peculiar prehensile development of the nose and upper lip 'proboscidian,' as it is manifested by the existing species of Elephants, which have been at different times introduced into Europe from the tropical regions of Asia and Africa; and we have seen in the preceding section that an extinct species of this genus once ranged over the whole of the temperate and part of the arctic zones of the northern hemisphere of the globe, and has left abundant evidence of its former existence in our island. In like manner we learn from the study of fossil remains that other quadrupeds as gigantic as Elephants, armed with two as enormous tusks projecting from the upper jaw, and provided with a proboscis, once trod the earth; the presence of the latter flexible organ being inferred not only by its necessary co-existence with long tusks, which must have prevented the mouth reaching the ground, but also by the configuration of the skull, by the holes which gave passage to large nerves, and by depressions for the attachment of particular muscles analogous to those which relate exclusively to the organisation of the trunk of the Elephant. Like the Elephant also, these other huge proboscidian quadrupeds were destitute of canine teeth, and provided with a small number of large and complex molar teeth successively developed from before backwards in the jaws, with a progressive increase of size and complexity from the first to the last. The broad crowns of the molar teeth are also cleft by transverse fissures; but these clefts were fewer in number, of less depth, and greater width than the Elephants; the transverse ridges were more or less deeply bisected, and the divisions more or less produced in the form of udder-shaped cones, whence the name Mastodon assigned by Cuvier to the great proboscidian quadrupeds of this kind. A more important difference presents itself when the teeth of the typical species of Mastodon are compared with those of the Elephant in reference to their structure. The dentine, or principal substance of the crown of the tooth, is covered by a very thick coat of dense and brittle enamel; a thin coat of cement is continued from the fangs upon the crown of the tooth, but this third substance does not fill up the interspaces of the divisions of the crown, as in the Elephant. Such at least is the character of the molar teeth of the first discovered species of Mastodon, which Cuvier has termed *Mastodon giganteus*, and *M. angustidens*. Fossil remains of proboscidians have subsequently been discovered principally in the tertiary deposits of Asia, in which the number and depth of the clefts of the crown of the molar teeth, and the thickness of the intervening cement, are so much increased as to establish transitional characters between the lamello-tuberculate teeth of the Elephant and the mammillated molars of the typical Mastodon, showing that the characters deducible from the molar teeth are rather the distinguishing marks of species than of genera in the gigantic proboscidian family of mammalian quadrupeds.

"Two dental characters however exist, though hitherto I believe unnoticed as such, which distinguish in a well marked and unequivocal manner the genus *Mastodon* from the genus *Elephas*. The first is the presence of two tusks in the lower jaw of both sexes of the Mastodon, one or both of which are retained in the male, and acquire a sufficiently conspicuous size, though small in proportion to the upper tusks; while both are early shed in the female. The second character is equally decisive; it is the displacement of the first and second molars in the vertical direction, by a tooth of a simpler form than the second, developed above the deciduous teeth in the upper jaw, and below them in the under jaw. These two dental characters, which are of greater importance than many accepted by modern zoologists as sufficient demarcations of existing generic groups of *Mammalia*, have been recognised in the species called *Mastodon giganteus*, most common in North America, and in the *Mastodon angustidens*, which is the prevailing species of Europe.

"To the last named species I refer the comparatively few remains of the Mastodon that have been discovered in England, and hitherto exclusively in these deposits, consisting of sand, shingle, loam, and laminated clay, containing an intermixture of the shells of terrestrial, fresh-water, and marine *Mollusca*, which extend along the coast of Suffolk and Norfolk, and have been so admirably described by Mr. Lyell under the name of the Fluvio-Marine Crag, and referred to the Older Pliocene division of his tertiary system."

The remains of the Great Mastodon (*Mastodon giganteus*, Cuvier), appear to have been the first that attracted attention. These occurred in considerable abundance in North America. They gave rise to much speculation and much erroneous opinion at first; for though the form and size of the molar teeth forbade the inference that they could have belonged to any of the large existing animals, the formidable appearance of the pointed conical tuberosities of the crowns led to conclusions directly the reverse of truth, as we shall presently see. Daubenton, indeed, at first thought that some of these teeth belonged to the Hippopotamus, but he soon perceived that they must have formed part of an animal which had no recent analogue, and Buffon announced that the whole evidence afforded by the remains led to the belief that this ancient species, which ought to be regarded as the first and the largest of terrestrial animals, existed only in the first ages of the world (n'a subsisté que dans les premiers temps), and never had come down to our time. This opinion of Buffon did not extend beyond the larger molar teeth, and he still regarded the middling-sized and worn teeth as those of the Hippopotamus; he also followed Daubenton in considering the femur found with the teeth as that of an elephant, though Dr. (William) Hunter had pointed out the differences between it and the same bone in the elephant, as well as the distinctions existing in the teeth and lower jaw. ('Phil. Trans.,' vol. lviii.). But while William Hunter did this good service, he introduced no small confusion and error. He had heard of the Siberian Mammoth, and not having seen the bones of that animal, he immediately concluded that it was identical with the North American fossil, and gave the name to the latter, a nomenclature which was for some time adhered to both by the Anglo-Americans and the English. The skeleton of the Great Mastodon was exhibited at London and Bristol as the Mammoth, and accounts of it under the same name were published in London in 1802 and 1803. Nor was this the only error of which William Hunter was the parent, for notwithstanding the rejection of such an opinion by Camper, the former declared that, from the structure of the teeth, the Mammoth, as he termed it, was carnivorous; and men, ever prone to catch at the wild and wonderful, greedily adopted this marvellous view, and named the gigantic beast the Carnivorous Elephant. We well remember in our early youth hearing the speculations of some as to the sort of prey on which the monster lived, and as to the great services that its enormous tusks, which in the skeleton above noticed were placed in an inverted position, with the curvature downwards, must have rendered when the animal was on its predatory excursions. The confusion created by the application of the same name *Mammoth* to two different genera was great, and for a long time almost inextricable, notwithstanding the endeavours of Pallas, who clearly refuted the supposed identity of the Siberian and American animals, by showing that the Siberian Mammoth is a true elephant. Cuvier at once dissipated the clouds that had gathered over the subject, and while he clearly pointed out the osteological differences between the two genera, gave to the supposed Mammoth of America the appropriate name of Mastodon (Μαστὸς, a teat; ὀδοὺς, a tooth).



Skeleton of *Mastodon giganteus*.

The first notice of the teeth and bones of this extinct genus of Pachyderms appears to be in 'Phil. Trans.' (vol. xxix., 1714), a century and a quarter ago; and it is not uninstructive to observe what rapid strides natural science has made since that time, when the Royal Society of London published in their 'Transactions' Dr. Mather's letter to Dr. Woodward, in which the former gives an account of a large work in manuscript in two vols. folio, but does not name the author. Dr. Mather recommends this work, which appears to have been a commentary on the Bible, with large philosophical remarks, "to the patronage of some generous Mecænas, to promote the publication of it," and transcribes, as a specimen, a passage announcing the discovery, in 1705, of enormous bones and teeth at Albany in New England, as the bones of a giant, appealing to them as a confirmation of the text in Genesis (vi. 4); another example, if any were wanting, of the folly and danger of mixing up religious questions with scientific inquiries. Portions of remains were sent to France and England at different intervals, and elicited the observations of European zoologists, whilst in America materials were collected for forming two complete skeletons by the zealous industry of Mr. Peale.

Of these two skeletons one was placed in the museum of Mr. Charles Wilson Peale in Philadelphia, and the other was exhibited in London and Bristol by his son Mr. Rembrandt Peale, who published two accounts of it under the name of the Mammoth above alluded to.

One of the principal deposits of Mastodon bones appears to have been the Big-Bone Lick in the north part of Kentucky, near the Ohio, whence the Mastodon has been called 'the animal of the Ohio.' None of the remains have the appearance of having been rolled, but seem to have been unmoved since the death of the animal; and it is worthy of remark that those which were found at the river of the Great Osages, which runs into the Missouri a little above its confluence with the Mississippi, were in a vertical position, as if the animals had been bogged or buried in the mud. [MEGATHERIIDÆ.]

The traditions which were rife among the Red Men concerning this gigantic form and its destruction must not be passed over in silence. M. Fabri, a French officer, informed Buffon that the savages regarded these bones scattered in various parts of Canada and Louisiana as belonging to an animal which they named the Père aux Bœufs. The Shawnee Indians believed that with these enormous animals there existed men of proportionate development, and that the Great Being destroyed both with thunderbolts. Those of Virginia state that as a troop of these terrible quadrupeds were destroying the deer, the bisons, and the other animals created for the use of the Indians, the Great Man slew them all with his thunder, except the Big Bull, who, nothing daunted, presented his enormous forehead to the bolts, and shook them off as they fell, till, being at last wounded in the side, he fled towards the great lakes, where he is to this day.

Buffon seems to have been the first who noticed the occurrence of these teeth in the Old World, and figures one alleged to have been found in Little Tartary, and given to him by the Comte de Vergennes. This is very large, having from eight to ten points, and weighing 11 lbs. 4 ozs. He also figures another from the museum of the Abbé Chappe, said to have been brought from Siberia. Pallas announces another instance; and gives a figure of one from the Ural Mountains. Cuvier states that he for a long time thought that his *Mastodon giganteus* inhabited the Old Continent as well as America, but he confesses his doubts as to this point. The Abbé Chappe, he remarks, had been in California, and there is no certain evidence that he brought back his Mastodon tooth from Siberia. The tooth figured by Pallas, he thinks, may perhaps have belonged to *M. angustidens*, and he asks, who shall assure us that the Comte de Vergennes was not in error as to the locality of the great molar presented by him to Buffon, and which, together with that formerly in the cabinet of the Abbé Chappe, is in the Paris Museum? Cuvier sums up by saying that he does not entirely pretend to invalidate these three proofs, but that he begins no longer to regard them as sufficient.

The following species have been named:—*Mastodon giganteus*, *M. angustidens* (Europe, America?), *M. Andium* (Andes), *M. Humboldtii* (Concepçion—Chili), *M. minutus*, *M. Tapiroides*, *M. Turicensis*, *M. Avernensis* (Epplesheim, Puy de Dôme), *M. elephantoides* (Irawaddi, Sewalik Mountains), *M. latidens* (Irawaddi, Sewalik Mountains), and *M. longirostris*, Kaup. Professor Owen has referred the teeth from the Norfolk Crag to the last-named species.

Remains of the Mastodon were found by Captain Cautley in the Sewalik Mountains; and in assigning an age to the formation, the Captain adopts the views of Dr. Falconer, who considers the deposit to be synchronous with that from which Mr. Crawfurd obtained the remains near Prome, on the banks of the Irawaddi. Captain Cautley having found jaws in which the front teeth are not to be distinguished from the teeth of *M. latidens*, and those in the rear from the teeth of *M. elephantoides*, he conceives that the distinction which was established on detached teeth will be found to be erroneous.

The genus *Tetracaulodon* of Godmann is, according to the best authorities, the young of the Great Mastodon—*M. giganteus*. One species only, *Tetracaulodon Mastodontoideum* (Godmann), is recorded. (Harlan, 'Bull. des Sc. Nat. et de Géol.,' 1830.)

We subjoin Professor Owen's remarks on the comparative age of the various species of Mastodon :—

"From the age assigned to the fluvio-marine crag, and to some of the continental formations from which remains of the *Mastodon angustidens* have been obtained, it would seem that this species preceded the Mammoth in Europe, and was of older date than the *Mastodon giganteus* of North America. No remains of the *Elephas primigenius* at least have hitherto been discovered in the Miocene or older Pliocene strata at Eppelsheim, which have yielded the most complete specimens hitherto recovered of the bony framework and dentition of the *Mastodon angustidens;* and not a fragment of a bone or tooth of the Mastodon has yet been found in these new pliocene and post-tertiary deposits of England, which are so rich in remains of the Mammoth.

"In other parts of the world the genus Mastodon, under different specific forms from our European *Mastodon angustidens*, has continued to be represented during a later epoch, and to have been contemporaneous with the Mammoth, or other extinct species of Elephant. In certain localities in North America famous for remains of the *Mastodon giganteus*, as Big-Bone Lick, the Mammoths bear to the Mastodons a proportion of one to five. A species of Mastodon nearly allied to the *Mastodon angustidens* by the form of the molar teeth, is associated with the Elephantoid Mastodon, and with a true species of *Elephas* in the tertiary formations of the Sub-Himalayan range. Another species of Mastodon, also nearly allied to *Mastodon angustidens*, if we may judge from the configuration of a molar tooth, has left its remains in the ossiferous caves and post-tertiary or newer tertiary deposits of Australia. From the conformity of the molar teeth, Cuvier regarded a Mastodon whose remains have been discovered in Peru, as identical in species with the *Mastodon angustidens* of Europe.

"We may therefore conclude that the gigantic proboscidian modification of the Mammalian type was first manifested on our planet under the generic form of the Mastodon, and with teeth which differed less from those of the older tapiroid Pachyderms than do the grinders of the true Elephants.

"No genus of quadrupeds have been more extensively diffused over the globe than the Mastodon. From the tropics it has extended both south and north into temperate latitudes; and in America remains of the Mastodon have been discovered on the western coast as high as the 66th degree of north latitude. But the metropolis of the *Mastodon giganteus* in the United States, like that of the *Mastodon angustidens* of Europe, lies in a more temperate zone; and we have no evidence that any species was specially adapted, like the Mammoth, for braving the rigours of an arctic winter.

"The Mastodon unquestionably possessed a long proboscis, the chief office of which in the Elephant is to seize and break off the boughs of trees for food. There is nothing in the ascertained organisation of the Mastodon to lead us to doubt that such was also the principal function of the trunk in that genus. Cuvier however was of opinion that the Mastodon applied its teeth, as the Hippopotamus and Hog do, to the mastication of the tender vegetables, roots, and aquatic plants. But the large eminences of the grinding teeth, the unusual thickness of the enamel, and the almost entire absence of the softer cement from the grinding surface of the crown, would rather indicate that they had been instruments for crushing harder and coarser substances than those for the mastication of which the more complex but weaker grinders of the Elephants are adapted. It has been conjectured that the Mastodons were more aquatic, or swamp-hunting, quadrupeds than the Elephants; their limbs were however proportionally shorter, although constructed on the same type, each foot being terminated by five short and stout toes, which were evidently, by the form of the last phalanx, confined in one common thick hoof. The leg-bones are stronger in proportion than those of the Elephant, the cranium is flatter, and, from the smaller development of the frontal air-cells, it presents a less intelligent character. The almost complete skeleton of the *Mastodon giganteus*, so well known to the public as the 'Missouri Leviathan,' when exhibited, with a most grotesquely-distorted and exaggerated collocation of the bones, in 1842 and 1843, in the Egyptian Hall, Piccadilly, is now mounted in strict accordance with its natural proportions in the British Museum."

MASTODONSAURUS, Dr. Jæger's name for an extinct Saurian Reptile found in the Alaunschiefer, or Alum-Slate (Würtemberg), founded upon teeth, the largest of which, with part of the stone adhering, is figured on the next column, one-half of the size of the original. The other teeth were considerably smaller.

Dr. Jæger is of opinion that these teeth must be held to approach the nearest to those of the animals belonging to some of the species of *Monitor*. The *Mastodonsaurus*, from the length of its teeth, may be said, in his opinion, to have equalled the *Mososaurus* of Maastricht in size; but in the formation of the teeth the former differs from the latter. The small teeth, he observes, agree so much in every respect with the large one, that their difference in size is only to be ascribed to their having belonged to animals of a different age, but not of a different genus, and also to their having occupied different places in the jaw.

Tooth of *Mastodonsaurus*.

(Dr. Jæger's memoir, *Ueber die Fossile Reptilien welche in Würtemberg aufgefunden worden sind*, Stuttgart, 1828.)

MATACO. [ARMADILLO.]

MATAGASSE. [LANIADÆ.]

MATAMATA. [CHELONIA.]

MATHI'OLA, a genus of Plants belonging to the natural order *Brassicaceæ*, having tapering pods, converging stigmas thickened at the back, a calyx with two saccate sepals, and compressed seeds arranged in a single row and surrounded by a thin membranous border. It consists of annual and perennial herbaceous plants inhabiting the warm countries bordering the Mediterranean, and extending eastward into Persia and some of the southern Asiatic provinces of Russia. Between 30 and 40 species are known to botanists, among which are those which form the Stocks and Gilliflowers of gardens, sweet-scented biennials much valued for the beauty and variety of their many-coloured flowers. The principal source of these has been *Mathiola incana*, to which are to be assigned the hoary-leaved, or Ten-Week Stocks, Brompton, and Queen's; and *M. glabrata*, which comprehends the smooth-leaved, or green Wallflower-Leaved Stocks: it is however probable that the numerous varieties now common in gardens under the name of German and Russian Stocks have been procured, at least in part, by muling the former species with some of the sad-coloured species of the genus. The latter are called *Luperias* by De Candolle, and are remarkable for their dingy flowers, which are exceedingly fragrant at night, but at no other time. *M. livida*, *M. tristis*, and *L. odoratissima*, are the best known of them, and are frequently cultivated in greenhouses.

MATICO. [PIPER.]

MATRICA'RIA, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Corymbiferæ*, the tribe *Senecionideæ*, and the section *Anthemideæ*. It has a nearly flat involucre, with an elongated conical receptacle: the fruit angular, not winged; the pappus is either absent, or in its place there is a slight membranous border.

M. Chamomilla, Wild Chamomile, has bipinnate smooth leaves, capillary simple or divided segments, solitary heads of flowers, and a hollow receptacle. This plant is common throughout Europe, on dung-hills, in cultivated ground, and on way-sides and waste places. It was formerly used as a medicine, but its place has been taken by the Common Chamomile and other plants of the same order. It is the 'Ανθεμίς of Dioscorides, lib. 3, cap. 144.

The *Pyrethrum Parthenium*, Fever-Few, is by some botanists referred to *Matricaria*. This plant appears to be the 'Ανθέμιον of Theophrastus, 'Hist. Plant.' lib. 14, cap. 7; and the Παρθένιον of Dioscorides, lib. 3, cap. 135; and of Plutarch ('Sulla,' cap. 13). Other plants, as species of *Parietaria*, *Chrysocoma*, &c., were called Παρθένιον by the Greek writers. [PYRETHRUM.]

(Babington, *Manual of British Botany;* Fraas; *Synopsis.*)

MATU'TA, the name of a genus of Brachyurous *Crustacea*. [OXYSTOMÆ.]

MAVIA, a genus of Plants belonging to the natural order *Leguminosæ*.

M. judicalis of Bertoloni is the Mavi of the Kaffirs, and yields a poisonous bark used by them as a test in judicial trials.

MAYACACEÆ, *Mayacs*, a natural order of Endogenous moss-like Plants, creeping over damp places, with narrow leaves, resembling Spider-Worts, but differing in their 1-celled anthers, carpels opposite the inner divisions of the perianth, 1-celled ovary and capsule, and parietal placentas. The species, four in number, are natives of North America. They are of no known use. (Balfour, *Class-Book of Botany.*)

MAY-FLY, the popular name of the Neuropterous Insects of the genus *Ephemera* and its allies. [EPHEMERA.] *Baetis* is one of the genera of *Ephemera*. The *Baetis venosa*, an insect inhabiting a great part of Europe, is the type.

MAY-WEED. [ANTHEMIS.]

MAZAMA. [ANTILOPEÆ.]

MEADOW-SAFFRON. [COLCHICUM.]

MEALY-BUG. [COCCIDÆ.]

MEANDRINA. [MADREPHYLLIŒA.]

MEAT-FLY. [MUSCA.]

MECINUS. [CIONUS.]

MECISTINA. [PARUS.]

MECISTOPS. [CROCODILIDÆ.]

MECONO'PSIS (from μήκων, a poppy, and ὄψις, a resemblance), a genus of Plants belonging to the natural order *Papaveraceæ*, and formerly referred to *Papaver*. This genus stands between *Papaver* and *Argemone*. It has 4 petals, numerous stamens, a short style, 5-6-radiating free stigmas, the capsule obovate, opening by pores beneath the apex.

There is but one species, *M. Cambrica*, the Welsh Poppy, a native of Great Britain, a rare plant. It is also fonnd in many parts of Europe. It has yellow flowers which are very fugacious, and are seated on long peduncles which are inflexed before the opening of the flower, so that the flower-bud is drooping. It is an ornamental plant, and may be introduced into tho garden. It will grow in a rich light soil, in a shady situation. It may be propagated by dividing the roots, or by seeds.

M. Nepalensis, a Nepaul plant, is described as being extremely poisonous, especially its roots.

MEDICA'GO (from Μηδική, the Greek name of one of the species), a genus of Plants belonging to the natural order *Leguminosæ*, to the tribe *Loteæ*, and the sub-tribo *Trifolieæ*. It has the calyx somowhat cylindrical, 5-cleft, the keel rather removed from the vexillum; the stamens diadelphous; the legume many-seeded, of various forms, reniform, falcate, or cochleate, but usually twisted in a spiral manner. The species are herbs or shrubs, with the stipules usually cut; the leaves trifoliate, the leaflet usually toothed, and the peduncles 1-2-many flowered. They are exceedingly numerous, upwards of 80 species having been described.

M. sativa, Lucern, has many-flowered racemes; the pods compressed, spiral, with two or three turns, downy, unarmed; the pedicels shorter than the calyx or bract; the leaflets obovate, oblong, dentate above, emarginate. This plant is a native of Europe, and is found wild in England and Scotland. It has an erect stem, with yellow or violet flowers. It is commonly cultivated in the fields of Europe, and Babington says that "the wild specimens found are scarcely naturalised." This is the Μηδική of Theophrastus, 'Plant. de Caus.,' lib. 2, cap. 20; and the *Medica* of Pliny, lib. 18, cap. 20.

M. falcata has the racemes many-flowered, the pods compressed, sickle-shaped, downy, unarmed; the pedicels shorter than the calyx, longer than the bract; the leaflets obovate-oblong, dentate above, emarginate, mucronate. It is a native of Europe on dry mountainous pastures. In England it is a rare plant, but is occasionally found on dry gravelly banks and old walls. This species is said to be the Lucern which is cultivated in Switzerland.

M. Lupulina, Black Medick, or Black Nonsuch, has many-flowered dense oval spikes; the pods compressed, kidney-shaped, with a spiral point rugged with longitudinal branched prominent veins; the stipules obliquely ovate, slightly toothed; the leaflets roundish-obovate, denticulate above, emarginate, mucronate. It has a procumbent stem with yellow flowers, and is a native of Europe in meadows, pastures, and waste ground, and is plentiful in Great Britain. It affords excellent fodder for sheep, and must be treated in the samo way as Lucern.

M. arborea, Tree Medick, is a villous shrubby plant; it has obovate-cordate leaflets nearly entire; tho stipules linear, acute, entire; the peduncles racemose; the legumes stipitate, twisted, reticulated from transverse veins; 2-3-seeded, the seeds somewhat kidney-shaped. This plant is a native of the south of Europe, and appears to be the Κύτισος of Theophrastus, 'Hist. Plant.,' lib. 4, cap. 5; lib. 1, cap. 9; 'De Caus. Plant.,' lib. 5, cap. 6; and the Κύτισος of Dioscorides, lib. 4, cap. 113. It is also the *Cytisus* of the Romans: Pliny, lib. 13, cap. 24; Virgil, 'Ecl.,' i. 79; 'Georg.,' ii. 431.

Besides the first three species described above, *M. sylvestris*, *M. maculata*, *M. minima*, and *M. denticulata* are natives of Great Britain. *M. muricata* was at one time admitted into the British Flora as growing on the sea-shore at Orford in Suffolk; Mr. Babington, in his 'Manual,' states that he is "convinced, from personal observation, that no such plant now exists in that locality."

In cultivation the species may be easily raised from seed, and the shrubby species propagated by cuttings. The perennial herbaceous species may be propagated by dividing their roots.

(Babington, *Manual Brit. Bot.*; Fraas, *Synopsis Plantarum Floræ Classicæ.*)

MEDICK. [MEDICAGO.]

MEDJIDITE, a Mineral consisting of Sulphate of Uranium and Lime. It is of a dark-amber colour, and found near Adrianople in Turkey.

MEDULLA OBLONGATA. [BRAIN.]

MEDULLA SPINALIS. [NERVOUS SYSTEM.]

MEDULLIN, a name given to the Pith of the Sunflower, &c.

MEDU'SA. [ACALEPHÆ.]

MEERSCHAUM, a Mineral belonging to the series of Silicates of Magnesia. It is dull-white, opaque, and earthy, nearly like clay. Its hardness is 2·0, and specific gravity 2·6 to 3·4. A variety from Anatolia, analysed by Thomson, gave—

Silica	42·0
Magnesia	30·5
Water	23·0
Lime	2·3
Alumina	2·0
	99·8

When heated it gives out water and a fetid smell, and becomes hard and perfectly white. When first dug up it has a greasy feel, like soap, and on this account is used by the Tartars in washing their linen. It is known in Europe from its being made use of in Turkey to make the bowls of tobacco-pipes, which are hence called meerschaums. These pipes are first imported into Germany, where they are softened in tallow and wax, and then polished.

Aphrodite and *Quincite* appear to be varieties.

(Dana, *Mineralogy.*)

MEGACEROS. [CERVIDÆ.]

MEGADERMA. [CHEIROPTERA.]

MEGADESMA, a name given by Bowdich to a genus of Fresh-Water *Conchifera* (*Potamophila* of Sowerby, *Galathea*, Lam.).

MEGÆRA. [CROTALIDÆ.]

MEGALI'CHTHYS, a genus of fossil Ganoid Fishes, from the Carboniferous Strata of Edinburgh, Glasgow, Leeds, Manchester, Wigan, &c.

The *Megalichthys* is one of those genera which may rank amongst the singular links connecting two great natural divisions, which are apparently so strongly marked, and separated from one another so widely, as to offer scarcely any points of resemblance. It combines with many of the characters of a true fish many close and striking analogies with reptiles; and the teeth more especially so closely resemble those of some crocodilean animals, that when first discovered they were immediately referred to that class; and not only the teeth but the scales also seemed to Dr. Hibbert (by whom they were first noticed) to indicate the same affinity.

There exists however a family of Ganoid Fishes, containing many extinct genera, represented in those existing by two genera, which together include seven species, in which the peculiar Sauroid character of the teeth indicates this approach to the reptiles, which seems carried to its height in the genus now under consideration. The dimensions of the teeth of the *Megalichthys* far exceed those of any other fishes teeth that have yet been examined, one of them having been found to measure nearly four inches in length, with a breadth at the base of nearly two inches. They are however of two kinds, the large teeth being accompanied by several very small ones, alternating with them, and distributed over the whole of the inside of the mouth. The teeth are conical, and possess a conical hollow at the base, in which the next tooth is prepared, so that there may be a constant succession as in reptiles.

The scales of the *Megalichthys* are of various forms, and exhibit a coating of enamel of a nut-brown colour, and of the most brilliant lustre. They are generally angular, and the surface is punctured like that of the dermal scutes of the recent crocodile. Besides however the angular scales, others have been found rounded, and of large size, having externally a lamellar structure, and not exhibiting the shining enamel so characteristic of the scales of Ganoid Fishes. The rounded scales have been found as much as five inches in diameter.

(Ansted, *Principles of Geology*; Agassiz, *Recherches sur les Poissons Fossiles.*)

MEGALOCHILUS. [DRACONINA.]

MEGA'LODON, Goldfuss, a genus of Fossil *Conchifera* from the Devonian Strata.

MEGALONYX. [MEGATHERIIDÆ.]

MEGALO'PA (Leach), a genus of Macrurous *Crustacea* (*Macropa* of Latreille).

The external antennæ are setaceous, hardly one-fourth so long as the carapace, and formed of elongated joints; the intermediate ones terminated by two bristle-like appendages, the upper of which is the longest. External jaw-feet, with the two first joints compressed, the second the shortest, and notched at the end for the insertion of the others; anterior feet equal, in form of didactylous pincers, rather short and stout; four last pair rather shorter, less stout, and terminated by a single nail, which is a little curved; carapace short, wide, and a little depressed, terminated in front by a pointed rostrum, which is wide at the base, and sometimes inflected; eyes very large, supported on a very short peduncle; abdomen narrow, extended, linear, composed of seven joints, of which the five intermediate ones are provided with appendages, namely, the four first with false feet, having their external division very large and ciliated, and the fifth, on each side, with a horizontal blade or lamina, which is oval and ciliated, composing, with the last joint, a sort of fin, differing a little from that of the other *Macrura*.

M. mutica differs from the other species in having the rostrum a little inflected perpendicularly on the carapace and canaliculated in the middle; also in the absence of a recurved spine on the haunches of all the feet. The shell is truncated posteriorly, and has no point like that of *M. armata*. Colour brownish.

It was found by Messrs. Audouin and Adolphe Brongniart at the mouth of the Loire.

Megalopa mutica.

a, magnified; *b*, internal antenna; *c*, external antenna; *d*, natural size.

MEGALOPHUS. [MUSCICAPIDÆ.]

MEGALOSA'URUS, the name assigned by Dr. Buckland and the Rev. W. Conybeare to an extinct genus of Saurians found in the Oolitic Slate at Stonesfield, near Woodstock, and other localities.

Though no entire skeleton has yet been discovered, the number of bones and teeth collected give sufficient data to enable the observer to pronounce upon the general osseous structure, with almost as great a certainty as would be the result of the examination of the bones of the animal in a perfect and connected state.

The femur, or thigh-bone, and tibia, or leg-bone, are nearly three feet in length severally, so that the entire hind-leg must have been nearly two yards long, and the discovery of a metatarsal bone measuring 13 inches indicates that the foot was of a corresponding length. From these and other remains, including the vertebræ, teeth, &c., the size of this gigantic saurian has been calculated and its habits ascertained.

"The most important part of the *Megalosaurus* yet found," observes Dr. Buckland, in his 'Bridgewater Treatise,' "consists of a fragment of the lower jaw, containing many teeth."

Anterior extremity of right lower jaw of *Megalosaurus*, from Stonesfield, one-fourth natural size.

a, view of the inside; *b*, view of the outside. Buckland.

"The form of this jaw shows that the head was terminated by a straight and narrow snout, compressed laterally like that of the *Delphinus Gangeticus*."

The structure of these teeth [FELIDÆ] leaves no doubt as to the carnivorous habits of this immense extinct lizard; and the internal structure of the cylindrical and other bones shows that is was a terrestrial animal, though it may have occasionally taken to the water in pursuit of prey, such as *Plesiosauri* and fishes. Its ordinary food is supposed to have been the smaller reptiles, crocodiles, and tortoises, whose remains occur abundantly in the strata where those of *Megalosaurus* abound.

The form of the teeth too exhibits a combination of mechanical contrivances extremely remarkable; and there is a provision for a constant succession of new teeth to supply the loss of the old ones. For this purpose the new teeth are formed in distinct cavities by the side of the old ones, and towards the interior surface of the jaw; so that each as it grew gradually pushed away the one previously existing there, expelling it by the usual process of absorption, and insinuating itself into the cavity thus left vacant. When young, and first protruding above the gum, the apex of the tooth presented a double cutting edge of serrated enamel; but as it advanced in growth its direction was turned backwards in the form of a pruning-knife, and the enamelled sawing edge was continued downwards to the base of the inner and cutting side, but became thicker on the other side, obtaining additional strength when it was no longer needed as a cutting instrument.

Tooth of *Megalosaurus*, two-thirds natural size. The dotted lines indicate the compressed conical cavity, containing pulp, within the root of the growing tooth.

a, transverse section of the same, showing the manner in which the back and sides are enlarged, and rounded in order to give strength, and the front is brought to a strong and thin cutting edge.

The vertebræ of the *Megalosaurus* indicate a more decided departure from the Lacertian type than the mode of dentition; but by far the most remarkable difference occurs in the group of five of these bones, which anchylosed together form the sacrum, and which are so characteristic of the Land Saurians. Up to the time indeed that these bones were discovered, there had been no instance recorded of any reptilian animal possessing more than two sacral vertebræ; and when first the megalosaurian remains were described by Dr. Buckland, three of the five were referred to by him as belonging either to the lumbar or caudal series. The whole five however properly belong to the sacrum, and they were so contrived as to give an amount of strength and resisting power that must have corresponded to enormous muscular energy and weight; and, as if to give them every possible advantage of position, they are not anchylosed in a straight line, but in a gentle curve, forming an arch, and therefore still better able to support the weight pressing upon them. All the bones of the extremities are exceedingly large compared with the same parts in existing Saurians; and the cylindrical ones are hollow, like those of land animals. The thigh-bone and the tibia each measure nearly three feet in length; and thus the contour of the hinder part of the body, raised high above the ground, must have been totally unlike that of any existing crocodilean; and the large share in the support of the trunk assigned to the hinder legs of the *Megalosaurus* probably made it necessary in that genus, as in the heavy land quadrupeds, that a greater proportion of the spine should be permanently and solidly fastened together, in order to transfer the weight through the bones of the pelvis to the legs.

The existence of the bones of the foot measuring 13 inches long, is also a sufficient proof that a proportionately large base was prepared for the immense column which the leg would form. Several bones of the anterior extremity have also been referred—some of them not without doubt—to this singular genus; and its dimensions have been calculated rather with reference to these than to the general anatomy of the animal.

This mode of calculation has however been objected to by Professor Owen, and with great reason; for it is in the highest degree improbable, that in an animal raised six or eight feet from the ground there should be a tail as long in proportion to the body as that of existing lizards. To obtain a correct idea of the probable dimensions it is certainly safest to calculate by the length of the vertebræ and their probable number, and in that way we shall arrive at the conclusion that the body may have attained a length of 12 feet; and that assuming it had as many vertebræ as the crocodile, which is perhaps hardly likely, the tail might also have been 12 or 14 feet long; while comparing the proportions of the bones of the head with those of the Java monster, the nearest analogue, we shall have an additional 5 feet, making in all nearly 30 feet; and this measurement is more likely to err on the side of excess than of curtailment.

Even however when we have thus halved the length originally assigned, we shall find that in attempting to picture to ourselves this strange animal we must draw largely on the imagination. From the size and form of its ribs, the trunk appears to have been broader and deeper than in modern Saurians; and this monstrous trunk was elevated on legs of unusual length and massive proportions, being raised to a height of several feet from the ground. The long narrow snout and powerful dental apparatus, well adapted to the carnivorous habits of the animal, would render it an object of terror as well as of astonishment; and it is difficult for us to appreciate the amount of change that has taken place, since a portion of the spot now called England was an island peopled by such reptiles, whose rivers and marshes were crowded with the aquatic crocodilians just described, and which was surrounded by an ocean in which the *Ichthyosaurus*, the *Plesiosaurus*, and the *Ceteosaurus* formed a group of predatory animals never surpassed in fierceness, strength, and voracity. (Ansted.)

Dr. Buckland says, speaking of the remains of this animal:—"Although the known parts of the skeleton are at present very limited, they are yet sufficient to determine the place of the animal in the zoological system. Whilst the vertebral column and extremities much resemble those of quadrupeds, the teeth show the creature to have been oviparous, and to have belonged to the oder of Saurians, or Lizards. The largest thigh-bone of this animal in the museum at Oxford is 2 feet 9 inches long, and nearly 10 inches in circumference at its central or smallest part. From these dimensions, as compared with the ordinary standard of the Lizard family, a length exceeding 40 feet and a bulk equal to that of an elephant 7 feet high have been assigned by Cuvier to the individual to which this bone belonged; and although we cannot safely attribute exactly the same proportions to recent and extinct species, yet we may with certainty ascribe to it a magnitude very far exceeding that of any living lacerta. Large as are the proportions of this individual, they fall very short of those which we cannot but deduce from the thigh-bone of another of the same species, which has been discovered in the ferruginous sandstone of Tilgate Forest, near Cuckfield, in Sussex, and is preserved in the valuable collection of Dr. Mantell, now in the British Museum, together with many other bones belonging to the same species, and of the same size with those from Stonesfield. The femur in question, which has lost its head and lower extremity, measures in its smallest part, at the distance of two feet from its extremity, more than twenty inches in circumference, and therefore, when entire, must have equalled in magnitude the femur of the largest living elephant. To judge from the dimensions of this thigh-bone, its former possessor must have been twice as great as that to which the similar bone in the Oxford Museum belonged; and, if the total length and height of animals were in proportion to the linear dimensions of their extremities, the beast in question would have equalled in height our largest elephants, and in length fallen but little short of the largest whales; but as the longitudinal growth of animals is not in so high a ratio, after making some deduction, we may calculate the length of this reptile from Cuckfield at from 60 to 70 feet."

In Cuvier's opinion *Megalosaurus* partook of the structure of the Crocodile and the Monitor. (Mantell, 'Geology of Sussex'; Cuvier, 'Ossemens Fossiles,' and 'Geol. Trans.,' vol. iii., 2nd series; Mantell, 'Fossils of the British Museum.')

Besides the localities above mentioned, we may notice the occurrence of this animal in the Oolite of Normandy; Forest Marble, Caen; and Jura, near Solothurn (?). (H. Von Meyer.) [SAURIA.]

MEGA'PHYTON, a genus of Fossil Plants, from the Coal-Measures. [COAL PLANTS.]

MEGAPODIIDÆ, Mr. Swainson's name for a family of *Rasores*, consisting of the genus *Menura*, the sub-genus *Megapodius*, and the genera *Dicholophus*, *Psophia*, and *Crax*, with the sub-genera *Crax*, *Ourax*, *Ortalida*, *Penelope*, and *Lophocerus*.

MEGAPODIUS. [CRACIDÆ.]

MEGAPTERA. [CETACEA.]

MEGARI'MA, the name proposed by Rafinesque for those species of *Terebratula* which are nearly equivalve and smooth, as *T. lævis*, *T. crassa*, &c. [BRACHIOPODA.]

MEGASPI'RA, Dr. Lea's name for a genus of pupiform, terrestrial, testaceous *Mollusca*, remarkable for the length of the spire of its shell, which consists of 23 close-set, narrow, gradually-increasing whorls, which he thus characterises:—

Shell clavate; aperture nearly oval, below rounded; margins reflected, above disjoined; columella many-folded, below entire, not effuse. Animal unknown.

This genus, which is closely analogous to the genera *Bulinus*, *Pupa*, and *Auricula*, according to Dr. Lea, is founded on a single species, *M. Ruschenbergiana*.

The shell is subcylindrical, turreted, thickly striate, brownish, with longitudinal reddish-brown spots, having a solid apex; whorls 23, rather flattened; spire obtuse at the apex; columella with four folds; outer lip reflected.

Megaspira Ruschenbergiana, Lea.

MEGASTOMA. [LANIADÆ.]

MEGATHE'RIIDÆ, *Megatheroids* of Owen, who includes under the family the following genera of extinct *Edentata*, namely, *Megatherium*, *Megalonyx*, *Glossotherium*, *Mylodon*, and *Scelidotherium*, all of which have as yet been found in America only.

Megatherium (Cuvier), a gigantic extinct Mammiferous Quadruped, more nearly allied to the Ant-Eaters and Sloths than to the Armadilloes. The dental formula cannot be definitely stated, because the number of teeth in the lower jaw is not known. The upper jaw, as Professor Owen has shown, contains five on each side, and from the analogy of *Scelidotherium* it may be conjectured that *Megatherium* had only four teeth on each side in the lower jaw. In that case the formula would be:—

$$\text{Incisors, } \frac{0}{0}\text{; Canines, } \frac{0}{0}\text{; Molars, } \frac{5-5}{4-4} = 18.$$

Cuvier pointed out the skull of this animal as very much resembling that of the Sloths, but observed that the rest of the skeleton bore a relationship partly to the Sloths and partly to the Ant-Eaters. The Madrid specimen was for a long time the principal if not the only source of information with regard to the genus; and as Mr. Clift remarks in his paper, to which we shall presently allude more largely,* that magnificent though imperfect skeleton had remained for the last century altogether unique. "Very few additional specimens," says that able osteologist, "appear to have been sent to Europe; and no other cabinet save the solitary one at Madrid possessed (as far as I am able to learn) a single intelligible fragment which could with certainty be assigned to this great unknown." The zeal and energy of Sir Woodbine Parish have added greatly to the materials for arriving at a just conclusion as to the proper place of this animal in the series; and the history of the *Megatherium* may now be considered to be complete.

According to the description of Don Joseph Garriga,† Spain possessed considerable parts of at least three different skeletons. The first and most complete is that which is preserved in the royal cabinet at Madrid. This was sent over in 1789 by the Marquis of Loreto, viceroy of Buenos Ayres, with a notice stating that it was found on the banks of the river Luxan, west-south-west of Buenos Ayres. In 1795 a second arrived from Lima, and other portions, probably not very considerable, were possessed by Father Fernando Scio, who had received them as a present from a lady who had come from Paraguay. According to Messrs. Pander and D'Alton, they were unable in 1818 to find any traces of the Lima specimen, or that which had belonged to Fernando Scio.

The remains collected by Sir Woodbine Parish were found in the river Salado, which runs through the flat alluvial plains (the Pampas) to the south of the city of Buenos Ayres, after a succession of three unusually dry seasons, "which lowered the waters in an extraordinary degree, and exposed part of the pelvis to view as it stood upright in the bottom of the river." This and other parts having been carried to Buenos Ayres by the country people, were placed at the disposal of Sir Woodbine Parish by Don Hilario Sosa, the owner of the property on which the bones were found. A further inquiry was instituted by Sir Woodbine Parish, and, on his application, the governor, Don Manuel Rosas, granted assistance, the result of which was the discovery of the remains of two other skeletons on his excellency's properties of Las Averias and Villanueva; the one to the north, the other to the south of the Salado, but at no great distance from the place where the first had been found. "An immense shell or case was found with the remains discovered on the properties of Don Manuel, portions of which were brought to this country, but most of the bones associated with the shell crumbled to pieces after exposure to the air," and the broken pieces preserved had not been sufficiently made out, when Mr. Clift published his memoir, to enable that zoologist to describe them satisfactorily; but he gives very accurate figures of a portion of the shell.

The cuts in the following page will convey to the reader more accurately than words the osseous structure of this enormous animal, which when full grown must have been more than 14 feet long including the tail, and upwards of 8 feet in height.

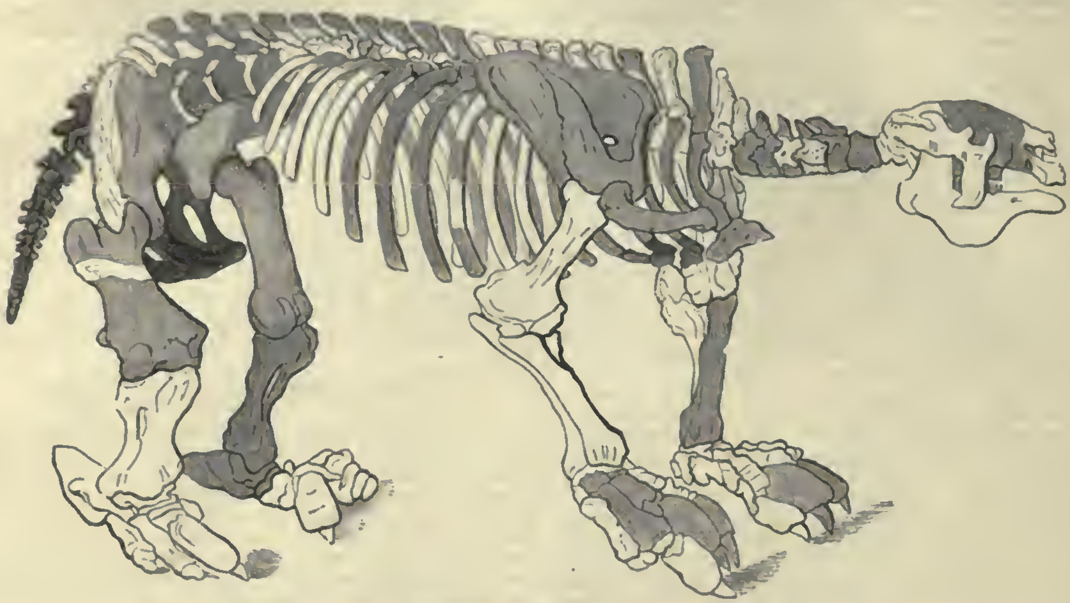
The simple outline (from Pander and D'Alton) shows the extent of the skeleton at Madrid. The pale tint expresses the extent of corresponding parts sent to England by Sir Woodbine Parish. The dark tint shows the additional parts, which are deficient in the Madrid skeleton. ('Geol. Trans.')

The thigh bone was twice the thickness of that of the largest elephant; the fore foot must have measured more than a yard in

* 'Some account of the Remains of the *Megatherium* sent to England from Buenos Ayres, by Woodbine Parish, Jun., Esq., F.G.S., F.R.S.,' by William Clift, Esq., F.G.S., F.R.S.

† 'Descripcion del Esqueleto de un Quadrupedo muy corpulento y raro que se conserva en el Real Gabinete de la Historia Natural de Madrid.' (Madrid, 1796.)

length, and more than 12 inches in width, and was terminated by an enormous claw, and the width of the upper part of the tail could



Skeleton of *Megatherium*. Clift.

not have been less than 2 feet. The following comparative measurements, furnished by Mr. Clift, will be found in Sir Woodbine Parish's

Scale of 2 feet.

Skeleton of *Megatherium* foreshortened, showing a nearly front view of the head and anterior and posterior extremities. Pander and D'Alton.

interesting work,* where a highly characteristic figure of the skeleton, drawn from the original bones, under Mr. Clift's superintendence, shows the parts which are wanting :—

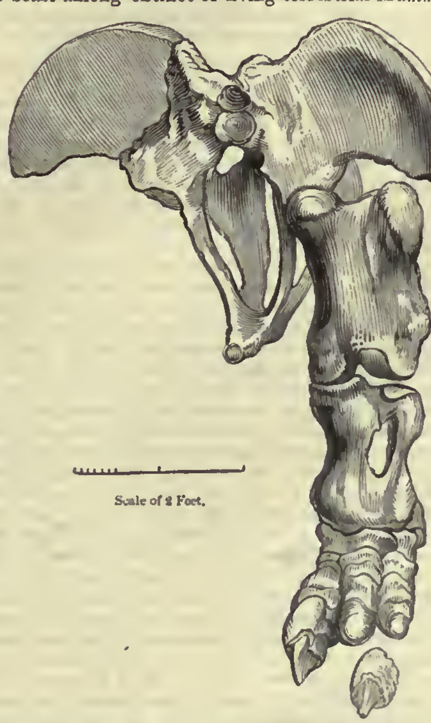
	Elephant.		Megatherium.	
	ft.	in.	ft.	in.
The expansion of the ossa ilia . . .	3	8	5	1
Breadth of the largest caudal vertebra .	0	7	1	9
Circumference of middle of femur . .	1	0	2	2
Length or the os calcis	0	7½	1	5

The whole of the structure of this extinct animal is admirably adapted for digging the earth so as to enable it to obtain the succulent roots, which, in all probability, constituted the principal part of its food. The snout of the animal appears to have terminated in a short proboscis, which must have borne a good deal of resemblance in its proportions to that of the modern Tapirs.

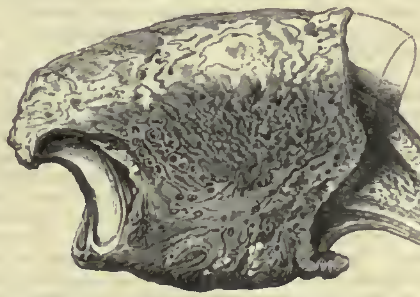
* 'Buenos Ayres and the Provinces of the Rio de Plata,' 8vo, London.

We have seen that an immense shell or case accompanied the remains discovered to the north and the south of the river Salado; and Dr Buckland was led to suppose, not without considerable apparent ground for the opinion, that this shell was the armour that protected the *Megatherium*.

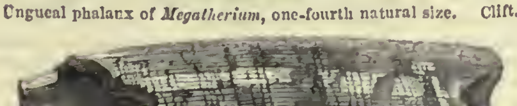
"The size of the *Megatherium*," says Dr. Buckland, in his 'Bridgewater Treatise,' "exceeds that of the existing *Edentata*, to which it is most nearly allied, in a greater degree than any other fossil animal exceeds its nearest living congeners. With the head and shoulders of a Sloth, it combined in its legs and feet an admixture of the characters of the Ant-Eater, the Armadillo, and the *Chlamyphorus;* it probably also still further resembled the Armadillo and *Chlamyphorus*, in being cased with a bony coat of armour. Its haunches were more than 5 feet wide, and its body 12 feet long and 8 feet high; its feet were a yard in length, and terminated by most gigantic claws; its tail was probably clad in armour, and much larger than the tail of any other beast among extinct or living terrestrial *Mammalia*. Thus



Bones of the pelvis of *Megatherium*, discovered by Sir Woodbine Parish, now in the Museum of the Royal College of Surgeons, London. The bones of the left hind leg and several of those of the foot are restored nearly to their natural place. (Dr. Buckland, 'Bridgewater Treatise.')



Unguical phalanx of *Megatherium*, one-fourth natural size. Clift.



Tooth of *Megatherium*, one-third natural size. Clift.

heavily constructed, and ponderously accoutred, it could neither run, nor leap, nor climb, nor burrow under the ground, and in all its movements must have been necessarily slow; but what need of rapid locomotion to an animal whose occupation of digging roots for food was almost stationary? And what need of speed for flight from foes, to a creature whose giant carcass was encased in an impenetrable cuirass, and who, by a single pat of his paw, or lash of his tail, could in an instant have demolished the Couguar or the Crocodile? Secure within the panoply of his bony armour, where was the enemy that would dare encounter this Leviathan of the Pampas? or in what more powerful creature can we find the cause that has effected the extirpation of his race? His entire frame was an apparatus of colossal mechanism, adapted exactly to the work it had to do; strong and ponderous, in proportion as this work was heavy, and calculated to be the vehicle of life and enjoyment to a gigantic race of quadrupeds, which, though they have ceased to be counted among the living inhabitants of our planet, have, in their fossil bones, left behind them imperishable monuments of the consummate skill with which they were constructed. Each limb and fragment of a limb forming co-ordinate parts of a well-adjusted and perfect whole; and through all their deviations from the form and proportion of the limbs of other quadrupeds, affording fresh proofs of the infinitely varied and inexhaustible contrivances of creative wisdom." Much of this eloquent passage is unassailable; but Professor Owen has demonstrated most clearly, and, we have reason to believe, to the entire satisfaction of Dr. Buckland himself, that the tessellated shell or case found with the Salado remains did not belong to the *Megatherium*, whose tegumentary covering seems to have been not unlike that of the Ant-Eaters and Sloths, but to a Dasypodoid or Armadillo-like gigantic extinct animal, to which Professor Owen has assigned the name of *Glyptodon*, whose hind foot, like the fore, appears to be expressly modified to form a base to a column destined to support an enormous incumbent weight; whilst in the *Megatherium* the toes were free to be developed into long and compressed claws, such as form the compensating weapons of defence of the hair-clad Sloths and Ant-Eaters. [GLYPTODON.] Professor Owen, in his paper read to the Geological Society of London, entitled, 'A Description of a Tooth and Part of the Skeleton of the *Glyptodon*, a large quadruped of the Edentate Order,' to which belongs the tessellated bony armour figured by Mr. Clift in his 'Memoir on the Remains of the *Megatherium* brought to England by Sir Woodbine Parish,' showed that the portions of tessellated armour described and figured by Weiss ('Berlin Trans.,' 1827) are identical in structure with those brought to England by Sir Woodbine Parish, and that the bones which were found with the armour in both cases are the same in their characters, and therefore that they belonged to animals specifically identical. He next entered upon the inquiry: Had the *Megatherium* a bony armour? and he concluded, from a comparison of its skeleton with that of the Armadilloes, that it had not. In the pelvis of the Armadillo there are 12 sacral vertebræ anchylosed together, and the spines of the vertebræ are greatly developed anterio-posteriorly, forming a continuous vertical ridge of bone, bearing immediately the superincumbent weight. In the Megathere the sacral vertebræ are only 4 in number, and are not anchylosed, and the spinous processes are comparatively small, not locked together, as in the Armadilloes, but separated by intervals as in the Sloths. In the Armadilloes, the weight of the cuirass is transferred from the sacrum to the thigh bones by two points on each side. One of them, the ischium, is anchylosed to the posterior part of the sacrum, the other point is formed by the conversion of the iliac bone into a stout three-sided beam passing straight from the thigh joint to abut against the anterior part of the sacrum, where the weight of the shell is greatest, a structure which is wanting in the Megathere. In no species of Armadillo is the ilium expanded, while in the Megathere it is greatly developed, resembling that of the Elephant in size, form, and position; and among the *Edentata* the nearest approach in this portion of the skeleton is to be found among the Sloths and Ant-Eaters. The most striking point however in the structure of the Armadilloes, with reference to the support of a bony covering, is the remarkable production of a part of the vertebra from above the anterior articular process on each side, in a straight direction upwards, outwards, and forwards, to nearly the level of the true spinous processes. Now these oblique processes, which are developed only in the loricated *Edentata*, beautifully correspond in form and use with the tie-bearers in the architecture of a roof, and are entirely wanting in the Megathere, the structure of this part of the vertebral column of that animal corresponding with the character of the vertebræ of the hair-clad Sloths and Ant-Eaters. Professor Owen noticed other supposed adaptations in the skeleton of the Megathere to sustain a bony covering, as the breadth of the ribs, but the ribs of the Sloths and Ant-Eaters are broader than those of the Armadilloes.

The paper contained a tabular account of the discovery of twelve skeletons of the Megathere, and in no instance did any portion of bony armour occur with or near the bone.* A notice was also given of the remains of a *Glyptodon*, found in the left bank of the Pedernal before its junction with the Sala, an affluent of the Rio Santo, near Monte Video, and preserved in the museum of that town. From the accounts which have been given of these remains, they appear to have belonged to the same species as that described in the paper. An allusion was also made to some portions of bony armour obtained in the Rio Seco, in the Banda Oriental, and similar in structure to the specimen of the Pedernal. One of the portions was the covering for the tail. It was hollow to its extremity, and presented in its concavity vestiges of caudal vertebræ very distant from each other.

In conclusion, Professor Owen observes, that having brought together evidence of the remains of five specimens (found in the Rio Seco, Rio Janeiro, Villanueva, Pedernal, and the Banda Oriental) of

* Sir Woodbine Parish, in May, 1839, communicated to the writer of this article a letter received by him, giving information of the discovery of an almost entire skeleton of an adult *Megatherium* on the banks of the Rio de la Matanza, with all the vertebræ of the body, all the ribs, all the teeth, the head, and the legs—in short, with the whole of the bones except the tail and one foot. Close to it was the skeleton of a 'Tatou gigantesque' (*Glyptodon* probably), with its bony armour complete. There was also found a very small and perfect *Megatherium*, which must have been only just born at the epoch of destruction. No mention is made of any traces of bony armour or shell about the *Megatheria*. In the old animal only one foot is wanting. It has been suggested that the so-called young *Megatherium* may possibly be a skeleton of *Scelidotherium*.

a large Edentate species undoubtedly covered with armour, and more or less corresponding with the characters of the *Glyptodon*, and having established the characters of that genus on both dentary and locomotive organs; he trusts at the same time that he has vindicated the opinion of Cuvier with reference to the Megathere, by proving it to be, by its tegumentary covering as well as its osseous system, more nearly allied to the Ant-Eaters and Sloths than to the Armadilloes. ('Geol. Proc.,' 1839.)

May we venture a suggestion as to the immediate probable cause of the extinction of these and other gigantic quadrupeds whose remains are found in America? The southern parts of that great continent are even now subject to long-continued droughts, sometimes lasting for three years in succession, and bringing destruction on the cattle; and, indeed, the discovery of the remains collected by Sir Woodbine Parish was owing to a succession of unusually dry seasons, as we have seen. The upright position of most of these skeletons found in situ, with the ponderous vertebræ and bones of the pelvis in their natural situation, indicates that the animal must have been bogged in adhesive mud sufficiently firm to uphold the ponderous bones after the decomposition of the soft parts. A long continued drought would naturally have brought these extinct animals from the drained and parched country to the rivers, dwindled by the continued dry seasons, to a slender stream running between extensive mud banks, in which these gigantic quadrupeds may have been ingulfed in their anxious efforts to reach the water.*

Megalonyx (Jefferson).—Under this name Mr. Jefferson, formerly President of the United States, described, from some bones found in caverns in the west of Virginia, an extinct mammiferous animal, which he considered to be carnivorous. The bones on which his description was founded were, a small fragment of a femur or a humerus, a complete radius, an ulna complete but broken in two, three claws,† and half a dozen other bones of the foot.

From the materials above mentioned, and on comparison with the analogous bones in the Lion, Mr. Jefferson came to the conclusion that the *Megalonyx* must have been upwards of 5 feet in height, that it must have weighed nearly 900 lbs., that it was the largest of unguiculated animals, and that it was probably the enemy of the Mastodon of the Ohio, as the Lion is of the Elephant. When once a theory takes possession of the human mind, there is generally no want of materials to confirm it in the imagination of the theorist. Thus Mr. Jefferson appeals to certain figures resembling a Lion mentioned by the most ancient historians of the Anglo-Americans as visible on a rock at the mouth of the Kanhawa, a branch of the Ohio, which must have been traced by the hands of the Indians from their rudeness; and to the accounts of travellers, some of them then living, who had heard during the night frightful roarings which terrified the dogs and the horses; and he asks if they do not prove the existence of some great unknown carnivorous species in the interior of America, and whether this redoubtable animal may not have been the *Megalonyx*?

Dr. Wistar, Professor of Anatomy in the University of Philadelphia, subsequently perceived some analogy between the bones of the fossil foot of Jefferson's animal and similar bones in the foot of the Sloth, without other aid than Daubenton's description.

Cuvier, who saw at once the true analogies of the animal, and was ridiculed for his opinion by Faujas de St. Fond, who mistook the clear-sightedness of that great zoologist for the blindness of one who would constrain nature to bend to the factitious classification of an artificial system, obtained casts of the bones indicated by Jefferson from Mr. Peale of Philadelphia, and was afterwards furnished by M. Palisot de Beauvois, with two morceaux found in the same cavern where Jefferson's specimens were discovered; fortunately one of these was a tooth. With these additional materials Cuvier completed his labours, and satisfactorily showed that the *Megalonyx* belonged to the *Edentata*.

Professor Owen, in his description of his genus *Mylodon*, says, "The greater part of Cuvier's chapter on *Megalonyx* is devoted to the beautiful and justly celebrated reasoning on the ungueal phalanx, whereby it is proved to belong not to a gigantic Carnivore of the Lion kind, as Jefferson supposed, but to the less formidable order of Edentate Quadrupeds; and Cuvier, in reference to the tooth—the part on which alone a generic character could have been founded—merely observes that it resembles at least as much the teeth of one of the great Armadilloes as it does those of the Sloths. In the last edition of the 'Règne Animal' Cuvier introduces the *Megatherium* and *Megalonyx* between the Sloths and Armadilloes, but alludes to no other difference between the two genera than that of size—'l'autre, le *Megalonyx*, est un peu moindre.' Some systematic naturalists, as Desmarest and Fischer, have therefore suppressed the genus, and made the *Megalonyx* a species of *Megatherium*, under the name of *Megatherium Jeffersonii*. The dental characters of the genus *Megatherium* are laid down by Fischer, as follows:—'Dent. prim. et. lan. $\frac{0}{0}$; molares, $\frac{4-4}{4-4}$, obducti, tritores, coronide nunc planâ transversim sulcatâ, nunc medio excavatâ marginulis prominulis.' That *Megalonyx* had the same number of molars as *Megatherium* (supposing that number in the Megathere to be correctly stated, which it is not) is here assumed from analogy, for neither Jefferson, Wistar, nor Cuvier—the authorities for *Megalonyx* quoted by Fischer—possessed other means of knowing the dentition of that animal than were afforded by the fragment of a single tooth." (Owen, in 'Zoology of H.M.S. Beagle.'

The same author adds, "With respect to existing *Mammalia*, most naturalists of the present day seem to be unanimous as to the convenience at least of founding a generic or subgeneric distinction on well-marked modifications in the form and structure of the teeth, although they may correspond in number and kind, in proof of which it needs only to peruse the pages of a 'Systema Mammalium' which relate to the distribution of the Rodent order. According to this mode of viewing the logical abstractions under which species are grouped together, the extinct Edentate Mammal discovered by Jefferson must be referred to a genus distinct from *Megatherium*, and for which the term *Megalonyx* should be retained. This will be sufficiently evident by comparing the descriptions given by Cuvier of one of the teeth of *Megalonyx Jeffersonii*, and by Dr. Harlan of a tooth of his *M. laqueatus*, with those of the *Megatherium* which have been published by Mr. Clift. The fragment of the molar tooth of the *Megalonyx Jeffersonii*, described and figured in the 'Ossemens Fossiles,' seems to have been implanted in the jaw like the teeth of the *Megatherium* by a simple hollow base, similar in form and size to the protruded crown: its structure Cuvier describes as consisting of a central cylinder of bone enveloped in a sheath of enamel. The transverse section of this tooth presents an irregular elliptical form, the external contour being gently and uniformly convex; the internal one undulating, convex in the middle, and slightly concave on each side, arising from the tooth being traversed longitudinally on its inner side by two wide and shallow depressions. The imperfect tooth of the species called by Dr. Harlan *Megalonyx laqueatus*, and of which a cast was presented by that able and industrious naturalist to the Museum of the Royal College of Surgeons, resembles in general form, and especially in the characteristic double longitudinal groove on the inner side, the tooth of the *Megalonyx Jeffersonii*."

Two claws of the fore foot, a radius, humerus, scapula, one rib, an os calcis, a metacarpal bone, some vertebræ, a femur, and a tibia of *Megalonyx laqueatus*, which were discovered in Big-Bone Cave, Tennessee, United States, are also described by Dr. Harlan,* who, though he does not enter into the question of the generic characters of *Megalonyx*, seems, as Professor Owen observes, to feel that they do not rest entirely on dental modifications; for Dr. Harlan remarks that "a minute examination of the tooth and knee-joint renders it not improbable, supposing the last-named character to be peculiar to it, that if the whole frame should hereafter be discovered, it may even claim a generic distinction, in which case either *Aulaxodon* or *Pleurodon* would not be an inappropriate name." Upon this Professor Owen makes the following pertinent observation:—"There can be no doubt, as it appears to me, with respect to a fossil jaw presenting teeth in the same number and of the same general structure as in the *Megatherium*, and with individual modifications of form as well marked as those which distinguish *Megatherium* from *Megalonyx*, that the palæontologist has no other choice than to refer it, either as Fischer has done with *Megalonyx*, to a distinct species of the genus *Megatherium*, or to regard it as a type of a sub-genus distinct from both. With reference however to the *Pleurodon* of Dr. Harlan, after a detailed comparison of the cast of the tooth on which that genus is mainly founded with the descriptions and figures of the tooth of the *Megalonyx Jeffersonii* in the 'Ossemens Fossiles,' they seem to differ in so slight a degree as to warrant only a specific distinction, and this difference even, viewing the various proportions of the teeth in the same jaw of the *Megatherium*, is more satisfactorily established by the characters pointed out by Dr. Harlan, in the form and proportions of the radius, than by those of the tooth itself."

Among the bones collected by Spix and Martius in the cave of Lassa Grande, near the Arrayal de Torraeigos in Brazil, and described by Professor Doellinger,† there were no teeth, and only a few bones of the extremities. The Professor concludes from their shape, the presence of an osseous sheath for the claw, and from the form of their articulation, that they doubtless belong to a Megatheroid animal of the size of an Ox. The bones, according to the Professor, are not those of an immature individual, and agree sufficiently with Cuvier's descriptions and figures of the *Megalonyx* to warrant their being referred to that kind of animal.

* Mr. Darwin states that he was informed by an eye-witness, that during the 'gran seco' the cattle in herds of thousands rushed into the Parana, and being exhausted by hunger, they were unable to crawl up the muddy banks, and were drowned. ('Voyages of the Adventure and Beagle between the years 1826 and 1836,' vol. iii., 1839.) Sir Woodbine Parish says, "In the last great drought, which continued during the summers of 1830, 1831, and 1832, it was calculated that from a million and a half to two millions of animals died; the borders of all the lakes and streamlets in the province were long afterwards white with their bones." ('Buenos Ayres and the Provinces of the Rio de la Plata,' 8vo, 1839.]

† The ungueal phalanx of *Megalonyx* is much more compressed than that of *Megatherium*.

* 'Medical and Physical Researches,' p. 323, &c.

† Spix and Martius, 'Reise in Brazil,' band ii., p. 5.

Glossotherium (Owen).—The genus is founded on a fragment of a cranium in Mr. Darwin's collection, discovered in the bed of the same river in Banda Oriental with the skull of the *Toxodon*. The fragment includes the parieties of the left side of the cerebral cavity, the corresponding nervous and vascular foramina, the left occipital condyle, a portion of the left zygomatic process, and, though last, not least, the left articular surface of the lower jaw. No tooth, no locomotive extremity, was present to lend its aid; and yet, upon the slender materials above stated, Professor Owen has been enabled to give generic distinction to the animal to which they belonged, and to fix its place in the animal series satisfactorily.

Professor Owen remarks, that the importance of the articular surface of the lower jaw in the determination of the affinities of a fossil animal has been duly appreciated since the relations of the motions of the lower jaw to the kind of life appointed for each animal were pointed out by Cuvier; but he observes that we should be deceived if we were to establish, in conformity with the generalisation laid down by Cuvier, our conclusion, from this surface, of the nature of the food of the extinct species under consideration; for the shape of the glenoid cavity is such as to allow the lower jaw free motion in a horizontal plane from right to left, and forwards or backwards, like the movements of a millstone: "Nevertheless," continues Professor Owen, "I venture to affirm it to be most probable that the food of *Glossotherium* was derived from the animal and not from the vegetable kingdom, and to predict, that when the bones of the extremities shall be discovered, they will prove the Glossothere to be not an ungulate but an unguiculate quadruped, with a fore foot endowed with the movements of pronation and supination, and armed with claws, adapted to make a breach in the strong walls of the habitations of those insect societies upon which there is good evidence, in other parts of the present cranial fragment, that the animal, though as large as an ox, was adapted to prey."

The data on which Professor Owen rests this affirmation, are, in the first place, a remarkable cavity situated immediately behind the tympanic bone, of nearly a regular hemispherical form and an inch in diameter. The surface of this cavity does not appear to have been covered with articular cartilage, because it is irregularly pitted with many deep depressions, and Professor Owen concludes therefore that it served to afford a ligamentous attachment to the styloid element of a large os hyoides. In addition to this evidence of the size of the bones of the tongue, there is a more certain indication of the extent of its soft and especially its muscular parts in the magnitude of the foramen for the passage of the lingual or motor nerve, which anterior condyloid foramen is larger than any of those which perforate the cranium, with the exception of the great foramen; it is eight lines in the long diameter, and readily admits the passage of the little finger.

The Professor remarks that it is only in the Ant-Eaters and Pangolins that we find an approximation to these proportions; and that in the Giraffe, the largest of ruminants, and having the longest and most muscular tongue in that order, the foramen for the corresponding nerve is scarcely more than one-fourth the size of that of *Glossotherium*. In the other parts of the cranium Professor Owen finds more decisive evidence of the relationship of this extinct edentate to the genera *Myrmecophaga* and *Manis*.

The question, Had the *Glossotherium* teeth? is answered by the Professor in the affirmative, from the rugged surface of the temporal fossa indicating an extensive temporal muscle; from the well-defined boundary, formed by a slightly-elevated bony ridge, extending to near the sagittal suture; the size of the zygomatic portion of the temporal bone, and the remains of the oblique suture by which it was articulated to the malar bone; and he is of opinion that they will probably be found to be molar teeth of a simple structure, as in the *Orycteropus*.

Here is evidence of the existence of an os malæ. This bone is wanting in the Pangolins; in the true Ant-Eaters it does not reach the zygomatic process of the temporal bone. From this evidence of the completion of the zygomatic arch, the Professor concludes that *Glossotherium* was more nearly allied to the Armadilloes and *Orycteropus;* and from the form and loose condition of the tympanic bone, which, through the care and attention of Mr. Darwin, was preserved in situ, that the affinity of the animal was closer to *Orycteropus* than to the Armadilloes: but the tympanic bone of *Orycteropus* differs from that of *Glossotherium* in forming part of the circumference of an ellipse whose long axis is vertical, and in sending outwards from its anterior part a convex eminence, which terminates in a point directed downwards and forwards: in the distance from the origin of the zygoma to the occipital plane, which is relatively greater in *Glossotherium* than in *Orycteropus*, the former is more similar to *Myrmecophaga* and *Manis*.

The internal surface of the cranial fragment shows that in *Glossotherium*, as in other *Bruta*, the cerebellum must have been almost entirely exposed behind the cerebrum, that the latter was of small relative size, not exceeding that of the Ass; and that it was chiefly remarkable, as in *Orycteropus*, the Ant-Eater, and Armadillo, for the great development of the olfactory ganglia.

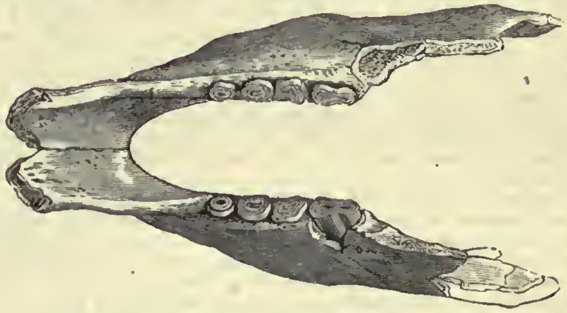
Such are the leading points on which the establishment of this extinct genus is placed. Our limits do not admit of our following out the interesting details which confirm the view taken by Professor Owen, and which the reader will find in his 'Fossil Mammalia,' as part of the 'Zoology of the Voyage of Her Majesty's Ship Beagle, under the command of Captain Fitzroy, R.N., edited and superintended by Mr. Darwin, and published with the approval of Her Majesty's Treasury;' but we think it advisable, with reference to the succeeding fossil species described by the Professor, and here noticed, to give the concluding paragraph in his paper on *Glossotherium*.

"A question," says Professor Owen, "may arise after perusing the preceding evidence, upon which the present fossil is referred to a great Edentate species nearly allied to the *Orycteropus*, whether one or other of the lower jaws, subsequently to be described, and in like manner referrible, from their dentition, either to the Orycteropodoid or Dasypodoid families of *Edentata*, may not have belonged to the same species as does the present mutilated cranium. I can only answer, that those jaws were discovered by Mr. Darwin in a different and very remote locality; that no fragments or teeth referrible to them were found associated with the present fossil; and that, as it would be therefore impossible to determine from the evidence we have now before us which of the two lower jaws should be associated with *Glossotherium;* and as both may, with equal if not greater probability, belong to a totally distinct genus, it appears to me to be preferable, both in regard to the advancement of our knowledge of these most interesting *Edentata* of an ancient world, as well as for the convenience of their description, to assign to them, for the present, distinct generic appellations."

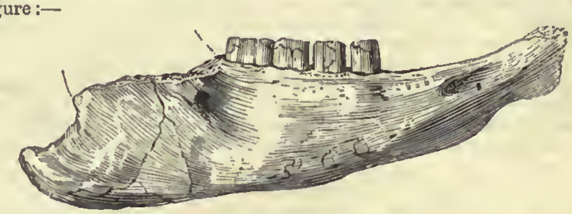
Mylodon (Owen), a genus of Edentate Megatherioids, founded on some fossil remains described by Dr. Harlan in his 'Medical and Physical Researches,' and referred by him to *Megalonyx*, and on a mutilated lower jaw and teeth discovered by Mr. Darwin among the many interesting novelties which have been the result of that zealous naturalist's researches in the southern division of America.

The fossil last alluded to was found in a bed of partly consolidated gravel at the base of the cliff called Punta Alta, at Bahia Blanca, in Northern Patagonia, and consists of the lower jaw, with the series of teeth entire on both sides: the extremity of the symphysis, the coronoid and condyloid processes, and the angular process of the left ramus, are wanting.

The teeth are implanted in very deep sockets, and about one-sixth only of the last molar projects above the alveolus; but the proportion of the exposed part increases gradually in the anterior teeth. This and the relative distance of the teeth will be seen in the following figure:—



Lower jaw of *Mylodon*, one-sixth natural size. Owen.

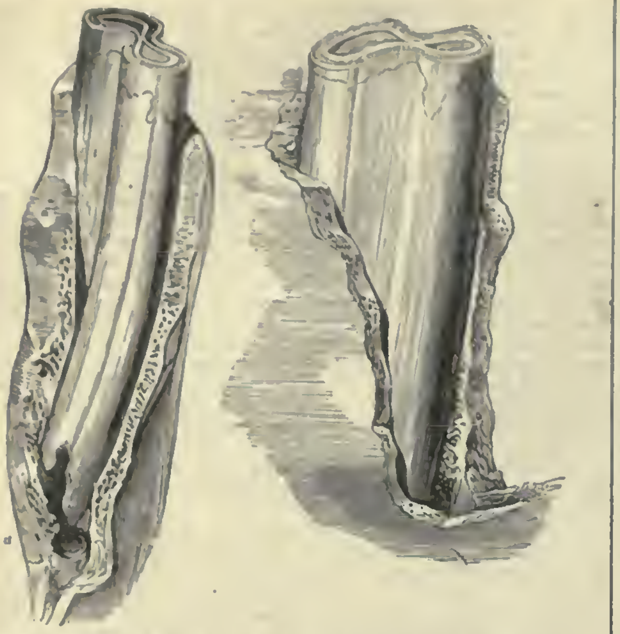


External view of right ramus of lower jaw of *Mylodon* (profile), one-sixth natural size.

The implanted part of each tooth is simple, of the same size and form as the projecting crown, and with a large conical cavity at the base, for the persistent pulp, and indicating that their growth during life was perpetual.

Professor Owen remarks that these teeth are composed, as in *Bradypus*, *Megatherium*, and *Megalonyx*, of a central pillar of coarse ivory, immediately invested with a thin layer of fine and dense ivory, and the whole surrounded by a thick coating of cement.

The exterior surface of the symphysis of the jaw (which is completely anchylosed) is characterised by two oval mammilloid processes, situated on each side of the middle line, and about half-way between the anterior and posterior extremes of the symphysis. Nearly 4 inches behind the anterior extremity of the above process is the large anterior opening of the dental canal, which is 5 lines in diameter, and situated about one-third of the depth of the ramus of the jaw from the upper margin. The Professor observes that the magnitude



Teeth of *Mylodon*, showing the depth of their implantation. The cavity at the base of the tooth is seen at figure *a*. Two-thirds natural size. Owen.

of this foramen, which gives passage to the nerve and artery of the lower lip, indicates that this part was of large size; and that the two symphyseal processes, which probably were subservient to the attachment of large retractor muscles, denote that the motions of such a lip were free and extensive. The angle of the jaw is produced backwards, and ends in an obtuse point, slightly bent upwards; a foramen, one-third less than the anterior one, leads from near the commencement of the dental canal to the outer surface of the jaw, a little below and behind the last molar tooth; and this foramen presents the same size and relative position on both sides of the jaw. Professor Owen finds no indication of a corresponding foramen, or of symphyseal processes in the figures or descriptions of the lower jaw of the *Megatherium*, nor in that of the Sloths, Ant-Eaters, Armadilloes, or Manises, which he had examined with a view to this comparison.

Professor Owen further observes that in the *Megatherium* the inferior contour of the lower jaw is peculiarly remarkable, as Cuvier has observed, for the convex prominence or enlargement which is developed downwards from its middle part; but in the *Mylodon* the corresponding convexity is slight, not exceeding that which may be observed at the corresponding part of the lower jaw of the Ai or the *Orycteropus;* and after entering into further interesting details, the Professor comes to the conclusion that the lower jaw of the *Mylodon* is very different from that of the *Megatherium:* with that of *Megalonyx* he had of course no means of comparing it.

"Among existing *Edentata,*" continues the Professor, "the *Mylodon*, in the form of the posterior part and angle of the jaw, holds an intermediate place between the Ai and the great Armadillo; in the form of the anchyloeed symphysis of the lower jaw it resembles most closely the Unau, or Two-Toed Sloth; but in the peculiar external configuration of the symphysis, resulting from the mamilloid processes above described, the *Mylodon* presents a character which has not hitherto been observed in any other species of *Bruta*, either recent or fossil."

Two species, *Mylodon Harlani*, founded on the fossil described by Dr. Harlan, and *Mylodon Darwinii*, on that discovered by Mr. Darwin, are recorded by Professor Owen; and he gives the following admeasurements of the lower jaw of the latter species:—

	Inches.	Lines.
Length (as far as complete)	17	6
Extreme width, from the outside of one ramus to that of the other	9	0
Depth of each ramus	4	9
Length of alveolar series	4	8
From first molar to broken end of symphysis .	6	0
Breadth of symphysis	3	7
Longitudinal extent of symphysis	4	6
Circumference of narrowest part of each ramus	5	9

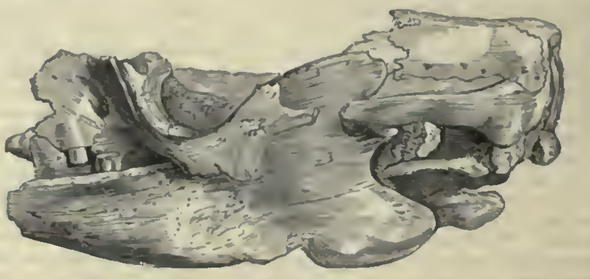
He further observes that the teeth and bones of *Mylodon Darwinii*, above described, exhibit all the appearances and conditions of those of a full-grown animal, and that they present a marked difference of size as compared with those of *Mylodon Harlani*, which must have been a much larger animal, for if the lower jaw of the latter species bears the same proportion to its teeth as that of *Mylodon Darwinii* does it must be about two feet in length. ('Zoology of H. M. S. Beagle.') [MYLODON.]

Scelidotherium (Owen), a large extinct Edentate Mammal, allied to *Megatherium* and *Orycteropus.*

The remains on which this genus is founded include the cranium, which is nearly entire, with the teeth, and part of the os hyoides; the seven cervical vertebræ, eight dorsal and five sacral vertebræ, both scapulæ, the left humerus, radius and ulna, two carpal bones, and an ungueal phalanx; the two femora, the proximal extremities of the left tibia and fibula, and the left astragalus.

These bones were discovered by Mr. Darwin at Punta Alta in northern Patagonia, and in the same bed of partly consolidated gravel as that wherein the lower jaws of *Toxodon* and *Mylodon* were imbedded. All the parts were discovered in their natural relative position, indicating, as Mr. Darwin observes, that the sublittoral formation in which they had been originally deposited had been but little disturbed. This beach is covered at spring-tides, and many portions of the skeleton were incrusted with *Flustræ;* small marine shells were lodged within the crevices of the bones.

Sufficient of the cranium remains to indicate that its general form resembled an elongated slender subcompressed cone, beginning behind by a flattened vertical base which expanded slightly to the zygomatic region, and thence contracted gradually in all its dimensions to the anterior extremity.



Remains of skull of *Scelidotherium*, reduced. Owen.

"The Cape Ant-Eater (*Orycteropus*)" [AARD-VARK], says Professor Owen, "of all *Edentata*, most nearly resembles the present fossil in the form of its cranium, and next in this comparison the great Armadillo (*Dasypus gigas*, Cuv.) may be cited. [ARMADILLO.] On the supposition therefore that the correspondence with the above existing Edentals observable in the parts of the fossil cranium which do exist, was carried out through those which are defective, the length of skull of the Scelidothere must have been not less than two feet. The cranium is singularly small and slender in proportion to the rest of the skeleton, especially the bulky pelvis and femur, of which bones the latter has a length of 17 inches and a breadth of not less than 9 inches; the astragalus again exceeds in bulk that of the largest hippopotamus or rhinoceros; yet the condition of the epiphyseal extremities of the long bones proves the present fossils to have belonged to an immature animal. Hence, although the Scelidothere, like most other Edentals, was of low stature, and, like the *Megatherium*, presented a disproportionate development of the hinder parts, it is probable that, bulk for bulk, it equalled, when alive, the largest existing pachyderms not proboscidean. There is no evidence that it possessed a tessellated osseous coat of mail."

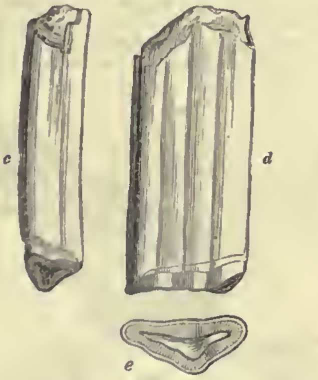
Professor Owen gives a most minute and interesting description of the various parts of the cranium, for which we refer to his memoir, remarking only that the most interesting features in the region of the temporal bone consist in the fine condition of the tympanic bones, and the presence of a semicircular pit, immediately behind the tympanic bone, for the articulation of the styloid element of the hyoid or tongue bone.

"In these points," observes the Professor, "we trace a most remarkable correspondence with the Glossothere, and in the separate tympanic bone the same affinity to the *Orycteropus* as has been already noticed in the more bulky extinct Edental. This correspondence naturally leads to a speculation as to the probable generic relationship between the Glossothere and Scelidothere. Now it may first be remarked that the styloid articular depression is relatively much larger and much deeper in the Glossothere than in the Scelidothere: in the former its diameter equals, as we have seen, one inch; in the Scelidothere it measures only a third of an inch, the whole cranium being about two-fifths smaller. If we turn next to the anterior condyloid foramina, which in the Scelidothere are double on each side, we obtain from them evidence that the muscular nerve of the tongue could only have been one-third the size of that of the Glossothere. These proofs of the superior relative development of the tongue in the Glossothere indicate a difference of habits, and a modification probably of the structure of the locomotive extremities; and when we associate these deviations from the Scelidothere with the known difference in the position of the occipital plane, which in the Glossothere corresponds with that in the *Myrmecophaga* and *Bradypus*, we shall be justified in continuing to regard them, until evidence to the contrary be obtained, as belonging to distinct genera."

The bones of the cranium connected with the organ of hearing and an accidental fracture of the right os petrosum, demonstating its usual dense and brittle texture, and at the same time exposing the cochlea with part of its delicate and beautiful lamina spiralis, give Professor Owen occasion to observe that the conservation of parts of the organs of vision in certain fossils has given rise to arguments which prove that the laws of light were the same at remote epochs of the earth's history as now; whilst the structure just alluded to demonstrate, iu like manner, that the laws of acoustics have not changed, and that the extinct giants of a former race of quadrupeds were endowed with the same exquisite mechanism for appreciating the vibrations of sound as their existing congeners enjoy at the present day.

"The brain," says Professor Owen, "being regulated in its development by laws analogous to those which govern the early perfection of the organ of hearing, appears to have been relatively larger iu the Scelidothere than in the Glossothere: it was certainly relatively longer: the fractured cranium gives us six inches of the antero-posterior diameter of the brain, but the analogy of the Orycterope would lead to the inference that it extended farther into the part which is broken away. The greatest transverse diameter of the cranial cavity is four inches eight lines; their dimensions however are sufficient to show that the brain was of very small relative size in the Scelidothere; and both in this respect and in the relative position of its principal masses the brain of the extinct Edental closely accords with the general character of this organ in the existing species of the same order. We perceive by the obtuse ridge continued obliquely upwards from above the upper edge of the petrous bone, that the cerebellum has been situated wholly behind the cerebrum; we learn also, from the same structure of the enduring parts, that these perishable masses were not divided, as in the Manis, by a bony septum, but by a membranous tentorium, as in the Glossothero and Armadilloes: in the Orycterope, as has been before remarked, there is a strong, sharp, bony ridge extending into each side of the tentorium. The vertical diameter of the cerebellum and medulla oblongata equals that of the cerebrum, and is two inches three lines: the transverse diameter of the cerebellum was about three inches nine lines; its antero-posterior extent about one inch aud a half. The sculpturing of the internal surface of the cranial cavity bespeaks the high vascularity of the soft parts which it contained, and there are evident indications that the upper and lateral surfaces of the brain had been disposed in a few simple parallel longitudinal convolutions. The two anterior condyloid foramina have the same relative position as the single corresponding foramen in the Glossothere, Orycterope, and Armadillos; and the inner surface of the skull slopes outwards from these foramina to the inner margin of the occipital condyle."

One-half natural size.



Dentition of *Scelidotherium*.

a, Teeth of upper jaw in situ, seen from above; *b*, teeth of lower jaw in situ, same view; *c*, *d*, teeth, showing the depth of their implantation in the jaw and their structure; *e*, crown of tooth, seen from above. Reduced. (Owen.)

The size of the orbit is relatively smaller than in the Orycterope, and still less than in the Ant-Eaters. "Here however," observes Professor Owen, "we have merely an exemplification of the general law which regulates the relative size of the eye to the body in the *Mammalia*. The malar bone does not extend so far forwards in front of the orbit as in either the Orycterope or Armadillo; iu the inclination however with which the sides of the face converge forwards from the orbits, the Scelidothere holds an intermediate place between the Armadilloes and Orycterope."

The Dental Formula of *Scelidotherium* appears to have been:—

$$\text{Incisors, } \frac{0}{0}\text{; Canines, } \frac{0}{0}\text{; Molars, } \frac{5-5}{4-4} = 18.$$

Though the teeth of *Mylodon* and *Scelidotherium* have a close analogy to those of existing small Insectivorous Edentals, there is nothing iu their structure to militate against the presumption that these extinct genera were fed on succulent plants, such as cabbage-palms, or on farinaceous vegetables, such as large ferns. Their teeth are well adapted to chew vegetable tissues of moderate firmness. ('Zoology of H.M.S. Beagle.')

M. Lund discovered the remains of a large number of fossil *Edentata* in Brazil. The portion of the country examined by this zealous zoologist is comprised between the rivers Rio das Velhas, one of the confluents of the Rio de San Francisco, and the Rio Paraopeba. This tract forms an elevated plateau of 2000 feet above the level of the sea, and is traversed in the midst by a mountain chain only from 300 to 700 feet high. The chain is formed by a secondary limestone (calcaire secondaire) stratified horizontally, and having all the characters of the zechstein and the hohlen-kalkstein of the Germans (calcaire à cavernes). It is entirely riddled with caverns, and traversed in all directions by fissures, the interior of which is more or less filled with a red earth identical with the red earth which forms the superficial bed of the country. In this basin of the Rio das Velhas M. Lund has discovered in company with the remains of *Feræ*, *Glires*, *Pachydermata*, *Ruminantia*, *Marsupialia*, *Cheiroptera*, *and Semiæ*, the following mammiferous fossils, which seem to claim attention here:—

"Family of *Edentata*.

"A *Myrmecophaga* (*Glossotherium?* Owen) of the size of an ox (*Myrmecophaga gigantea*).

"Family of *Effodientia*.

"1. Two species of *Dasypus*; one allied to *D. octocinctus*, and the other twice as large as the living species.

"2. *Xenurus*.

"3. *Euryodon*, a lost genus of Tatou, or Armadillo.

"4. *Heterodon*, distinguished from all the living Armadilloes by the proportion of its teeth.

"5. *Chlamydotherium*, a new genus of Armadillo, representing on a great scale the genus *Euphractus* of Wagler (the Eucoubert of Buffon); two species, one of the size of a Tapir, the other larger than a Rhinoceros.

"6. *Hoplophorus* (*Glyptodon*? Owen), a very extraordinary genus, whether we consider the massive proportions of the species, their gigantic structure, or the singular combination of different types of organisatiou manifested in them. Their characters nevertheless approach more and more to the family of Sloths.

"These singular animals were armed with a cuirass which covered all the upper parts of their body, and was composed of small hexagoual scutcheons, except on the middle of the body, where the scutcheous put on a square form and were arranged in immoveable transverse bands. The bones of the truuk as well as the large bones of the extremities are very similar to the Armadilloes (Tatous) and especially to those of the Cachicames [ARMADILLO]; but the bones of the feet are so abridged and the articular surfaces present such a considerable flattening, that nothing similar is to be seen in any animal skeleton, and one cannot couceive how such feet could serve for digging in the earth (creuser la terre): the form of the teeth, too, indicates that these singular animals could only have been nourished with vegetable substances, and we must suppose that they fed after the manner of the great *Pachydermata*. However this may be, the *Hoplophori*, of which M. Lund distinguishes two species, present this particularity, that their zygomatic arch is furnished with a descending branch, a character regarded till now as exclusively proper to the Sloths. These two species were each of the size of an ox. Fragments of these skeletons have already been described by Messrs. Weiss and D'Altou of Berlin.

"M. Lund has found fragments belonging to a genus approaching *Hoplophorus*, and to which he assigns the name of *Pachytherium*. Its proportions were still more massive and its stature taller.

"Family of *Bradypoda*.

"M. Lund is thus conducted to the family of the Sloths, which, 'at the Antediluvian epoch,' played in these countries a very important part, whether the number and variety of their forms, or the great size which the species attained, are cousidered.

"The first genus which he notices is *Megalonyx*. It is counected with the Armadillos (Tatous) by the osseous plates which protected a part of its body; but these plates, although of excessive size, far from forming a continuous cuirass as in the Tatous, were separated from each other by great intervals. The *Megalonyx* exhibits the greatest affinity to *Megatherium*, priucipally in the structuro and composition of the feet, but those of the posterior limbs present the same torsion as the feet of *Bradypus tridactylus*, although proceeding from a different cause. In the Ai this torsion is produced by the particular mode of the articulation of the leg with the astragalus; in the *Megalonyx*, according to M. Lund, the articulation is effected in the ordinary manner, and it is the carpal surface of this last bone which, by its anomalous conformation, caused the contorsion of all the rest of the foot.

"The molars, to the number of five above and four below, are deprived of roots as in the animals of the order *Edentata*; in that they differ from those of *Megatherium*, which are described as having two roots.

"The Megalonyxes were provided with a tail, which was excessively strong and probably prehensile, and this, joined to the contorsion of the hind feet and the enormous size of their claws, leads to the belief, says M. Lund, that these animals, notwithstanding the enormous weight of their body, were destined to climb, like their analogues in the present creation.

"This genus appears to have been very rich in species. M. Lund already distinguishes five; one of which, *M. Cuvieri*, was of the stature of a very stout ox; and this was not the largest species.

"By the Megalonyxes a new genus (*Sphenodon*), which was of the size of a hog, finds its place.

"Still nearer to the Sloths must be arranged a new genus which M. Lund designates under the name of *Colodon*, and which consists of one species.

"Returning to the consideration of the animals which he enumerates, and which are comprised in the order *Bruta*, or *Edentata* of Cuvier, M. Lund observes:—

"1. That the family of Ant-Eaters properly so called, that of the Tatous, and that of the Sloths, which, at the present epoch, are peculiar to America, were also found at the preceding epoch.

"2. That then, these same families were exclusively proper to this part of the world, as they are at the present epoch; and that this gives cause for thinking that no species of these three families has hitherto been found in the diluvial beds of the other parts of the world.

"3. That this great order of the *Edentata* was then more numerous both in genus and species than it now is.

"4. That the greater part of these mammiferous genera which once peopled the country have disappeared.

"5. That every species has been destroyed, two species only exhibiting affinity, but not perfect identity, with the living species.

"6. Finally, that the animals of this order attained at that epoch dimensions much greater than those which they now present.

"The family of the Sloths has now entirely disappeared in the basin of the Rio das Velhas, which is explained by the want of virgin forests, all this country being occupied by the form of vegetation called by the Brazilians 'Campos.' It is probable that at the epoch when these great animals lived it was otherwise, and that the country was then covered by immense forests. Everything leads to the belief that they led the same kind of life as their analogues of the present creation, that is to say, that notwithstanding the colossal proportions of their bodies, they sought their nourishment on trees." ('Comptes Rendus.')

MEGATRE'MA, Dr. Leach's name for those species of *Pyrgoma* which have a large aperture. [CIRRIPEDIA.]

MEGRIM. [PLEURONECTIDÆ.]

MEIONITE. [SCAPOLITE.]

MELALEUCA (from μέλας, black, and λευκός, white), a genus of Plants belonging to the natural order *Myrtaceæ*. It has the calyx-tube nearly hemispherical, the limb 5-partite; the petals 5; the stamens numerous, combined into 5 elongated bundles, which alternate with the petals; the anthers incumbent; the style filiform, the stigma obtuse; the capsule connate with and inclosed in the thickened tube of the calyx, which is sessile on and adnate at its base to the flower-bearing branch, 3-celled, many-seeded; the seeds angular. The species are trees or shrubs with alternate or opposite entire leaves, equal at the base, with flowers perfectly sessile, or somewhat combined with the branch, arranged in spikes or heads, and of a white, yellowish, or purplish colour.

M. Cajuputi (Roxburgh), *M. minor* (Smith), has the leaves alternate, elliptic-lanceolate, acutish, rather falcate, 3-5-nerved; the flowers rather distant, in spikes, the rachis and calyxes villous. This is the species which yields the chief part of the oil brought to Europe under the name of Cajeput Oil. It is a native of Amboyna and other East India islands.

In its action on the human frame Cajeput participates in the properties of other volatile oils, and is rubefacient externally, stimulant and antispasmodic when taken internally. Mixed with other ingredients it has proved a useful application to the joints in rheumatism and similar affections, while a few drops of it have often relieved or warded off slight attacks of hysteria or epilepsy. It by no means realised the expectations entertained of it as a remedy in spasmodic cholera.

M. leucodendron, White-Tree, or Cajeput-Tree, has alternate long lanceolate acuminated falcate 3-5-nerved leaves; the flower-bearing branches pendulous; the flowers in spikes rather distant, which, as well as the rachis, are quite glabrous. It is a native of the East India Islands, and was at one time supposed to yield the oil of commerce. Roxburgh asserts that it possesses little or no fragrance in its leaves, and that it is seldom or never used for the distillation of the oil which is used in the European markets.

Upwards of 30 species of *Melaleuca* have been described, the majority of which are natives of Australia. Many of them are fine plants with beautiful blossoms, and very desirable for the conservatory or greenhouse. They grow well in a mixture of peat, loam, and sand, and may be propagated by cuttings, which will readily take root if planted in a pot of sand and placed under a hand or bell-glass.

(Lindley, *Flora Medica*; Don, *Dichlamydeous Plants*.)

MELA'MPUS, De Montfort's name for a genus of Turbinated *Mollusca* (*Conovula* or *Conovulus* of Lamarck), placed by Cuvier next to the great genus *Auricula*, and by M. De Blainville and M. Rang under the family *Auriculacea*. De Blainville arranges both *Melampus* (*Conovula*) and *Tornatella* under *Pedipes* (Adanson).

This genus has, like the *Auriculæ*, plaits on the columella or pillar of the shell, but the external lip has no roll or bourrelet, and is finely striated internally. The general contour of the shell is that of a cone, of which the spire forms the base.

M. coniformis may be taken as an example.

Melampus coniformis, a little enlarged.

MELAMPY'RUM (from μέλας, black, and πυρός, wheat), a genus of Plants belonging to the natural order *Scrophularineæ*, or *Scrophulariaceæ*. It has a tubular 4-toothed calyx; a ringent corolla; the upper lip compressed laterally with reflexed margins; the lower lip furrowed, trifid; the capsule oblong, obliquely acuminate, compressed; one or two seeds in each cell, smooth. The species are annual plants, with opposite lanceolate linear entire leaves, with opposite usually secund terminal flowers. Eight species are enumerated by Don, six of which are European and two American. Of the six European four are natives of Great Britain.

M. cristatum, Crested Cow-Wheat, has the spikes densely imbricated, 4-sided, and the bracts heart-shaped. It is a native of woods and thickets in the eastern counties of England, and also generally of the north and middle of Europe.

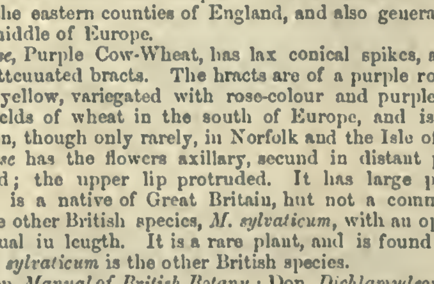
M. arvense, Purple Cow-Wheat, has lax conical spikes, and ovate-lanceolate attenuated bracts. The bracts are of a purple rose-colour; the flowers yellow, variegated with rose-colour and purple. It is a native in fields of wheat in the south of Europe, and is found in Great Britain, though only rarely, in Norfolk and the Isle of Wight.

M. pratense has the flowers axillary, secund in distant pairs; the calyx closed; the upper lip protruded. It has large pale-yellow flowers. It is a native of Great Britain, but not a common plant. There is one other British species, *M. sylvaticum*, with an open calyx, and lips equal in length. It is a rare plant, and is found in alpine woods. *M. sylvaticum* is the other British species.

(Babington, *Manual of British Botany*; Don, *Dichlamydeous Plants*.)

MELANCHLOR. [IRON.]

MELA'NIA, a genus of Gasteropodous *Mollusca*, placed by Lamarck in his family Melanians; by M. De Blainville in his family *Ellipsostomata* [ELLIPSOSTOMATA]; by Cuvier in his order *Pectinibranchiata*, between the genera *Helicina* and *Rissoa*; and by M. Rang under the order last mentioned, and in the first family of it (Turbinés of De Férussac), between the sub-genera *Paludina* and *Rissoa*.



Animal and Shell of *Melania* (*Pirena*) *aurita*.

a, operculum.

The animal elongated, with a foot which is ordinarily short and not thick; head proboscidiform, subconical, truncated, and terminated by a buccal slit which is small and longitudinal; one pair of tentacles elongated, filiform, carrying the eyes on the external side, sometimes near the base, sometimes towards one-fourth of their length; mantle open, with festooned edges; operculum horny, elongated, and narrow, with an apical and paucispiral summit. (Deshayes.)

Shell with an epidermis, of an oval oblong, a pointed spire, which is often elongated or turriculated, and an oval aperture which is widened anteriorly, and has a very sharp edge.

It inhabits the rivers of warm climates generally, and of Asia especially. Species are also recorded from Africa and North and South America. Mr. Conrad has described several new species from the rivers of Alabama.

M. Deshayes thus divides the *Melaniæ*:—

a. Shell oval or sub-turriculated.
Ex. *M. amarula.*

Melania amarula.

β. Shell elongated, turriculated.
Ex. *M. truncata.*

γ. Shell with the inferior angle detached.
Ex. *M. costellata.*

δ. Shell with a bordered aperture.
Ex. *M. marginata* and *M. subulata.*

Melania subulata.

Lamarck gives the rivers of the East Indies, Madagascar, the Mauritius, &c., as the locality of *M. amarula*, the animal of which, he says, is very bitter, and passes for an excellent remedy for the dropsy.

The apex of all the species is generally eroded as the animal advances in age.

Woodward, in his 'Manual,' says, there are 160 recent species. The following are sub-genera:—*Melanatria*, Bowdich; *Vibex*, Oken; *Ceriphasia*, Sw.; *Hemisinus*, Sw.; *Melafusus*, Sw.; *Melatoma*, Anthony; *Anculotus*, Say; *Amnicola*, Anthony; and *Pachystoma*, Gray.

Fossil Melaniæ.—M. Deshayes, in his 'Tables' (Lyell, 1833), makes the number of living species 34, and the number of fossil (tertiary) 25. The species recorded as both living and fossil (tertiary) are—*Melania inquinata*, *M. inflexa*, *M. Cambessedesii*, and a new species. The habitations allotted to the living species of *M. inquinata*, *M. inflexa*, *M. Cambessedesii*, and the new species, are—the Philippine Isles, the Mediterranean, and the lakes of Como and Geneva. *M. lactea*, *M. nitida*, and *M. costellata* are noticed as fossil species found in more than one tertiary formation. In the last edition of Lamarck (1838) the number of recent species is 36, and of these *M. inquinata* only is noted as occurring in a fossil state. The number of fossil species recorded in this edition is 8, and of these M. Deshayes notes the species *M. costellata*, *M. marginata*, and *M. nitida* as not being *Melaniæ*, *M. nitida* having all the characters of the genus *Eulima*. The other two M. Deshayes keeps provisionally among the *Melaniæ*. *Melania semiplicata*, another of the eight, he conceives to be a variety of *M. lactea*, and is of opinion that it should be expunged from the catalogue.

Dr. Mantell records two species (*M. sulcata* and *M. costellata?*) in the Blue Clay of Bracklesham. Professor Phillips notes a *Melania* (?) in the Speeton Clay, and two species (*M. Heddingtonensis* and *M. striata*) in the Coralline Oolite, *M. Heddingtonensis* and *M. vittata* in the Cornbrash, and *M. Heddingtonensis* and *M. striata* in the Bath Oolite. In the table at the end of his work ('Geology of Yorkshire') he records *Melania striata* in the Coralline and Bath Oolite, *M. Heddingtonensis* in the Coralline Oolite, Cornbrash, and Inferior Oolite, *M lineata* in the inferior Oolite, and *M. vittata* in the Coralline Oolite and Cornbrash. Dr. Fitton records *Melania Heddingtonensis* in the Oxford Oolite (Dorset and Oxford).

MELANIADÆ, *Melanians*, Lamarck's name for a family of fluviatile, testaceous, operculated *Mollusca*, breathing water only, and belonging to the order *Trachelipoda.* The family consists of the genera *Melania*, *Melanopsis*, and *Pirena*, according to Lamarck, and Mr. G. B. Sowerby, Jun. ('Conchological Manual'), suggests that to these may be added *Anculosa* and *Pasithæa.* M. Deshayes, in the last edition of Lamarck, adds the genera *Eulima* and *Rissoa* to *Melania*, *Melanopsis*, and *Pirena*, the latter of which, it seems, should be expunged. In Woodward's 'Manual of the Mollusca' the *Melaniadæ* include the genera *Melania* [MELANIA], *Paludomus*, and *Melanopsis.* [MELANOPSIS.]

MELANITE. [GARNET.]

MELANOCHLORITE, a native Chromate of Lead, containing 23·64 of chromic acid. It has a dark-red colour, with a brick-red streak. It occurs in tabular crystals reticulately arranged. It comes from Siberia.

MELANOPSIS, a genus of fresh-water Testaceous Turbinated *Mollusca*, to which Lamarck assigns a position among his family of Melanians. M. De Blainville places it in his family *Entomostomata*, between *Cerithium* and *Planaxis;* and M. Rang, who includes in it the genus *Pirena*, between *Scalaria* and *Planaxis.*

The genus *Melanopsis* was established by M. De Férussac, and much difference of opinion appears to have existed among zoologists as to its proper place in the series. M. Deshayes, in the last edition of Lamarck, gives it as his opinion that it should be arranged in the family of Melanians; and he observes that if one considers the zoological and conchological characters of the two genera *Melania* and *Melanopsis*, the conviction that they should be united soon arises. He remarks that M. De Férussac gave, in the first volume of the 'Memoirs of the Society of Natural History of Paris,' an interesting account of the animal of the *Melanopsides*, which he had observed in Spain in the neighbourhood of Seville and of Valencia, and that M. Quoy has since made known the animal of *Pirena terebralis* of Lamarck; so that the means are now at hand for comparing with exactness the three principal types of the family of Melanians, and of observing the analogy of their zoological characters.

"If," continues M. Deshayes, "we have before us a great number of species of *Melaniæ* and *Melanopsides*, living and fossil, we remark a phenomenon entirely similar to that which we have pointed out with relation to the genera *Bulimus* and *Achatina;* that is to say, that we have seen the columellar truncation established by nearly insensible degrees from the most uncertain commencement to a notch as deep as that which marks the *Buccina.* If, in relying on the identity of the organisation of the *Bulimi* and *Achatinæ*, we have been able to reduce almost to nothing the value of the character of the columellar truncation, we are authorised to employ here the same means for demonstrating the little importance which the truncation of the columella in the *Melanopsides* ought to have in the eyes of zoologists as a ground for separating them from the *Melaniæ.* Already we have explained ourselves as to the value of the genus *Pirena*, and have shown that it was composed by Lamarck from heterogeneous materials: on one side we find true *Melaniæ*, and on the other singular shells, approximating in their characters to certain *Cerithia* which Linnæus comprised among his *Strombi.* On approximating these species we soon find that they have all the principal characters of *Melanopsis*, and that they do not in reality differ from them, except by a notch in the right lip, which notch occupies in these species the place of the posterior gutter in the bucciniform *Melanopsides.* M. De Férussac clearly perceived the relation of these shells to the *Melanopsides*, and joined them to that group, leaving in the genus *Pirena* only those which we actually comprise among the *Melaniæ.* Thus dismembered, the genus *Pirena* should be expunged from the system."

M. Deshayes observes that the *Melanopsides* inhabit the fresh-waters of the south of Europe, and particularly those in the neighbourhood of the Mediterranean; and that they show themselves abundantly in a fossil state in the greater part of the tertiary beds of Europe. He remarks that M. De Férussac has noticed that among the fossil species in our temperate countries there are some analogous to those which live in much warmer regions—an interesting fact, from which he has been led to conclude that the lowering of the temperature had been a sufficient cause for the destruction of the races which once lived in the centre of France. M. Deshayes states that he had objected to M. De Férussac drawing a conclusion so general from so confined a number of observations; and he thinks that, in order to establish a fact so important as that of change of temperature by the aid of observations on the molluscs, it would be necessary to find a great collection of facts, not only regarding the fresh-water molluscs, but also respecting those which inhabit the sea. He has, he says, collected these facts, and is thus able to estimate approximatively the temperature proper to each of the principal tertiary epochs.

Melanopsis, Fér., and *Pirena*, Lam., have the following generic characters:—Animal with a proboscidiform muzzle and two contractile tentacula, which are conical, annulated, and each with an oculated peduncle at their external base; foot attached to the neck, very short, oval, angular on each side anteriorly; respiratory orifice in the gutter formed by the union of the mantle with the body. Operculum horny, subspiral.

Shell with an epidermis, elongated, fusiform or conicocylindrical, with a pointed summit; spire consisting of from 6 to 15 whorls, the last often forming two-thirds of the shell; aperture, oval, oblong; columella twisted, solid, callous, truncated at its base, separated from the external border by a sinus, the callosity prolonging itself on the convexity of the penultimate whorl, forming a gutter backwards; sometimes a sinus at the posterior part of the right lip.

α.—A single sinus at the external border of the aperture, separating it from the columella. (Genus *Melanopsis*, Lam.)

Ex. *M. prærosa* (*M. lævigata*, Lam.; *Melania buccinoidea*, Oliv.; *Melanopsis buccinoidea*, Fér.).

Melanopsis prærosa.

β.—Two distinct sinuses at the external border of the aperture, one which separates it from the columella, the other situated near the union of this border with the penultimate whorl.

Ex., *M. atra* (*Pirena terebralis*, Lam.; *Strombus ater*, Linn.).

It is found at Madagascar.

Melanopsis atra.

Fossil Melanopsides.—Mr. G. B. Sowerby, who also includes the genera *Melanopsis* and *Pirena* under the first generic appellation, says, "We are not aware that any of the *Melanopsides* are marine, for all the recent species occur either in rivers or lakes, and yet most of the fossil species are found in beds that are considered by geologists (in this country) to be of marine formation. We know not what degree of credit is to be given to the assertion of a celebrated author, 'that the greater number of the genera of the *Pectinibranchia* might formerly have contained species peculiar to rivers and lakes as well as to the sea,' but this we do know, that wherever the fossil *Melanopsides* are found, they are accompanied by many other species of genera that at present only live in fresh-water; and therefore we think they ought to be considered as characteristic of the formation in which they occur."

M. Deshayes, in his 'Tables,' makes the number of living species of *Melanopsis* ten, of fossil species (tertiary) eleven, and notes *Melanopsis buccinoidea* (*prærosa*), *M. Dufourei*, *M. costata*, *M. nodosa*, *M. acicularis*, *M. incerta*, as species occurring both living and fossil (tertiary). He assigns as habitations to the latter, Asia, Spain, Greece, and Laybach. Of *Pirena* he makes the number of living species three, and of fossil (tertiary) two. In the last edition of Lamarck, M. Deshayes gives nine recent species, and of these he notices *M. costata*, *M. prærosa*, *M. nodosa*, *M. Dufourei*, and *M. acicularis* (?) (*M. subulatus*, Sow., 'Min. Con.'), as occurring in a fossil state, observing that it is to be presumed that the species found fossil at Dax is to be distinguished from *M. Dufourei*, which occurs in a fossil state in the Isle of Rhodes. The number of species which are fossil only he makes seven. The number of recent species of *Pirenæ* he gives as four, but records none as fossil only. Under *Pirena terebralis* (*M. atra*) is a reference to Férussac's Fossil *Melanopsides* pl. 2, f. 7, &c.

Dr. Fitton records three species with a query, two under the names of *M. attenuata* (?) and *M. tricarinata* (?), in the Weald Clay (Dorset), and Hastings Sand (Sussex), and the third, without a name, in the Purbeck Beds (Bucks).

Woodward gives 20 recent species and 25 fossil. The latter are all Eocene.

MELANORRHŒA, a genus of Plants belonging to the natural order *Anacardiaceæ*, so called from the brown fluid with which every part of the principal species abounds turning black upon exposure to the air.

M. usitata, familiarly known as the Birmese Varnish-Tree, or Theetsee, was not described by botanists until discovered by Dr. Wallich, and figured in his splendid work 'Plantæ Asiaticæ Rariores,' t. 11 and 12. The tribe to which it belongs abounds in plants yielding a blackish, acrid, and resinous juice used for varnishing and other such purposes, as the Marking Nut and the Japan Varnish-Tree. This tree was first seen near Prome, and is found in different parts of Birma and along the coast from Tenasserim to Tavoy, extending from the latter in 14° to 25° N. lat., as Dr. Wallich has identified it with the Kheu or Varnish-Tree of Munipoor, a principality in Hindustan, bordering on the north-east frontier districts of Silhet and Tippera. It grows especially at Kubbu, an extensive valley elevated about 500 feet above the plains of Bengal, and 200 miles from the nearest sea-shore. There it attains its greatest size, some, and those not the largest, having clear stems of 42 feet to the first branch, with a circumference near the ground of 13 feet. It forms extensive forests, and is associated with the two staple timber-trees of continental India, Teak and Saul (*Tectona grandis* and *Shorea robusta*), especially the latter, and also with the gigantic Wood-Oil Tree, a species of *Dipterocarpus*.

The Theetsee forms a large tree, with the habit of *Semecarpus*, and abounds in every part with a viscid ferruginous juice, which quickly becomes black by the contact of the atmosphere. Its leaves are large, coriaceous, simple, very entire, and deciduous. The panicles of flowers are axillary, oblong; those of the fruit simple and lax, with very large rufous and finally ferruginous involucres. It sheds its leaves in November, and continues naked until the month of May, during which period it produces its flowers and fruit. During the rainy season, which lasts for five months, from the middle of May until the end of October, it is in full foliage.

Birmese Varnish-Tree (*Melanorrhœa usitata*). A branch with leaves.

At Prome a considerable quantity of varnish is extracted from this tree, but very little at Martaban. It is collected by inserting a pointed joint of a bamboo, which is closed at the other end, into wounds made in the trunk and principal boughs, which are removed after 24 or 48 hours, and their contents, which rarely exceed a quarter of an ounce, emptied into a basket made of bamboo and rattan previously varnished over. The collecting seasou lasts from January to April. Iu its purc state it is sold at Prome at about 2*s.* 6*d.* for about 3½ lbs. avoirdupois. (Wallich.) Mr. Smith, who was long resident at Silhet, aud was acquainted with this substance in 1812, states that it is procurable in great quantities from Munipoor, where it is used for paying river-craft and for varnishing vessels designed to contain liquids. The drug, he says, is conveyed to Silhet for sale by the merchants, who come down annually with horses and other objects of trade. In Birma, Dr. Wallich states that almost every article of household furniture intended to contain either solid or liquid food is lacquered by means of it. The process consists in first coating the article with a layer of pounded calcined bones, after which the varnish is laid on thinly, either in its pure state or variously coloured. The most difficult part consists in the drying. It is also much employed in the process of gilding: the surface, being first besmeared with this varnish, has then the gold leaf immediately applied to it. Finally, the beautiful Pali writing of the Birmese on ivory, palm-leaves, or metal, is entirely done with this varnish in its native and pure state. Some difference of opinion exists as to the effects of this juice on the human frame. Dr. Wallich states that it possesses very little pungency, and is entirely without smell, and that both Mr. Swinton and himself have frequently exposed their hands to it without any serious injury, and that the natives never experience any injurious consequences from handling its juice; but he has known instances where it has produced extensive erysipelatous swellings attended with pain and fever. Sir D. Brewster, on the contrary, considers it a very dangerous drug to handle, one of his servants having been twice nearly killed by it. A second species of the genus, *M. glabra*, was obtained by Dr. Wallich from Tavoy. (Wallich, 'Pl. As. Rar.,' i., p. 9, t. 11 and 12; and 'Edinb. Journ. of Science,' viii., p. 96 and 100.)

Birmese Varnish-Tree (*Melanorrhœa usitata*).
A naked fruit-bearing branch, with the large involucres.

MELANOSPERMEÆ, or FUCALES (Harvey), the first sub-class of the class *Algæ*. [ALGÆ.] It consists of plants of an olive-green or olive-brown colour. Fructificatiou monœcious or diœcious; spores olive-coloured, either external, or contained singly, or in groups, in proper conceptacles, each spore euveloped in a transparent skin (perispore), simple, or finally separating into several sporules; antheridia, or transparent cells, filled with orange-coloured vivacious corpuscles, moving by means of vibratile cilia. It includes the following orders:—

Fucaceæ.—Spores contained in spherical cavities immersed in the frond. [FUCACEÆ.]

Sporoclinaceæ.—Spores attached to external jointed filaments, which are either free or compacted together in knob-like masses.

Laminariaceæ.—Spores forming indefinite cloud-like patches, or covering the whole surface of the frond.

Dictyotaceæ.—Spores forming definite groups (sori) on the surface of the frond.

Chordariaceæ.—Frond cartilaginous or gelatinous, composed of vertical and horizontal filaments interlaced together. Spores immersed.

Ectocarpaceæ.—Frond filiform, jointed. Spores external.

(Harvey, *British Marine Algæ.*)

MELANTERITE a native Sulphate of Iron (*Green Vitriol*). It occurs massive, fibrous, earthy, and crystallised. Primary form an oblique rhombic prism. Cleavage parallel to the primary planes. Colour green, with shades of yellow or brown. Streak white. Fracture conchoidal. Hardness 2·0. Brittle. Lustre vitreous. Transparent, translucent. Taste astringent. Specific gravity 1·84. Massive varieties amorphous; structure granular, botryoidal, reniform, stalactitic. It is formed by the decomposition of iron pyrites, aud is frequently found in coal-mines. It is found at Hurlet near Paisley, and Campsie, Scotland. The following analysis is by Berzelius:—

Sulphuric acid	28·8
Protoxide of Iron	25·7
Water	45·4
	99·9

MELANTHA'CEÆ, *Melanths*, a natural order of poisonous Endogenous Plants very nearly related to *Liliaceæ*, from which indeed they are only to be distinguished with certainty by their anthers being turned towards the sepals and petals, and by their styles or carpels being distinct or at least separable. The species vary exceedingly in their appearance, some being subterranean-stemmed herbaceous plants, producing a few flowers without their leaves just above the surface of the ground, as is the case with *Colchicum*; others forming a stem of considerable size with large leaves and numerous flowers. The consequence of this difference in their mauner of growth is a considerable variation in the appearauce of the species, but they are all found to conform to the characters of *Liliaceæ*, with the difference above explained. *Iridaceæ*, to which they bear a striking resemblance, because of the similarity between *Colchicum* and *Crocus*, are readily distinguished by their inferior fruit and triandrous flowers.

The most important species of this order are medical plants, namely, *Colchicum*, or Meadow Saffron, which is employed as a remedy for gout and rheumatism [COLCHICUM]; *Veratrum album*, whose acrid poisonous rhizoma is White Hellebore [VERATRUM]; *Asagræa officinalis* and *Veratrum Sabadilla*, both of which furnish the seeds called Cebadilla, now largely consumed in the preparatiou of Veratria [CEBADILLA]; and a few North American plauts of less moment. [TOFIELDIA; HELONIAS.]

1, a diminished figure of *Veratrum Sabadilla*; 2, an expanded flower; 3, a vertical section through part of the ovary; 4, a ripe seed-vessel.

MELASOMA. [HETEROMERA.]

MELA'STOMA (from μέλας, black, aud στόμα, a mouth, because the berries when eaten stain the mouth black), a genus of Plants, the type of the natural order *Melastomaceæ*. It has the tube of the calyx ovate, half-adhering to the ovary, densely covered with scales or bristles; the limb 5- rarely 6-cleft, the segments alternating with the appendages, both deciduous; the petals 5-6; the stamens twice the number of the petals; the anthers oblong linear, a little arched, opening by a pore at the apex, each furnished with a stipe-formed connective, which is in some species elongated and in others short, but always biauriculate or emarginate in front; the free part of the ovarium conical and bristly: the style filiform, somewhat thickened at the apex; the stigma a pruinose dot; the capsule baccate, 5-6-celled, opening irregularly; the seeds cochleate. The species of this genus are shrubs, which are usually covered with strigæ. The leaves are petiolate, and either quite entire or serrulated. The flowers are large, white, rose-coloured, or purple.

M. Malabathricum, Malabar Melastoma, is a shrubby plant with tetragonal branches rough from strigæ; the leaves elliptic-oblong, obtuse at the base, acute at the apex, quite entire, green on both surfaces, and scabrous from strigæ; the corymbs 1-5-flowered; the calyx clothed with adpressed strigose scales, with ovate acute lobes; the connectives of the anthers short, or very long. It is a native of the East Indies, and frequent in the Indian Archipelago. The leaves of this plant are employed by the natives where it grows as a remedy in diarrhœa, dysentery, and mucous discharges.

Between 30 and 40 species of *Melastoma* have been described. They grow in the warmer districts of the Old and New World, and are found in South America, Asia, and Africa. Their flowers are very handsome, and all the species may be cultivated for ornament. They grow well in a mixture of loam, peat, and sand, and young cuttings root freely in sand in heat under a hand-glass.

(Lindley, *Vegetable Kingdom;* Don, *Dichlamydeous Plants.*)

MELASTOMA'CEÆ, *Melastomads*, an extensive natural order of Polypetalous Exogenous Plants, nearly related to *Myrtaceæ*. They have opposite ribbed leaves without any trace of dots; anthers prolonged into a beak, and having in the bud their points curved downwards, and inserted into sockets between the side of the ovary and that of the calyx; the ovary itself is many-celled and many-seeded, and connected with the calyx by vertical plates, which form the partitions between the sockets in which the anthers are confined. The species are extremely numerous in tropical countries, where they usually form bushes or small trees, and are scarcely known beyond the tropics, with the exception of some Rhexias, which straggle into North America. In Europe the order is unknown, unless in gardens, where many species are cultivated for the sake of their gay purple or white flowers. Some of the species bear berries, which are eatable, and stain the mouth a deep purple, whence their name *Melastoma*, or black-mouth. Others are slightly astringent; some yield dyes and edible fruits: none are poisonous.

2 1 4 3

1, a branch of *Rhexia speciosa;* 2, a vertical section of the flower; 3, a calyx; 4, a transverse section of the ovary.

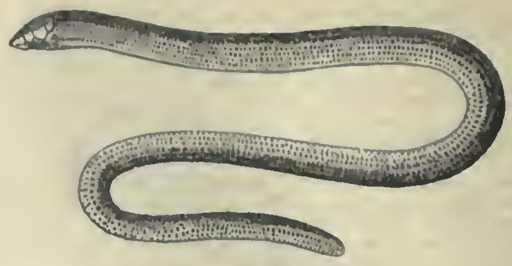
MELEAGRINA. [AVICULA; MALLEACEÆ.]

MELEAGRIS, the specific name of a species of *Acontia* (Cuvier), a genus of Snakes, described in the article ACONTIAS. By an error in the 'Règne Animal' a wrong figure is given: the species to which Cuvier refers in 'Seba' is the one given at the top of next column.

MELEA'GRIS. [PAVONIDÆ.]

MELES. [BADGER.]

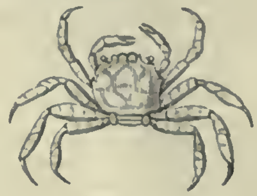
ME'LIA (Zoology), Latreille's name for a genus of *Crustacea* (*Lybia* of Milne-Edwards, who has since withdrawn the name in favour of Latreille's prior appellation). This form approximates to *Pilumnus*, but has also some analogy with *Grapsus*.



Acontia Meleagris.

M. tessellata: Colour whitish, with red lines. Some hairs on the feet. Length about five lines.

It inhabits the island of Mauritius.



Melia tesselata.

ME'LIA (so called from Μελία, the Greek name of the Common Ash, which one species of the genus is thought to resemble in foliage), a genus of Plants belonging to the natural order *Meliaceæ*, to which it has given its name, and which is, like *Melia*, characterised by having the filaments of the anthers combined into a tube, with the anthers sessile within it, and opening inwards; the seeds without wings. The species are few in number, and chiefly Indian; one is naturalised in the south of Europe, and one is found in North America.

2 1 3 4

Meliaceæ.

1, *Trichilia spondioides;* 2, an expanded flower; 3, a ripe fruit; 4, a transverse section of the same.

M. Azadirachta, the Neem-Tree or Margosa-Tree of the peninsula of India, has been separated into a distinct genus on account chiefly of its ternary, not quinary, structure of the parts of the pistil, and its single-seeded fruit. This has been named *Azadirachta* from the Persian (Azad-I-Durukht, 'the excellent tree'). Its bark is bitter, and considered a valuable tonic. The fleshy part of the fruit (like that of the olive) yields a fixed oil, which is bitter, and considered anthelmintic and stimulant. The leaves are universally used in India for poultices, and both the flowers and seeds are irritating and stimulant. According to Dr. Ainslie a kind of toddy is procured by fermenting the sap of healthy young margosa-trees.

M. Azedarak, sometimes called Persian Lilac, Pride of India, and Common Bead-Tree (Hill Margosa by Dr. Ainslie), is said by Dr. Roxburgh to be a native of China; it is also a native of the north of India. It is much cultivated in the southern parts of the United States of America. It is called Dek in the northern provinces of India, and may be confounded with another species under the name *Azedarach* by Avicenna. When in flower it has some resemblance to the Lilac, and its flowers are very fragrant. The berries are sweetish, and, though said to be poisonous, are eaten by children in the United States without inconvenience, but are reputed to be a powerful vermifuge. The bark of the root in its recent state has a bitter nauseous taste, yielding its virtues to boiling water, and is cathartic and emetic, and considered in the United States an efficient anthelmintic, and also useful in infantile remittents.

M. Bukayun is distinguished by Dr. Royle from the West Indian *M. sempervirens* of Schwarz, with which it was united by Dr. Roxburgh. This tree appears to be a native of Persia, though common throughout India. It is called by the Arabs Ban, and by the Persians Azad-i-Durukht. It is probable therefore that this may be one of the trees included under the *Azedarach* of Avicenna. The seeds are bitter, and considered laxative and anthelmintic, as is also the bark. *M. tomentosa* is a species found in the island of Penang; and *M. composita*, in which are included both *M. superba* and *M. robusta*, is a species found in Malabar and Mysore.

MELIA'CEÆ, *Meliads*, a natural order of Polypetalous Exogenous Plants, distinguished from all others by their stamens being united into a complete cup, within and often below the rim of which the anthers are inserted. It consists of trees or shrubs with alternate often compound leaves, inhabiting all countries within the tropics, but very rare in colder climates; *Melia Azedarach*, or Bead-Tree, a Syrian plant, now naturalised in the south of Europe, forming the principal exception. [MELIA.] In general the species are bitter and astringent, but they are sometimes dangerously poisonous, acting violently as emetics and purgatives. Notwithstanding this, the pulpy fruit of the *Lanseh* is esteemed in the Indian Archipelago; and that of *Milnea edulis* is eaten in Silhet, where it seems to resemble the Litchi and Longan of China. There are 33 genera and 150 species.

ME'LICA, a genus of Plants belonging to the family of Grasses. It has nearly equal glumes, with lateral ribs nearly as long as the ovate spikelet of 1 or 2 flowers, rounded on the back, and a club-like rudiment of 1 or 2 more; the paleæ hardening on the loose fruit; the styles terminal. There are two British species of this genus, *M. uniflora* and *M. nutans*, which are found in damp shady woods. (Babington, *Manual of British Botany*.)

MELICERTA. [ACALEPHÆ.]

MELILO'TUS (from μέλι, honey, and λωτός, lotus), a genus of Plants belonging to the natural order *Leguminosæ*. It has a calyx with 5 nearly equal teeth, the keel obtuse, the filaments filiform, the ovary straight, the pod subglobose or oblong, 1-celled, 1-4-seeded, longer than the calyx; the petals distinct, deciduous. The species are herbaceous plants with stipules adnate to the petiole, and trifoliate leaves with usually toothed leaflets. None of them are ornamental plants, and they are seldom cultivated except in botanical collections. Two of the species are used as fodder for animals. Three species are found native in Great Britain.

M. officinalis, the Common Melilot, has lax racemes, with the corolla twice as long as the calyx; the wings, keel, and standard equal; the pods ovate, acute, compressed, transversely wrinkled, hairy; the leaflets serrate, truncate, narrowly ovate; the stipules setaceous, entire. It grows wild in woods, hedges, and neglected fields. When cultivated in a dry soil and made into hay it has a powerful aromatic smell, and mixed in a small proportion with meadow-hay gives it an agreeable flavour. This plant is used in making the Swiss cheese called Schabzieger. It is ground in a mill, and mixed with the curd into a kind of paste, which is put into conical moulds and there dried. [CHEESE, in ARTS AND SC. DIV.]

M. vulgaris has the wings and keel equal, but shorter than the standard; the pods ovate, obtuse, mucronate, reticulate, rugose, and glabrous. It is a rare plant, and is found in sandy and gravelly places near the sea.

M. arvensis has the wings and standard equal, longer than the keel; pods ovate, obtuse, mucronate, rounded, and slightly keeled on the back, transversely plicate, rugose, glabrous. The flowers are yellowish, in long racemes. It is found in waste places in Cambridgeshire.

M. Messanensis, Messina Melilot, has an erect stem, with obovate-cuneated denticulated leaflets; the stipules broad at the base, toothed, linear at the apex; the racemes few-flowered; the teeth of the calyx nearly equal, hardly shorter than the tube; the legume lanceolate, acute, very much nerved, 1-seeded; the seeds ovate, compressed, large, black, rugged from dots. This plant is a native of Barbary, Sicily, Piedmont, and the Straits of Messina. It is the Λωτός of Theophrastus, 'Hist. Plant,' lib. 7, cap 9 and 14; the Λωτός ἥμερος of Dioscorides, lib. iv., cap. 171. It is also the *Lotus* of the Romans (Pliny, xiii. 17; xxxii. 21; Virgil, 'Georgic.,' ii. 84, and iii. 394).

None of the species of this genus are worth cultivating as ornamental plants. They may be easily propagated by seeds, which should be sown in the open border in spring. A light dry soil suits them best.

(Fraas, *Synopsis*; Babington, *Manual of British Botany*; Don, *Dichlamydeous Plants*.)

MELI'NA, Schumacher's name for the genus *Perna*. [MALLEACEA.]

MELIPHAGA. [MELIPHAGIDÆ.]

MELIPHA'GIDÆ, Honey-Suckers, a family of Tenuirostral Birds. Mr. Vigors, in his paper 'On the Natural Affinities that connect the Orders and Families of Birds' ('Linn. Trans.,' vol. xv.), thus generally refers to the *Meliphagidæ*. "That extraordinary group, the existence of the much more considerable portion of which was unknown to the Swedish naturalist, for which there was consequently no place in his system, occupies a prominent and important situation in the ornithological department of nature. Chiefly confined to Australasia, where they abound in every variety of form; and in an apparently inexhaustible multitude of species, they find a sufficient and never-failing support in the luxuriant vegetation of that country. There the fields are never without blossom, and some different species of plants, particularly the species of *Eucalyptus*, afford a constant succession of that food which is suited to the tubular and brush-like structure of the tongue in these birds. Their numbers and variety seem in consequence to be almost unlimited. Like the Marsupial Animals of the same country, a group to all appearance equally anomalous, which contains within its own circle representatives of all the other groups of the *Mammalia*, this division of birds comprises every form which is observable among the families of the *Insessores*. From the powerfully constructed and strong-billed *Corvidæ* and *Orioli*, down to the slender *Merops* and the delicately shaped *Cinnyris*, every Insessorial group has its analogous type in this family. Their approach to the Scansorial tribe is strongly conspicuous. The hind toe of the greater portion of the group is long, powerful, and apparently formed for climbing, as Mr. Lewin has pointed out in his generic description of *Meliphaga* ('Birds of New Holland'). In this point of view they seem in Australasia to supply the place of the genuine *Pici*; no species of Woodpecker, as far as I have been able to ascertain, having hitherto been found in that country. This strong affinity to the *Scansores* is preserved by their forming one of the extremes of the present circle, which comes in contact with that tribe. I have indeed some doubts whether, in consequence of this affinity, they may not be even still more intimately united to that group, and form the immediate point of junction of the present tribe with the *Certhiadæ*. I have consequently entered them and their conterminous families into the tabular series with a mark of uncertainty. Time, with more accurate examination of their manners and internal economy, will clear away, it is to be hoped, these and similar points of doubt respecting groups so interesting. The following facts however are, I think, sufficiently decided, namely, that the three groups, the *Promeropidæ*, *Meliphagidæ*, and *Nectariniadæ*, constitute distinct and prominent divisions in the tribe, of which, by that generally stronger and more perfect conformation which distinguishes them from the more typical families, they form the aberrant groups; that they are united among themselves by general affinities; and that they connect the tribe on each side with the conterminous tribes that approach it, that is, with the *Scansores* at the one extreme, and with the *Fissirostres*, where we first entered on the order, at the other."

Mr. Swainson ('Classification of Birds,' vol. i.), after observing that he never had the opportunity of examining the tongue of the African Sun-Birds (*Cinnyridæ*), states that by a fortunate chance he had discovered that the type among the Australian Honey-Suckers (*Meliphagidæ*) which represents the *Trochilidæ*, has the tongue constructed precisely the same as in those birds. "This brings us," continues Mr. Swainson, "to the second description of extensible or rather of suctorial tongues, and which is of a form almost peculiar to the honey-suckers of Australia and its islands. In these birds the tongue is not nearly so extensible as in the *Trochilidæ*, being seldom more than half as long again as the bill; nor are the bones of the os hyoides carried back upon the skull, as in the woodpeckers and humming-birds. Nevertheless the structure appears especially adapted for suction; the form of the lower part is the same as in ordinary birds, but the end is composed of a great number of delicate fibres or filaments exactly resembling a painter's brush. Lewin, who drew and described these birds in their native region, has figured the tongue of the Warty-Faced Honeysucker (*Meliphaga Phrygia*) ('Birds of New Holland,' pl. 4), and describes the bird as sometimes to be seen 'in great numbers, constantly flying from tree to tree (particularly the blue gum), feeding among the blossoms by extracting the honey with their long tongues from every flower as they passed.' What will appear still more extraordinary to the scientific naturalist is the fact that some birds of this Meliphagous group are actually woodpeckers, and yet retain the typical structure of the tongue of their own natural family. The same observer, speaking of the blue-faced honey-sucker, describes it as being 'fond of picking transverse holes in the bark, between which and the wood it inserts its long tongue in search of small insects, which it draws out with great dexterity.' Now, as Lewin describes this bird as a honey-sucker, we must conclude, until facts prove otherwise, that it has the filamentous tongue of the honey-suckers, but that it is used for the purpose, not of spearing insects, but of catching them by means of the glutinous matter on the filaments, a mode of capturing its prey by no means improbable, provided the insects are of small size. It must not be supposed however that the food of the *Meliphagidæ*, several of which are as large as a thrush, and three or four much larger, is restricted, any more than that of the humming-birds, simply to the nectar of flowers. They indeed feed upon the honey, but, as Lewin declares, combined with the numerous small insects lodged in most of the flowers, which they extract in a dexterous manner with their tongues, peculiarly formed for that purpose. It is clear however, when we come to reflect upon the matter, that birds which are attached to the secretions of particular trees, as are many of the *Meliphagidæ*, can only enjoy their favourite food for a comparatively short season, that is, while the tree or plant is in blossom. They must therefore either feed at other times upon small insects or upon fruit. The two first habits we have shown them to possess; and the last, that of devouring fruits also, is exemplified in the yellow-eared honey-sucker of Lewin, who remarks that 'in the winter season these birds have been seen feeding on the sweet berry of the white cedar in great numbers.'"

Mr. Swainson makes the *Meliphagidæ* the first family of the tribe *Tenuirostres;* and he thus characterises these Honey-Suckers:—Bill the strongest in this tribe (*Tenuirostres*), having the mandible distinctly notched; feet large, strong; the hinder toe much developed; tongue extensible, generally ending in a bunch of filaments.

The following genera and sub-genera are placed by this author under the *Meliphagidæ*.

Meliphaga (Lewin).—Bill moderate or short, weak: the under mandible not thickened; lateral toes unequal: the inner the shortest; tail rounded or graduated; tongue bifid: each division ending in numerous filaments. (Sw.)

Sub-genera:—*Meliphaga*.

Ex. *M. barbata*. ('Ois. Dor.,' pl. 57, and *M. Australasiana*.)

Ptilotis (Sw.), leading to *Glyciphila*.

Ex. ('Lew. Bds.,' pl. 5.)

Zanthomiza (Sw.)

Ex. *Z. Phrygia*, Shaw ('Zool. of N. H.,' pl. 4, the tenuirostral type).

Anthochæra (Horsfield and Vigors), the rasorial type.

Ex. *A. carunculata*. (White's 'Voyage,' pl. 6.)

Glyciphila (Sw.).—Habit of *Meliphaga*. Bill either shorter or slightly longer than the head: the notch in the upper mandible far removed from the tip; tongue rather short, terminated by numerous filaments; the third and three following quills longest and nearly equal; lateral toes equal; tail even. (Sw.)

Ex. *G. fulvifrons*. (Lewin, 'Nat. Hist. Birds,' pl. 22.)

Anthomiza.—Habit of *Meliphaga*. Bill rather short; tongue (?); wings much rounded: all the quills more or less terminating in points; tail forked; lateral toes equal; the fissirostral type. (Sw.)

Ex. *A. cærulocephala*. ('Mus. Carl.,' i., pl. 5.)

Leptoglossus (Sw.).—Habit of *Cinnyris*. Bill remarkably long, slender, and curved; tongue retractile, long, bifurcated, as in *Trochilus;* lateral toes unequal; tail nearly even; the tenuirostral type. (Sw.)

Ex. *L. cucullatus*. ('Ois. Dor.,' pl. 60.)

Ptiloturus (Sw.).—Bill much lengthened, slightly curved; the upper mandible dilated, and folding over the base of the under: the margins of both inflected towards their tips; nostrils lengthened: the aperture linear; wings moderate, rounded; the first quill spurious: the four next very broad at their base, and emarginate at the inner web; lateral claws unequal; tail very long, graduated: the middle feathers lax and narrow; the rasorial type. (Sw.)

Ex. *P. Capensis*. (Le Vaill., 'Af.,' vi., pl. 287-288.)

Manorhina (Vieill.).—Bill short, robust; the under mandible thickened: culmen arched, and much elevated from the base, considerably compressed its whole length; commissure curved; upper mandible notched near the tip.

Ex. *M. viridis*. ('Ill. of Orn.,' pl. 78.)

Sub-genera:—*Gymophrys* (*Gymnophrys?*). (Sw.)

Ex. *G. torquatus*. (Lewin, 'Nat. Hist. Birds,' pl. 24.)

Eidopsarus (Sw.).

Ex. *E. bicinctus*.

Entomiza (Sw.).—Bill strong, moderate: culmen much elevated; nostrils large, naked; the aperture large, oval, and placed in the middle of the bill, at the termination of the naked membrane: culmen obtuse, convex; frontal feathers small, compact; hind toe and claw very large, and as long as the middle toe.

Ex. *E. cyanotis*. (Lewin, 'Nat. Hist. Birds,' pl. 4.)

Philedon (Cuv.).—Culmen sharp, carinated; head and face naked; front with an elevated protuberance; hind toe and claw shorter than the middle.

Ex. *P. corniculatus*. (White's 'Voyage,' pl. 16.)

Myzomela (Horsfield and Vigors).—Bill with both mandibles very considerably curved: the sides broad and much compressed; tongue and nostrils as in *Meliphaga;* wings lengthened: the third, fourth, and fifth quills equal; tail short, even; middle toe much longer than the hinder; lateral toes equal.

Ex. *M. cardinalis*. (Lewin, 'Nat. Hist. Birds,' pl. 19.)

Mr. Swainson inquires whether this can be the fifth sub-genus of *Meliphaga?* or an aberrant *Melithreptes?*

Mr. Vigors and Dr. Horsfield, in their 'Description of the Australian Birds in the Collection of the Linnæan Society,' after remarking on the then (1826) imperfect state of knowledge with regard to this group, and the constant influx of new species from Australia and the Australian Islands, observe that the then known species exhibited five prominent modifications of form, according to the variation chiefly of the characters of the bill and tail, and that they wished to consider these types of form as sections only of the group which they name provisionally the genus *Meliphaga*. When the species should become more known, they express their opinions that the sections there marked out might justly be considered genera, and the higher group be denominated *Meliphagina*. "When this sub-division takes place," say our authors in conclusion, "the section which stands first in our text may be considered the true *Meliphiga*." The *Meliphaga Novæ Hollandiæ* will form the type. It may be thus characterised:—Bill rather slender, subelongate; the culmen arched, subcultrated at the base; nostrils longitudinal, linear, very narrow, covered above by a membrane, and exceeding the middle of the bill in length; tongue furnished at the apex with many bristles; wings moderate, somewhat rounded: first quill short; second, third, and fourth (which last is longest) gradually longer; the third and fifth, the second and sixth, equal: external beards (pogoniæ) of the third to the seventh inclusive widest in the middle; tail subelongate, rounded; feet rather strong; hallux subelongate, strong; acrotarses scutellated.

M. Novæ Hollandiæ. Mr. Caley says, "This bird is most frequently met with in the trees growing in scrubs, where the different species of *Banksia* are found, the flowers of which, I have reason to think, afford it a sustenance during winter. In the summer I have shot it when sucking the flowers of *Leptospermum flavescens*. In the scrubs about Paramatta it is very common."

Meliphaga Novæ Hollandiæ.

The following are the sections given by Mr. Vigors and Dr. Horsfield:—

* Tail rounded; bill rather long and slender.
M. Novæ Hollandiæ, M. Australasiana, and *M. melanops*.

** Tail rounded; bill rather shorter, and rather strong.
M. auricomis, M. chrysotis, and *M. leucotis*.

*** Tail equal; bill rather short, strong. (*Melithreptus* of Vieillot?)
M. chrysops, M. lunulata, M. indistincta, and *M. brevirostris*.

**** Tail equal; bill rather short and slender.
M. cardinalis.

***** Tail equal; bill rather slender and longer.
M. tenuirostris, and *M. fulvifrons*.

The other genera recorded by Mr. Vigors and Dr. Horsfield are—*Myzantha* (V. and H.), *Anthochæra, Tropidorhynchus* (V. and H.), *Sericulus* (Sw.), *Mimeta* (King), *Psophodes* (V. and H.), and *Pomatorhinus* (Horsf.).

MELISSA, a reference from article HYMENOPTERA. [MELITTA.]

MELISSA (from μέλισσα, a bee), a genus of Plants belonging to the natural order *Labiatæ*, or *Lamiaceæ*. This genus has been variously defined according to the different views of systematic botanists. Bentham, in his monograph on the *Labiatæ*, has referred about 30 species to this genus. They are all known by the common name of Balms, and some of these species are described under CALAMINTHA. The genus thus extended has the following characters:—The calyx is tubular, 13-nerved, usually striated, bilabiate; the upper lip generally spreading, tridentate; the lower lip bifid; the throat naked or villous inside; the tube of the corolla straight or incurvedly ascending, naked inside, usually exserted; the throat generally inflated; the limb bilabiate, the upper lip erect, flattish, entire, or emarginate; the lower one spreading, with flat lobes, the middle lobe usually the broadest, entire or emarginate; the stamens 4, didynamous, ascending, approximate by pairs at apex, or rarely a little distant, lower two the longest, the superior two sometimes sterile, the filaments toothless, anthers free, 2-celled, the connective often thickened, the cells distinct, parallel, diverging; the lobes of style sometimes equal, subulate with minute terminal stigmas; sometimes the lower lobe is elongated, recurved, flattened, with stigmatiferous margins; the achenia dry and smooth. The species are usually herbs, sometimes under-shrubs, with a variable inflorescence.

The only species of the old genus *Melissa* admitted into the British Flora is *M. officinalis*, Common Balm. It has ovate crenato-serrate acute leaves, paler beneath; the calyx subcampanulate, slightly ventricose in front, distinctly 2-lipped, the upper lip flat truncate, with three short broad teeth, the lower with two lanceolate teeth. This plant, although it has a place in the British Flora is a doubtful native. In its recent state it has a rough aromatic taste, and a pleasant lemon-like smell. It is frequently used in infusion, under the name of Balm-Tree, as a common drink in fevers. It was one of the medicines recommended by Paracelsus, but at the present day it is only used as a popular remedy.

(Don, *Dichlamydeous Plants;* Babington, *Manual of British Botany.*)

ME'LITA (Leach), a genus of Amphipodous *Crustacea*, generally found beneath stones on the sea-shores.

M. palmata (*Cancer palmatus*, Montagu). Colour blackish; antennæ and feet annulated with pale grayish.

Melita palmata, enlarged.

MELITÆA. [ACALEPHÆ; POLYPIFERA.]

MELITHREPTA. [CINNYRIDÆ.]

MELITOPHILUS. [SCARABÆIDÆ.]

MELITTA (Kirby), a name for a genus of Insects belonging to the order *Hymenoptera*, and to the tribe *Mellifera* of Latreille. The genus as originally constituted by Kirby embraced all the Honey Bees known at that time. This genus is now split up into numerous smaller ones. Leach divides the *Mellifera* into two families, *Andrenidæ* and *Chrysididæ*.

The ANDRENIDÆ include the following genera:—

1. *Colletes.*
2. *Prosopis.*
3. *Sphecodes.*
4. *Halictus.*
5. *Andrena.*
6. *Cilissa.*
7. *Macropis,*
8. *Panurgus.*
9. *Dasypoda.*
10. *Megachile.*
11. *Osmia.*
12. *Anthocopa.*
13. *Stelis.*
14. *Ammobates.*
15. *Epeolus.*
16. *Nomada.*
17. *Cœlioxys.*
18. *Melecta.*
19. *Anthidium.*
20. *Heriades.*
21. *Chelostoma.*
22. *Eucera.*
23. *Saropoda.*
24. *Anthophora.*
25. *Apathus.*
26. *Bombus.*
27. *Apis.*

The CHRYSIDIDÆ—

1. *Cleptes.*
2. *Chryris.*
3. *Euchrœus.*
4. *Hedychrum.*
5. *Elampus.*

(*British Museum Catalogue—Hymenoptera.*)

MELITTIS, a genus of Plants belonging to the natural order *Labiatæ*. It has anthers approaching in pairs and forming a cross bursting longitudinally. The upper lip of the corolla flat, entire, straight; lower lip with 3 rounded nearly equal lobes; calyx membranous, bell-shaped, ample, variously lobed.

M. Melissophyllum, Bastard Balm, has oblong, ovate, or slightly cordate leaves. The upper lip of the calyx with 2 or 3 teeth; flowers purple, with a white margin, or variegated in different ways, large. Stem 1 or 2 feet high. *M. grandiflora* (Smith) is only a slight variety. They are both found in woods in the south of England.

(Babington, *Manual of British Botany.*)

MELIZO'PHILUS. [MERULIDÆ; SYLVIADÆ.]

MELLILITE. [SCAPOLITE.]

MELLITE, or *Honey-Stone*, a Mineral, consisting of Mellate of Alumine. It is found in Prussia and Austria. It occurs in square octahedrons, looking like a honey-yellow resin, and may be cut with a knife.

MELLIVORA. [URSIDÆ.]

MELO (Broderip), a sub-genus of *Voluta*. [VOLUTA.]

MELOBE'SIA. [CORALLINACEÆ.]

MELOCACTUS. [CACTACEÆ.]

MELOCRINITES. [ENCRINITES.]

MELOCRI'NUS, a genus of *Crinoidea*, employed by Goldfuss, in his 'Petrifacta Europeæ' for some fossils of the Transition Limestone. [ENCRINITE.]

ME'LOE. The Linnæan genus *Meloe* included the several genera of Heteromerous *Coleoptera* now forming the family *Cantharidæ*, interesting on account of its including those beetles known under the name of 'blistering flies,' and employed in medicine. [CANTHARIDÆ.]

The term *Meloe* is now restricted to the Apterous *Cantharidæ*, and the species are all beetles with large and swollen bodies, and short oval elytra, lapping over each other at the base of the suture. They are sluggish creatures and feed on various plants, especially the species of *Ranunculus*. When alarmed they emit from the articulations of their legs an oily, yellow, or reddish liquid. Latreille maintained that this insect was the *Buprestis* of the ancients, to which noxious qualities were attributed. (See his paper on the subject in the 12th volume of the 'Mémoires du Museum d'Hist. Naturelle.') The nature of the larva of the *Meloe* has been a subject of considerable discussion among entomologists, having been supposed to be a minute, active, parasitic animal found on bees and flies. Most entomologists have held this view since the time of Linnæus, but the observations of Geoffroy, Newport, and Westwood, go far to prove that it is a mistake, and that there is no anomaly in the case.

MELOLO'NTHIDÆ, a family of Coleopterous Insects of the section *Lamellicornes*, and sub-section *Phyllophagi*. This family, of which the Common Cockchafer (*Melolontha vulgaris*) is an example, may be thus characterised:—Labrum transverse, and in most instances deeply cleft in the middle; mentum as long as broad, or with the length exceeding the breadth; sometimes nearly heart-shaped, and sometimes square; the anterior margin either straight or notched in the middle, but without any projecting process or tooth; mandibles strong and horny, and having at most but a single membranous appendage, which is situated in a concavity on the inner margin; the apex truncated, and having two or three denticulations; maxillæ generally horny, and armed in most cases with five or six denticulations; antennæ usually with more than three lamellated joints; all the tarsi terminated by two claws, which are usually furnished with a spine on the under side near the base, and sometimes divided at the apex.

The family *Melolonthidæ* consists of three genera: *Melolontha*, *Rhizotrogus*, and *Serica*, and some sub-genera of minor importance. Species of this family are found in all parts of the world. In the genus *Melolontha* the antennæ are 10-jointed; the terminal 5, 6, or 7 joints are lamellated, and form a large fan-like appendage; in the females the lamellated joints form a smaller club than in the males, owing to their smaller size, and also to a decrease in their number, their being 6, 5, or 4; the labrum is deeply cleft on its lower margin; the claws of the tarsi are furnished with a spine on the under side near the base; the abdomen in the male sex often terminates in a horny pointed process.

Two species of this genus are found in England, the Common Cockchafer, *M. vulgaris*, Fab., of which there is a figure in the article COLEOPTERA, and the *M. fullo*, a large species nearly an inch and a half in length, and which is of a blackish-brown colour, with irregular white markings. This beautiful insect is common in some parts of the Continent, but rare in this country, and has been found chiefly in the neighbourhood of Deal.

The genus *Rhizotrogus* differs from *Melolontha* chiefly in having but three lamellated joints to the antennæ, which are 9-jointed.

R. solstitialis, an insect which makes its appearance in the month of June, and often occurs in great abundance in some parts of this country; it very closely resembles the Common Cockchafer, but is of a smaller size, narrower form, and paler colour.

In the species of *Rhizotrogus*, as in *Melolontha*, the claws of the tarsi are furnished with a spine on the under side at their base; but in the next genus, *Serica*, the claws of all the tarsi are divided at the apex; the body is of a convex ovate form, generally has a silk-like appearance, and changes in hue according with a change in the direction of the light.

S. brunnea, a common insect in England, as well as in various parts of the Continent, is about three-eighths of an inch in length, and of a uniform pale-brown colour; the elytra are rather deeply striated, and, as well as the thorax, thickly punctured.

S. ruricola, another British species of the present genus, is of a black colour; the elytra are reddish-brown, and have the suture and outer margin black. This is a smaller insect than the last (being about three-twelfths of an inch in length), and of a shorter and more rounded form: it also differs in having the palpi obtusely terminated, and not acute, as in *S. brunnea*. This difference in the form of the palpi is considered by many authors of sufficient importance to separate the two insects generically, and by these authors the *S. ruricola* is placed in the genus *Omaloplia*.

The genus *Serica* is found in all the quarters of the globe, and in M. Dejean's 'Catalogue des Coléoptères' there are 60 species enumerated.

In addition to the foregoing three groups, which appear to constitute the more typical *Melolonthidæ*, Latreille places in this family the following six genera:—

Dasyus (Lepel. and Serv.).—This genus contains but few species, and appears to be confined to Brazil; they have the claws of the two anterior tarsi bifid, and those of the other tarsi entire.

Macrodactylus (Latreille).—In this genus all the joints of the tarsi are alike in both sexes, and all the claws are bifid; the legs are very long, and the body is of an elongated and slender form: the thorax is narrower than the elytra, and is contracted both anteriorly and posteriorly.

M. subspinosus, a common insect in some parts of North America, is about three-eighths of an inch in length; the head and thorax are black, but covered with minute yellow scales; the elytra are of a yellowish brown-colour, also covered with yellow scales; the under parts of the body are nearly white, owing to the dense clothing of scales with which they are furnished; the legs are deep-yellow, and the tarsi are black. About seven other species of the present genus are known, nearly all of which inhabit South America.

Diphucephala (Dejean).—The species of this genus are confined to Australia. [DIPHUCEPHALA.]

Plectris (Lepel. and Serv.).—The claws of the intermediate tarsi unequal in size; the larger of these two pairs of claws are bifid, and all the claws of the remaining tarsi are also bifid. Twelve species are known; they inhabit Brazil.

Ceraspis (Lepel. and Serv.)—The species of this genus, all of which inhabit Brazil, may be distinguished by having two small notches near the middle of the hinder margin of the thorax; the space between the notches is received into a notch in the scutellum. The antennæ are 10-jointed: the claws of all the tarsi, with the exception of the anterior pair, are unequal; the larger claw of the intermediate tarsi is entire in the male sex, the other claws are bifid. In the females all the claws are bifid. The body is covered with minute scales, and is of an elongated form.

Areoda (Leach). — Antennæ 10-jointed; sternum produced anteriorly; the claws of the tarsi unequal in the male sex, and equal in the females. The larger claws of the males are bifid. The basal joints of the tarsi are short, and the terminal joint is very large, and grooved beneath. These insects are of large size, and adorned with brilliant colours. In the form of the sternum, and structure of the tarsi and claws, they depart from the true *Melolonthidæ*, and evince an affinity to the *Rutelidæ* and *Anoplognathi*, where, as in the present genus, the species have the power of folding the claws backwards against the under side of the terminal joint of the tarsus (like the closing of the blade of a penknife); and when thus closed the point of the larger claws is lodged between the penultimate and antepenultimate joints of the tarsi.

A. lanigera, a common species in some parts of North America, is rather more than three-fourths of an inch in length, of an oval form, and pale yellow-colour, with green reflections: the under parts of the body are of a dark green-colour, and thickly furnished with white hairs.

There are six other known species of this genus: one is found in Guadaloupe, and the remainder inhabit South America.

MELON. [CUCUMIS.]

MELO'PHUS (Swainson), a sub-genus of *Leptonyx* (Sw.). It is thus characterised:—General structure of *Fringillaria*, but the upper mandible is notched near its tip. Hinder claw lengthened, but rather shorter than its toe. Lateral toes equal. Tail even. Head crested. Tertials not lengthened. (Sw.)—Ex. *M. erythropterus.* ('Ill. of Orn.,' pl. 132.) [FRINGILLIDÆ.]

MELOSIREÆ, a family of *Diatomaceæ*, formed by Kützing. The species are striated, not having a central opening on the secondary side. The striæ are interrupted in the median line. It includes the genera *Gallionella*, *Melosira*, *Podosira*, and others. Meneghini, in his 'Natural History of Diatomeæ,' makes the following critical remarks on this group:—

"The *Melosiræ* in general may be regarded as polypariform associations of *Cyclotellæ*, and the comparison prevails principally in the second sub-genus. The distinction of the two sub-genera is also proposed by Hassall (*Sphærophora*, *Meloseira*); but it is to Kützing we are indebted for establishing it upon the important character of the carina, which occurs only in the first two species (*M. salina*, *M. nummuloides*), a character on whose organographic value we cannot decide anything, but which merits some consideration in a morphological point of view: for that projecting ring bounds the lateral surfaces; whilst in the other species, with sides more or less convex, these are continuous, as it were, with the primary surfaces. In all the species we may notice the double furrow which forms a ring connecting the body of each individual laterally to the interstitial ring; this furrow or canal presents apertures disposed in a regular manner. Kützing believes these supposed apertures to be sections of the canals themselves, that is, portions of them seen in projection. This opinion is the only one consistent with the fact that the filament being cylindrical, and therefore presenting itself indifferently on every side, these apparent apertures are always seen arranged near the margin. Ehrenberg's assertion that they are more numerous in some species, does not seem to be confirmed. This appearance is still more complicated, inasmuch as these fine tubular canals project from the internal surface of the shield, and a slight furrow externally corresponds with them. This condition is evident in *Melosira distans*, in which, owing to the greater depth of the furrow, the apparent perforations remain separated from the margin. The interstitial ring presents peculiarities of which we have no instance in the preceding genera. Its tenuity and the great variety of its extension are important characters. But here we must add the very important one of the changes it undergoes during observation. It is not uncommon to see the two halves of the articulation separate themselves slowly, and enlarge at the same time with the ring. This fact is not decisive in respect to the great question of the animal nature of these beings; for it is not subject to a subsequent contraction, and because in plants we have the analogy of *Spirogyræ*, in which, on the rupture of the outer tube, the extremities of the articulation, which were inflected like the finger of a glove, expand themselves as if by elasticity; but many facts controvert this inference. In support of the opposite opinion is the frequent enlargement of a particular articulation, in a manner similar to that of the *Œdegonia*. But Hassall justly observes, 'for this endochrome . . . never becomes condensed into a distinct organ or sporangium.' For this reason, the resemblance is reduced to a mere appearance. As to this supposed endochrome, proofs are certainly wanting that it is an ovary, as Ehrenberg supposes; but they are also wanting to shew that it consists of gum, starch, or chlorophyll, which would be necessary were it a gonimic substance, as advanced by Kützing; and analogy even is wanting, for we do not see in any *Alga* a similar disposition of the internal substance. The often-quoted resemblance to the *Conferræ* cannot even be deemed apparent; for in no *Conferræ* are distinct spherulæ met so regularly, or disposed so symmetrically. During desiccation it happens in the marine species, as in the *Podosiræ* already described, that the internal substance adheres to the inner wall in the form of oily globules surrounded by a distinct transparent margin, and compressed one against another in the form of regular polygons. Ehrenberg also speaks of diaphanous vesicular spaces, which he regards as stomachs. Kützing enumerates, figures, and describes nineteen species, marine, freshwater, and fossil, besides the four doubtful ones placed at the end, and the famous *Ferruginea* (*M. ochracea*, Ralfs), which he proves not to belong to the class of *Diatomeæ*.

"We shall find, as a character common to them all, the circular figure of the vertical section parallel to the lateral surfaces; a character which, as well as the other, of a radiated disposition of the striæ upon the lateral surfaces, we shall find repeated in the family of *Coscinodisceæ*, which, having the shield of a cellular structure, belong to the tribe of *Areolatæ*. Perhaps we may suspect some *Melosiræ* (*sulcata*, *decussata*, *lirata*) to be furnished with the same organic condition, and hence arises a fresh doubt respecting the systematic value that has been ascribed to it.

"In general we may also say, that in the *Melosireæ* the development of the lateral surfaces prevails over that of the primary ones, which we find finally to disappear in certain genera (*Pyxidicula*, *Podosira*), as well as in some species of *Melosira* (*varians*, *erichalcea*), the increased length of the articulations involving the corresponding development of the primary surfaces: and it is to be observed, that although in this family the primary surfaces differ precisely as much in form as they do in the three preceding ones, yet we find in these the same organic character as in the greater number of the other genera, namely, the presence of longitudinal furrows or canals. The separation of one lateral surface or valve from the other, with the consequent dilatation of superficies, which the primary surfaces exhibit before the duplication takes place (though verified to some degree in other genera, yet in the *Melosiræ* better than elsewhere), presents an undeniable analogy with the reduplication of *Desmidieæ*, which Brébisson distinguishes from the deduplication of *Diatomeæ*. The particular disposition of the internal substance, the currents or mucous threads radiating from a centre, the enlargement of some articulations, and the dilatation of the interstitial ring, are isolated facts, which however merit particular attention in the paucity of our knowledge." [DIATOMACEÆ.]

ME'LYRIS, a genus of Coleopterous Insects established by Fabricius for the reception of certain species of the Linnæan genera *Cantharis* and *Dermestes*. It belongs to the family *Serricornes* of Latreille, and constitutes the type of the family *Melyridæ*. The *Melyridæ* are active and often gaily-coloured little beetles, usually found on flowers, which they frequent for the purpose of preying on other insects. They have soft, oblong, or ovate depressed bodies; short filiform pointed palpi; exserted heads; dentated mandibles; and usually filiform and serrated antennæ. Some of the species of *Malachius*, a genus of *Melyridæ* found in Britain, are furnished with red bladder-like appendages at the anterior angles of the thorax and base of the abdomen, capable of being contracted or dilated at the will of the insect, and usually exhibited when it is alarmed. Mr. Westwood regards these bodies as portions of an apparatus for emitting an offensive effluvium, and Curtis as means of enabling the insect to increase or decrease its gravity during flight. The larvæ, as well as the perfect insects, are carnivorous. The family is intermediate between the *Telephoridæ* and *Cleridæ*. The genera *Malachius*, *Dasytes*, *Enicopus*, *Dolichoroma*, and *Aplocnemus* contain British species. (Westwood, *Modern Classification of Insects.*)

MEMBRANE (in Anatomy) is an expansion of any tissue in a thin and wide layer. Since the time of Bichat [BICHAT, in BIOG. DIV.] the membranes have been generally enumerated as of three kinds, the serous, the mucous, and the fibrous, which are distinguished as well by their physical characters and their functions, as by the diseases to which each is peculiarly subject.

The Serous Membranes are so named from the character of their secretion, which consists of a very small quantity of thin serous fluid. In the adult condition of man and the higher vertebrata, they form what are called shut sacs. In each of the cavities of the chest, for example, which are exactly filled by the lungs, there is a serous membrane, the pleura [PLEURA] which lines the walls of the chest, and is then reflected on and covers the surface of the lung; and thus there is inclosed between the surface of that part which lines the chest and of that which envelops the lung an extremely narrow space, a sac, into which a very small quantity of fluid is secreted. During respiration there is a constant friction between the lung and the walls of the chest, which the fluid, by its lubrication of their surfaces, renders easy. It is the general condition of serous membranes, that they exist, with the single exception of the conjunctiva of the eye [EYE], wherever there is friction between the surface of an organ and the cavity in which it is contained. They are adapted for this condition by possessing a remarkable smooth polished surface, covered by a very fine layer of epithelium, through which their moistening secretion can easily pass. The basis of their structure is a fine and rather loose cellular tissue, which by boiling is at once converted into gelatine. The serous membranes in man are the arachnoid, which is found in the cerebro-spinal cavity [BRAIN], lining the dura mater, and covering the brain and spinal chord, and lining the ventricles; the pluræ, lining the chest and covering the lungs [RESPIRATION]; the pericardial serous membrane, similarly related to the heart and its investing sac [HEART]; the peritoneum, lining the abdominal walls and covering the abdominal part of the digestive canal, the liver, spleen, part of the pancreas, &c. [PERITONEUM]; and the tunica vaginalis, forming the sac of the testis.

The Synovial Membranes, by which joints are lined, and the heads of bones which move on each other covered, may be regarded as a modification of serous membranes, differing from them chiefly in the character of their secretion and in some of their diseases. [ARTICULATION.]

A membrane very similar to the serous lines the whole vascular system, and forms the internal membrane of the arteries, veins, lymphatics, and lacteals [ARTERY; VEINS; ABSORBENT SYSTEM], forming a closed cavity with innumerable ramifications, and affording, with its polished surface and fine epithelium, the least possible obstacle to the movement of the circulating fluids.

The Mucous Membranes, like the serous, are named from their peculiar secretion. [MUCUS.] While the serous membranes line all those cavities whose surfaces are in contact with living parts, the mucous membranes line those canals and cavities which in the adult condition of man and the higher *Vertebrata* are exposed to the contact of the air and other inorganic substances. The basis of these membranes is a compact cellular tissue, which does not yield gelatine in boiling, and whose areolæ do not contain fat. [INTESTINES.] Their epithelium is thicker than that which covers serous membranes, but thinner than the epidermis covering the skin, to which they are in many respects similar. [SKIN.] In the parts where they line the organs of sense the mucous membranes are generally beset with fine nervous papillæ; in other parts, numerous glands for peculiar secretions open on their surface by orifices through which the membrane is continued up the branches of the ducts into the very substance of the gland. [GLAND.] Nearly all the tracts of mucous membrane in man communicate with each other: they are, the nasal, which lines the cavities of the nose [NOSE]; the conjunctival, which covers the front of the eye-ball and lines the eye-lids, and opens by the lachrymal duct into the nose [EYE]; the auditory, which lines the cavities of the ear [EAR] and opens into the pharynx; the digestive, including that which lines the mouth, œsophagus, stomach, intestines, and the several glands whose ducts open into this canal [STOMACH; INTESTINES]; the respiratory, which lines the larynx, trachea, and bronchial tubes [LUNGS; RESPIRATION]; the urogenital; and the mammary. [MAMMARY GLANDS.]

The Fibrous Membranes are those which are chiefly formed of tendinous tissue. They serve either to form strong cavities for the protection of important parts, as the pericardium, the dura mater, the fibrous capsules of joints, the sheaths of tendons, &c., or to envelop and strengthen certain parts, as the periosteum, fasciæ, &c.; or they are merely expanded tendons, as aponeuroses. They are tough and inelastic membranes, composed of the shining dense wavy fibres which constitute the usual structure of tendons, mixed with more or less of a dense cellular gelatinous tissue. [AREOLAR TISSUE.]

MEMBRANIPORA. [POLYZOA.]

MEMECYLA'CEÆ are a very small natural order of Polypetalous Exogenous Plants, consisting of a few tropical species of little interest. Most of them inhabit the East Indies, the Mauritius, and Madagascar. They are in habit and foliage like *Myrtaceæ*, with which order they agree in most respects; but they have anthers which in form resemble those of many *Melastomaceæ*, and the leaves have no transparent dots. From the latter order they are distinguished by their leaves not being ribbed, and by their cotyledons being convolute. In the opinion of Brown and Chamisso, it is rather as a section of *Melastomaceæ* than as a peculiar order that *Memecylaceæ* are to be accounted. No useful properties have been assigned to any of the species, except to *Memecylon edule*, an East Indian plant, whose leaves, according to Roxburgh, are an ingredient in the dyes of Coromandel, and whose ripe astringent pulpy black berries are eaten by the natives.

MEMINNA, a genus of the sub-family *Moschina* (Gray). [MOSCHIDÆ.]

MENACANITE. [TITANIUM.]

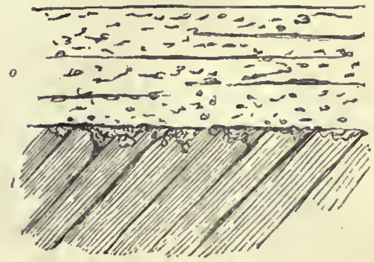
MENÆTHIUS. [MAIIDÆ.]

Memecylaceæ.

1, *Mouriria Guayanensis*; 2, a full-blown flower; 3, a stamen, with the anther opening by pores at the upper end; 4, a transverse section of a ripe fruit. Copied from a figure by Turpin.

MENDIP HILLS, a long ridge of limestone extending from Wells in Somersetshire to the Bristol Channel at Bleydon Hill and Brean Down. Through its whole length it is what geologists term an anticlinal axis, the strata dipping to the north under the drainage of the Avon and the Yeo, and to the south under the low plains watered by the Axe and the Brue. This axis passes from Frome by the Beacon Hill above Shepton Mallet, Masbury Castle, Nine-Barrow Hill, and Black Down, to Bleydon Hill, Uphill, and Brean Down, from whence, according to Buckland and Conybeare, it may be supposed to be continued into the Steep Holm in the Bristol Channel.

Along the line of the axis of Mendip old red-sandstone strata show themselves for considerable lengths, and form the nucleus of this miniature mountain range. They are exposed on the roads from Wells to Chewtown Mendip, and to Harptree, in each case evidently lying below the carboniferous limestone. Upon the slopes of this limestone, both north and south, rest considerable stratified masses of what is often justly termed magnesian conglomerate, and this is covered by the general mass of red marls which fill so large a tract in the low parts of Somersetshire. The limestone series is estimated by Buckland and Conybeare at from 500 to 700 yards thick. The axis of the Mendip Hills runs irregularly east and west: the geological era of its principal upward movement appears to be anterior to the red marls, and probably to the red conglomerate; though near Wells and in other parts the slope of the conglomerate beds proves a subsequent movement. There is no better example known of the unconformity of strata than that presented in Vallus Bottom, near Wells, by the junction of the lower oolite formation and the mountain or carboniferous limestone. Here the upturned and almost vertical strata of mountain-limestone are found covered by horizontal strata of oolite, each of these contrasted rocks containing the characteristic fossils which belong to them elsewhere. What renders the case more curious is the fact that the level surface of the subjacent inclined beds of limestone is not only worn smooth by littoral action below the oolite, but also covered by attached oysters, and perforated by the lithophagous shells of the oolitic sea into large and small holes now full of the oolite, and partly retaining the boring shells not uncommon in that rock.



o, the Oolite in level beds; *l*, the Mountain Limestone in steeply-inclined beds.

The most elevated point of the Mendip Hills is Masbury Castle, about 999 feet above the sea-level.

The features of these hills remind the observer of some parts of northern Derbyshire, both in the wide bare surface of limestone and the rugged glens which suddenly break the dulness of the open country. These narrow valleys appear like cracks and fissures in the mass of calcareous rocks, which, in Cheddar Cliffs, rise 285 feet perpendicularly from the feet of the spectator, and undoubtedly exceed in grandeur the noblest rocks of Derbyshire or Yorkshire. Several of these glens are called 'combes,' and Brockley Combe may be taken as a beautiful example of the mixture of gray rock and ancient wood.

From the chasms just alluded to the transition is easy to the caves and internal fissures, which are numerous in Mendip. Many of these have become familiar to geologists by the uncommon abundance of bones found in them by a host of explorers since the days of Catcott, the celebrated and unfortunate explorer of Hutton Hole.

Dr. Buckland, in his 'Reliquiæ Diluvianæ,' describes, from the notes of Mr. Catcott and Mr. Conybeare, the circumstances under which the teeth and bones of elephants, horses, oxen, stag, bear, fox, and other animals of the Mæstozootic era occurred at Hutton. The bones were found in the ochre-pits, which were anciently worked; they were mostly white, well preserved, and appear to have been drifted in by water, or collected from the falling in of quadrupeds roaming on the surface.

At Buringdon, in the Mendip Hills, and also in Wokey Hole, a celebrated cavern near Wells, human bones have been found of high antiquity, but being accompanied by urns or other marks of sepulture, it is not supposed they belong to races contemporary with the mammoth and large cavern bear. The specimens of this latter animal in the cave at Hutton are of enormous bulk.

Not far from Hutton Hole is the no less renowned cavern of Banwell, explored under the direction of the Bishop of Bath and Wells. The best collection of the contents of this rich repository was to be seen near the mouth of the cave. The complicated parts of this cavern are accessible by steps made in the rock, and are much visited. The bones belong chiefly to oxen and deer. Bones of elephants, bears, and other *Carnivora* occur less commonly. The specimens are usually in admirable preservation, and contrast remarkably with the fragmentary bones of the same animals at Kent's Hole and Kirkdale.

At the meeting of the British Association held at Newcastle, Mr. Long communicated a notice of human bones found in a cave at Cheddar.

The Mendip Hills, in their metalliferous products, resemble the similarly constituted mountains of Derbyshire and Flintshire. They yield galena, calamine (carbonate of zinc), and ochre. Manganese is dug about East Harptree. The galena occurs principally in limestone; the calamine belongs to the overlying magnesian conglomerate. In that rock agates occur, and the large geodic crystallisations of quartz called 'potato-stones.' The fossil corals, shells, trilobites, &c. of the Mendip Hills have been long known to collectors; but a complete account of them has, we believe, never been prepared.

(Conybeare and Phillips, *Geology of England and Wales*; Buckland and Conybeare, 'On the South-West Coal District of England,' in *Geological Transactions*, vol. i. new series.)

MENGITE. [MONASITE.]

MENISPERMA'CEÆ, *Menispermads*, an important and extensive natural order of Exogenous Plants, considered by some to be Polypetalous, and referred to De Candolle's Thalamifloral subclass; by others placed among the *Monochlamydeæ* of that author. The order consists of twining or scrambling shrubby plants, with alternate leaves without stipules, and small greenish or white unisexual flowers, often collected in large loose panicles or racemes. The floral envelopes are arranged in a power of three or four, and usually in more rows than one; whence arises the opinion that these plants belong to Polypetalous Exogens, the inner series being regarded as a corolla. The stamens are either distinct or monadelphous, either equal in number to the inner series of the calyx, and of the same number, or much more numerous. The carpels are in most cases three, or some multiple of that number, either distinct from each other or consolidated. The fruit consists of succulent one-celled drupes, with a solitary seed, and a horseshoe-shaped embryo, with thin flat cotyledons.

The wood of the stem is arranged essentially upon the Exogenous plan, but has some striking peculiarities. According to M. Decaisne, it has no annual concentrical layers. The woody plates are always simple, and do not divide longitudinally, as in other Dicotyledons, but increase each year by the formation of a new woody layer outside the former and inside the liber. The latter ceases to grow after the first year. In *Cissampelos Pareira* and some others new woody plates, like the first in appearance, but having no spiral vessels or liber, show themselves, at the end of several years, on the outside of the first, and produce around them a concentric circle, a formation which may be repeated a great many times. ('Comptes Rendus,' v. 393.) The order is common in the tropics of Asia and America, but uncommon out of these latitudes. All Africa contains but five, North America six, and Siberia one. The species are universally found in woods twining round other plants. *Cocculi* are most common in the Old World, and *Cissampeli* in the New World.

Menispermaceæ are usually bitter and tonic plants; the species of *Cocculus* called *Bakis*, *Fibraurea*, *cinerascens*, and others, are used in their native countries as a remedy for intermittent fevers. *Cocculus palmatus* furnishes the Calumba Root of the shops, a valuable bitter. *Pereiria medica* is used for the same reason in Ceylon, as is *Clypea Burmanni* in Malabar, and various sorts of *Cissampelos* in Brazil. But the bitter principle, which in its diluted state is thus valuable, becomes a dangerous poison if concentrated, as in the seeds of *Anamirta cocculus*, the Cocculus Indicus of the shops.

There are 11 genera and 175 species of this order.

Menispermum Canadense.

1, a male flower; 2, a female; 3, the ripe fruit; 4, a vertical section of the same, showing the embryo and horse-shoe seed.

MENISPERMI'NA, a vegetable alkali extracted by Pelletier and Courbe from the *Menispermum cocculus*, or *Cocculus Indicus*, in the shells of the fruit of which it occurs.

MENISPERMUM (so called from μήνη, the moon, and σπέρμα, seed, from the crescent-like form of its fruit), a genus of the natural family of *Menispermaceæ*, which formerly contained numerous species, many of them valuable for their medicinal and other qualities, such as the Calumba Root, and the berries called *Cocculus Indicus*, which are now referred to the genus *Cocculus*. [COCCULUS.] *Menispermum*, as at present constituted, contains but few species; and these are climbing shrubs, which have their sepals and petals in quaternary order, arranged in two or three whorls. Male, stamens 16 to 20; Female, ovaries 2 to 4; drupes baccate, round, kidney-shaped, single-seeded. *M. Canadensis* and *M. Smilacinum* are found in the United States of America, and M. *Dauricum* in the wooded hills of Daüria.

MENOBRANCHUS. [NECTURUS.]

MENOPOMA. [AMPHIBIA.]

MENTHA, a genus of Plants belonging to the natural order *Lamiaceæ*, or *Labiatæ*. It has a campanulate or tubular calyx, 5-toothed, equal, or somewhat 2-lipped, with the throat naked inside or villous; corolla with the tube inclosed, the limb campanulate, nearly equal, 4-cleft, the upper segment broader, nearly entire, or emarginate; stamens 4, equal, erect, distant; filaments smooth, naked; anthers with two parallel cells; style shortly bifid, with the lobes bearing stigmas at the points; fruit dry and smooth.

M. viridis, Spearmint, is a native of Britain, and is also found in the milder parts of Europe, the Canaries, Cape of Good Hope, and America, both North and South. It is a creeping rooted herbaceous plant, with an erect smooth stem; leaves subsessile, ovate-lanceolate, unequally serrated, smooth, those under the flowers all bract-like, rather longer than the whorls, these and the calyxes hairy or smooth; spikes cylindrical, loose; whorls approximated, or the lowest or all of them distant. This plant greatly resembles *M. piperita*. The colour however is of a deep green. It is also frequently confounded with *M. crispa*, than which it has a stronger and more agreeable odour, but weaker than peppermint. It has not the aromatic odour of that plant, nor does it leave the sense of coolness in the mouth. From it are prepared a distilled water, a spirit, and a volatile oil, which are used as the former.

M. piperita, Peppermint, is found by the sides of ditches and rivers in Britain, all over Europe, in Egypt, the middle of Asia, India, and North and South America. It has a procumbent ascending branched stem, reddish, quite smooth, or fringed with a very few spreading hairs; petioles generally ciliated; leaves ovate-oblong, or somewhat lanceolate, rounded at the base, deep-green, smooth, or hairy on the under side; the upper floral leaves small, lanceolate, subulate, shorter than the flowers; whorls few, lax, the uppermost collected into a short oblong obtuse reddish spike, the lowermost remote, with the cymes shortly stalked; bracts subulate, the outer ones as long as the calyx: pedicels quite smooth; teeth of the calyx hispid, subulate, erect. Peppermint is an aromatic stimulant, and the most pleasant of all the mints. It is employed in medicine for several purposes; the volatile oil is an antispasmodic.

M. Pulegium, Pennyroyal, also a British plant, is found in wet ditches in most parts of Europe, also the Caucasus, Chili, and Teneriffe. The stems are procumbent or prostrate, very much branched, more or less hairy, rooting; leaves scarcely half an inch long, often much less, stalked, ovate, obtuse, with a few shallow unequal serratures full of pellucid dots, and a little hairy, chiefly underneath; whorls sessile, numerous, many-flowered, globose, distant, large in proportion to the foliage; flowers light-purple, or nearly white; calyx hispid, 2-lipped, villous in the inside of the throat. The properties of this plant are the same as the other mints. It is supposed to possess peculiar power as an emmenagogue and antispasmodic.

The other British species of the genus are:—

M. rotundifolia, Round-Leaved Mint, having sessile leaves, crenate, serrate, wrinkled, shaggy beneath, and lanceolate bracts.

M. sylvestris, Horse-Mint, has subsessile leaves, serrate, hoary beneath, and subulate bracts.

M. aquatica, Capitate-Mint, is distinguished by its stalked leaves, the uppermost being shorter than the whorls; whorls few, subglobose, capitate, the uppermost terminal.

M. pratensis has nearly sessile leaves, the floral leaves acute, serrate, the smaller ones longer than the whorls; whorls distant, subglobose; calyx bell-shaped; teeth hairy. It is a rare plant.

M. sativa, Whorled Hairy Mint, has stalked ovate leaves, the upper ones similar but smaller, all longer than the whorls; calyx tubular or bell-shaped, with triangular lanceolate teeth.

M. arvensis, Corn-Mint, is known by its stalked ovate or elliptical serrate leaves, the upper leaves similar and equally large; calyx bell-shaped; teeth triangular, as broad as long.

(Babington, *Manual of British Botany*; Lindley, *Flora Medica*.)

MENURA. [MÆNURA.]

MENYANTHES, a genus of Plants belonging to the natural order *Gentianaceæ*. It has a 5-parted calyx; corolla funnel-shaped, with an induplicate æstivation; the limb spreading, 5-lobed, equal, stupose; stigma capitate, furrowed; capsule 1-celled, 2-valved, with the placentæ in the middle of the valves.

M. trifoliata, Buckbean, is common in spongy boggy soils in Europe, North America, and Great Britain. The rhizoma penetrates horizontally in the bog-earth to a great distance, regularly intersected with joints at the distance of about half an inch from each other; these joints are formed by the breaking off of the old petioles and their sheaths; the leaves proceed from the end of the rhizoma on long stalks furnished with broad sheathing stipules at the base; they are trifoliate, nearly oval, glabrous, somewhat fleshy, and slightly repand, or furnished with many irregularities at the edge, which hardly prevent them from being entire; scape round, ascending, smooth, bearing a conical raceme of flowers; peduncles straight, supported by ovate concave bracts; calyx erect, somewhat campanulate, 5-parted, persistent; corolla white, its tube short; border 5-cleft, spreading, and at length revolute, clothed on the upper part with a coating of dense fleshy obtuse hairs; stamens 5, shorter than the corolla, and alternate with its segments; anthers oblong, arrow-shaped; ovary ovate; stigma bifid, compressed; capsule ovate, 2-valved, 1-celled; seeds numerous, minute. All the plant, the root especially, is intensely bitter. It is considered to be a valuable tonic. Large doses produce vomiting, and frequently powerful diaphoresis. It is recommended in intermittent and remittent fevers, gout, hepatic complaints, rheumatism, dropsy, scurvy, and worms.

(Lindley, *Flora Medica*.)

MEPHITIS. [MUSTELIDÆ.]

MERCENA'RIA, Schumacher's name for the *Venus mercenaria* of authors, which passes current as money, under the name of Wampum, among the Indians of North America. [VENERIDÆ.]

MERCURIA'LIS, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has diœcious or monœcious flowers; the perianth 2-3-parted; with 9 to 12 stamens in the male flowers; the style short and forked in the female flowers; the capsule 2-celled; the cells 1-seeded, bursting at the back. The species are herbs; two of them are natives of Great Britain.

M. perennis, Perennial Mercury, has a simple stem; the leaves stalked, ovate-oblong, rough; the female flowers on long common stalks; the root creeping. It is a native of woods and thickets. It is considered to be very poisonous, though some old writers speak of it as being boiled as a pot-herb. According to Sloane, it produces violent vomiting, diarrhœa, stupor, convulsions, and even death.

M. annua, Annual Mercury, has the stem branched, leaves stalked, ovate or ovate-oblong, smooth; the female flowers nearly sessile; the root fibrous. It is a common plant in waste cultivated lands. It once had a place in the British Parmacopœia on account of its supposed efficacy as an emmenagogue, but it is not now used for that purpose. The leaves abound in mucilaginous matter, and are cooked and eaten in Germany in the same way as we eat spinach. Professor Burnett has pointed out the peculiar instability of the stamens of this plant. At the period when they are fully developed if they are touched they become loosened from their footstalks, and vault off elastically towards the pistilline flowers.

(Burnett, *Outlines of Botany*; Babington, *Manual of British Botany*.)

MERCURY, or QUICKSILVER. This metal, which possesses the remarkable property of being fluid at usual temperatures, has been known from the remotest ages. Although it is met with in very large quantity, yet the mines occur in comparatively few places; those of Almaden in Spain, and Idria in Carniola, are the most important. There are however mines of this metal in Hungary, Transylvania, and the district of Deux Ponts in Germany. Mercury has been obtained for a very long time in China and Japan, and although the amount of the produce is unknown, there is every reason to think it considerable; it is also found at Huancavelica in Peru.

Mercury is always obtained from cinnabar, which is a bisulphuret of the metal. It is found at Almaden in a dark-coloured slate intermixed with quartzite; sometimes, as in the district of Deux Ponts, the cinnabar occurs in the subordinate porphyries; and at Idria it is found in the subordinate bituminous schist, but rarely in limestone itself.

The cinnabar which is found in coal-sandstone is often accompanied with argillaceous and bituminous schist, and imprinted with fishes and plants, often with combustible fossils, and sometimes even intimately mixed with coal.

Pliny states (xxxiii. 7) that Callias, an Athenian, discovered the preparation of vermilion, or cinnabar, B.C. 505. He also mentions the mines of Almaden [ALMADEN, in GEOG. DIV.] as producing in his time 10,000 Roman pounds annually; but this was not the amount which the mines could have produced, for the supply was purposely limited. Le Play, a French geologist, who visited Almaden in 1833, describes the mines as being richer than at any former period, furnishing annually nearly 2,244,000 lbs. of mercury. About 700 workmen are employed under ground, and 200 in the operations connected with the extraction of the metal from the ore at the surface. The mines were visited by Capt. Widdrington in 1843. [ALMADEN.]

Formerly mercury was imported in packages of 50 or 60 lbs. weight; the metal was poured into a fresh sheep-skin, from which the wool was taken off, the ends were tied tight, and the sort of bag thus made was inclosed in a second skin, and that in a third, and three or four bags were packed in close barrels. Of late years however mercury has been brought to this country in wrought-iron bottles.

Various processes are adopted for the purpose of separating the mercury from the ore, all of which depend upon the volatility of the metal, its conversion into vapour in distilling-vessels or retorts, and its condensation by cold. In order to separate the sulphur from the metal, either iron or lime may be employed; the first forms sulphuret of iron, and the latter of calcium, with the sulphur, and the metal is thus set free, volatilised, and condensed. The retorts employed are made of cast or sheet iron, or earthenware.

According to Dumas the following mines yield annually the annexed number of quintals of mercury (a quintal is 108 lbs. avoirdupois nearly):—

Almaden	25,000	to	32,000
Idria	6,000	„	10,000
Hungary / Transylvania	700	„	700
Deux Ponts	400	„	500
Palatinate	180	„	200
Huanca Velica (Peru)	3,000	„	3,000
	35,280		46,400

We may perhaps reckon the average at about 2000 tons.

The properties of mercury are—that it is fluid, of a silvery white colour, and possesses a high degree of lustre; it is inodorous, tasteless, unacted upon or very slightly by exposure to air at common temperatures, and not at all by water at any temperature. The specific gravity of mercury is about 13·568. It boils at 670°; the density of its vapour is 6·976; and yet, as shown by Priestley, it vaporises at common temperatures, and Faraday has confirmed the observation. At 40° below Zero, mercury becomes solid, crystallises in octohedrons, and gives a dull sound like lead; at the moment of congelation it contracts considerably; for while its density at 47° is 13·545, that of frozen mercury is 15·612; when in this state it is malleable, and may be cut with a knife.

Mercury is a good conductor of electricity and of heat, but its capacity for heat is extremely small; it expands uniformly at all temperatures between its boiling and freezing points. When mercury is pure it assumes the spherical form in small portions, but when it contains other metals, it forms into long striæ; a very minute admixture is sufficient to produce this effect; when thus impure it must be subjected to distillation, by which the mercury is volatilised, and the metals mixed with it remain; or it may be purified to a considerable extent from the more oxidisable metals by agitation with dilute nitric acid. The minerals in which mercury occurs are not numerous.

Native Mercury.—This occurs in but few places, and is met with in small cracks or crevices of the rocks in which the common ore occurs, and is frequently accompanied by red silver.

The principal localities are Almaden in Spain, and Idria in Carniola; some is also met with in the Palatinate.

Chloride of Mercury (*Horn Mercury; Baumerite; Muriate of Mercury*)—Occurs crystallised and in tubercular crusts. Primary form a square prism. Cleavage parallel to the lateral faces and the diagonal planes of the primary form; the latter are the more brilliant. Fracture conchoidal. Hardness 1·0 to 2·0. Readily scratched with the knife. Colour pearl-gray, or yellowish-gray. Lustre adamantine. Translucent. Specific gravity 6·482.

Heated by the blow-pipe, it is entirely volatilised, and it yields by analysis—

Chlorine	14·89
Mercury	85·11
	100

It occurs principally at Moschelandsberg in Deux Ponts, but it is also met with in Spain, Bohemia, and the Palatinate.

Cinnabar; Vermilion; Bisulphuret of Mercury.—This is the common ore of the metal. Occurs crystallised and massive. Primary form of the crystal an acute rhomboid. Cleavage easy, parallel to the lateral faces of a regular hexahedral prism. Fracture conchoidal. Hardness 2·0 to 2·5. Colour carmine red. Lustre adamantine, approaching metallic. Opaque, translucent, transparent. Specific gravity 8·098.

Heated by the blow-pipe, whitens a piece of copper held over it. Unacted upon by nitric or hydrochloric acid, but readily by a mixture of them.

It occurs in the places which have been mentioned; as Almaden, Idria, &c.

Massive Varieties amorphous. Structure granular, compact. Fibrous and pulverulent.

The following is an analysis by Klaproth—

Sulphur	14·25
Mercury	85·00
	99·25

This compound is often made for use in the arts, especially by the colour-makers.

Native Amalgam—Occurs crystallised and massive. Primary form a cube. Cleavage indicating the form of a rhombic dodecahedron. Fracture conchoidal. Hardness 3·0 to 3·5. Scratches gypsum; is scratched by fluor-spar. Colour silver white. Lustre bright metallic. Opaque. Specific gravity 14·119.

When heated by the blow-pipe, the mercury is volatilised, and the silver remains in the metallic state.

The following are the analyses by Klaproth and Cordier—

	Klaproth.	Cordier.
Mercury	64	72·5
Silver	36	27·5
	100	100·0

Massive Variety amorphous. Structure compact. Sometimes semi-fluid by mixture with excess of mercury. Found in France, Spain, Sweden, Hungary, the Palatinate, &c.

Iodide of Mercury—Occurs in spots of a fine lemon-yellow colour in the variegated sandstone of Casas Viejas, Mexico. When exposed either to the air or ammonia it becomes black.

Selenide of Mercury is a dark steel-gray ore, which is wholly evaporated before the blow-pipe. It occurs in Mexico near San Onofre.

MERCURY, Herb. [MERCURIALIS.]

MERGANSER. [DUCKS.]

MERGELLUS. [DUCKS.]

MERGULUS. [AUK.]

MERGUS. [DUCKS.]

MERIDION. [DIATOMACEÆ.]

MERIONES. [MURIDÆ.]

MERLANGUS, a genus of Fishes belonging to the family *Gadidæ*. It is distinguished from the genus *Morrhua*, to which the Cod-Fish belongs, by the absence of the barbule at the chin. [MORRHUA.]

M. vulgaris (*Gadus vulgaris*, Linnæus), the Whiting. This fish is well known for the excellence and delicacy of its flesh. The pearly whiteness of its flaky muscles, added to its extreme lightness as an article of food, recommend it particularly to invalids as an article of diet. It is caught in great abundance all round our coast, and may be traced from the Orkneys to Cape Clear. Whitings of several pounds weight have been caught as far north as the Dogger Bank; they have also been taken of nearly equal size on the coast of Cornwall, and on the Nymph Bank along the extended line of the south coast of Ireland. In that country they have also been found on the eastern coast, from Waterford to Antrim, and from thence north and west as far as Lough Foyle. The fishing for Whiting with lines is pursued nearly all the year through, but the fish is most plentiful in the months of January and February, when it comes in large shoals towards shore for the purpose of depositing its spawn, and is taken in abundance within half a mile and seldom exceeding three miles from land. The whiting is a voracious feeder, and seizes indiscriminately *Mollusca*, worms, small *Crustacea*, and young fishes. Though occasionally occurring in the London market of three or four pounds weight the most usual size is from 12 to 16 inches in length, and weighing about one pound and a half. The body of the Whiting, like the bodies of those belonging to this division, is longer for its depth than that of the Cod-Fish; the scales small, oval, and deciduous; the lateral line dark and straight posteriorly, but rising gradually throughout the anterior half; the head elongated; the mouth and gape large, the tongue white and smooth; the upper part of the head and the back above the lateral line pale reddish ash-brown; sides and belly silvery white; pectoral, caudal, and dorsal fins pale brown; ventral and anal fins almost white, the pectoral fins each with a decided dark patch at the base.

M. albus (*Gadus albus*, Risso), Couch's Whiting. It is mentioned by M. Risso, in his volume on the 'Ichthyology of Nice,' published in 1810, but was not caught in the British seas until 1840 by Mr. Couch. His description is as follows:—"Length 15 inches; the depth in a straight line 2½ inches; from the base of the first dorsal fin to the vent along the curve, 3 inches; from the mouth to the edge of the gill-covers 3 inches; from the same to the anterior edge of the eye one inch; the eye large, the form a perpendicular oval; under jaw the longest; the upper maxillary bone terminal, the snout receding from it backward, contrary to the form of the Whiting, in which the upper jaw is under a projection. The general form of the body resembles that of the Whiting, but rather more slender; the back rounded as if the specimen was plump, thus showing its slender form not to be the result of emaciation. The distinctions between this fish and the Whiting are obvious, in the jaws, fins, lateral line, colour, and vertebræ."

M. carbonarius (*Gadus carbonarius*, Linnæus), the Coal-Fish. This is decidedly a northern fish, but being a hardy species, is not without considerable range to the southward. It was the only fish found by Lord Mulgrave on the shores of Spitzbergen, and the fry, only 4 or 5 inches long, were caught with the trawl-net on the west coast of Davis's Strait, during the first voyage of Captain Sir E. Parry. It is found on the coast of the United States. It abounds in all the northern seas, and in the Baltic, and may be said to swarm in the Orkneys, where the fry all the months of summer and autumn are the great support of the poor. As an article of food it is more prized when small than when of large size. The flesh of specimens weighing from 15 to 20 lbs. is usually dried or salted. This fish has more provincial names than any other species, some of which only refer to it when of a particular size. Among the Scotch islands the Coal-Fish is called Sillock, Piltock, Cooth or Ruth, Harbin, Cudden, Setho, Sey, and Gray Lord. In Edinburgh and about the Forth the young are called Podleys; at Newcastle the fry are called Coalsey, and when 12 inches long Poodlers. The Coal-Fish may be traced on the Irish coast from Waterford along the eastern shore to Belfast. When detained and well-fed in a salt-water pond they attain a large size, and are very bold and voracious. The head and body are elegantly shaped; the scales small and oblong; the lateral line silvery white and nearly straight; the upper part of the head and back above the lateral line almost black, much lighter in colour below the line, becoming grayish-white with golden reflections on the sides and belly; pectoral, caudal, and dorsal fins bluish-black; ventral and anal fins grayish-white; the upper jaw rather the shortest, the lips tinged with purple red, the mouth black, the teeth very small, the irides silvery white, the pupil blue.

M. Pollachius (*Gadus Pollachius*, Linnæus), the Pollack. This fish is much less abundant on some parts of the coast than the Coal-Fish, but like that species is an inhabitant of the seas all round our shores. The fish is called Lythe in Scotland, but whether from its supple pliant activity, or from 'lithos,' a stone, in reference to its living among the rocks, is not decided. The Pollack is caught at Hastings and Weymouth, also in Devonshire, where it is sometimes sold as Whiting. When only 12 or 14 inches long it possesses a considerable portion of the flavour and delicacy of that fish. It is also caught along the Irish coast under the names of Pollack, Laith, and Lythe. The body is elongated; the upper part of the head and back above the lateral line olive brown, the sides dull silvery white mottled with yellow, and in young fish spotted with dull red; the lateral line dusky, curved over the length of the pectoral fin, then descending and passing in a straight line to the tail; the dorsal fins and tail brown; the pectoral and anal fins edged and tinged with reddish-orange.

M. virens (*Gadus virens*, Linnæus), the Green-Cod. This fish was first added to the list of British fishes by Sir Robert Cullum, and if a distinct species, as some doubt it, is not only abundant, but has an extensive range. It is mentioned as an inhabitant of the northern seas by Linnæus and others, and is taken on the coast of Scotland, the Isle of Man, and on the Cornish coast. By some it is thought to be the young of the Coal-Fish, and by others as the young of the Pollack. The northern naturalists, who have opportunities of making constant comparison between this fish and the Coal-Fish from the abundance of both, consider them as distinct species. It seems to combine in itself the colouring of the Pollack, with some of the peculiarities of the Coal-Fish, but appears also to be deeper for its length than either, though if the young of a large species, judging by analogy, that would not be the case. The subject in its present state is open to investigation, and invites the attention of those who are so located as to be able to obtain examples of both.

(Yarrell, *British Fishes*.)

MERLIN, the English name for the *Falco Æsalon* of Linnæus; Emerillon, Rochier, and Faucon de Roche, of the French; Stein-Falke of the Germans; Smerlio, Smeriglio, and Falchetto, of the Italians; and Corwalch and Llymystem of the Welsh. This species belongs to the third sub-family, *Falconina*, of the large family *Falconidæ*. [FALCONIDÆ.] The following are the characters of this hird :—

Old Male.—Bill bluish horn-colour, palest at the base, darkest towards the tip; cere yellow, irides dark brown; top of the head blue-gray, with dark lines passing backwards; the cheeks and thence round the back of the neck pale reddish brown, also marked with dark streaks, forming a collar; the whole of the back and wing-covers fine hlue-gray, the shaft of each feather forming a dark central line; wing primaries pitch-black; upper surface of the tail-feathers bluish-gray over two-thirds of their length, with slight indications of three dark bands, the distal third nearly uniform black, the tips of all the feathers white; breast, belly, thighs, and under tail-coverts rufous, with brown central patches, and darker brown streaks; under surface of the tail-feathers barred with two shades of gray, a broad dark terminal band, and white tips; legs and toes yellow, claws black.

Female.—Top of the head, back, wing-coverts, and secondaries dark liver-brown, the shaft of each feather darker, the edge tipped with red; the tail-feathers browu, with fine narrow transverse bars of wood-brown; under surface of the body pale brownish-white, with darker brown longitudinal patches; bill, cere, eyes, legs, toes, and claws, as in the male.

Young Males—Resembling the females.

Birds of the Year.—The wings do not reach so far towards the end of the tail as thoso in the adult. (Yarrell, 'History of British Birds.')

The length of this, the smallest of the British hawks, is from 10 to 12 inches, according to sex.

Merlin (*Falco Æsalon*).

Upper figure, young male of tho year, which the female, unless very old, resembles. Lower figure, adult male.

"Assuredly," saith the author of the 'Book of Falconrie,' "divers of these Merlyns become passing good hawkes and verie skilful; their property by nature is to kill thrushes, larks, and partridges. They flee with greater fierceness and more hotley than any other hawke of prey. They are of greater pleasure, and full of courage, but a man must make greater care, and take good heed to thom, for they are such busie and unruely things with their beakes, as divers times they eate off their own feet and tallons very unnaturally, so as they die of it. And this is the reason and true cause, that seldom or never shall you see a mewed or entermewed Merlyn. For that in the Mew they do spoyle themselves, as I have before declared." Sir John Sehright says that the Merlin will take blackbirds and thrushes, and that he may he made to wait on, that is, hover near till the hird be pursued and started again; "and thongh a Merlin will kill a partridge, they are not strong enough to he effective in the field." ('Ohservations on Hawking.') The nest is placed on the ground, and but poorly made. The eggs (1 inch 7 lines long, and 1 inch 3 lines hroad) vary in number from four to five, and aro mottled with reddish-brown of two shades of colour.

This bird is found in Europe, as high as Denmark, and as low as the shores of the Mediterranean; Smyrna (Strickland), Cape of Good Hope (Smith); North America, according to Sir John Richardson, who says that "a single pair were seen in the neighbourhood of Carlton House in May, 1827, and the female was shot. In the oviduct there were several full-sized white eggs, clouded at one end with a few bronze-coloured spots. Another specimeu, prohably also a female, was killed at Sault St. Marie, between Lakes Huron aud Superior, but it could not be preserved." Sir John Richardson was unable to ascertain the extent of its migrations on the American continent. Neither Wilson, Nuttall, nor Prince C. L. Bonaparte notices it as occurring in the United States; but the latter ('Specchio Comparativo') mentions it as very rare at Rome, and he only observed the young, and that in winter. It "was formerly considered to he ouly a winter visitor to this country; but it is now very well ascertained that this species breeds on the moors of some northern counties. Mr. Selby has found the nest several times in Northumberland; and Dr. Heysham mentions three instances that came to his knowledge of Merlins' nests in Cumberland, where, he says, this bird remains all the year. Mr. Eyton tells me that it breeds on Cader Idris; and Mr. Dovaston sent a notice to his friend Mr. Bewick, 'on the authority of the game-keeper at Wynstay Park, North Wales, that he had often seen the nest of the Merlin, and that it huilt and bred there iu the summer of 1826.'"

"In the more southern counties of Cornwall and Devonshire the Merlin is considered to be rare, and only seen in winter. On our eastern coast it is killed, but not very often, in Kent, Essex, aud Norfolk. The specimens ohtained are generally young birds, and these occur most frequently in autumn, or at the heginning of winter. In Ireland, according to Mr. Thompson, the Merlin is indigenous in several northern counties. It breeds also in Scotland, in Orkney, and in Shetland. In North Wales the young hirds are called Stone-Falcons; but among ornithologists the Stone-Falcon is considered to be an adult bird. It is not however improbable that the hahit of sitting on a bare stone or portion of rock, by which this species has acquired the name of Stone-Falcon, is common to it at all ages and in other countries." (Yarrell.)

The character of the Merlin is thus summed up in the old French quatrain :—

"L'Esmerillon beau par extremitè
A le cœur gay, et fort hardy courage,
Et bien qu'il soit petit, si fait-il rage
A pour suyvir sa proye eu gayeté."

MERLU'CIUS, a genus of Fishes belonging to the *Gadidæ*, or family of Cod-Fishes, distinguished by the possession of only two dorsal fins and one anal fin, and the absence of the barbulo on the chin. This latter character distinguishes the speciès of the genus *Merlucius* from the Burbots (*Lota*) and Rocklings (*Motella*), and there being only two dorsal fins removes the present genus from the more typical Cod-Fishes, where there are three dorsal fins.

M. vulgaris, Cuv. (*Gadus Merlucius*), the Hake, affords a familiar example of this genus. This fish is found on various parts of the coasts both of England and Ireland. It inhabits also the seas of the western coast of Norway, and is common on the northern shore of the Mediterranean. "A hake of 3 feet 8 inches long," says Mr. Yarrell, in his 'History of British Fishes,' "supplied the means of obtaining the following particulars :—The length of the head, compared to the length of the body alone, as one to three; the depth of the hody not so great as the length of the head; the ventral fins are placed in advance of the pectorals, the rays not unequally elongated; the pectoral fius commence in a line under the posterior angle of the operculum, the rays ending with the end of the first dorsal fin; the first dorsal fin itself short and triangular in shape; the second dorsal fin commences in a line over the vent; tho anal fin begins immediately behind the vent; both the second dorsal fin and the anal fin terminate on the same plane, near the tail; the rays strong and stiff; the caudal rays about three inches long and nearly even.

"The fin rays in number are:—Dorsal, 10, 29; pectoral, 11; ventral, 7; anal, 21; caudal, 19.

"The head is depressed; the inside of the mouth and gill-covers black; the lower jaw the longest; tceth slender and sharp, in a single row in each jaw; the irides yellow, with a dark outer circle; the lateral line of the body straight throughout the posterior half, then gradually rising to the upper edge of the operculum; the appearance of the lateral lino is that of one white liue between two dark ones; the scales large; colour of the hody dusky hrown ahove, lighter heneath; dorsal and caudal fins dark; ventral and anal fins pale brown."

The *Gadus Magellanicus* of Forster, and the *G. Maraldi* of Risso, are mentioned by Cuvier as species belonging to the present genus.

ME'ROE (Schumacher), a name for certain Cowry-Shells, *Cytheræa sulcata*, *C. cripta*, *C. hians*, &c.

MERO'PIDÆ, a family of Fissirostral Birds, which, in the opinion of Mr. Vigors, is most nearly connected with the contermiuous trihe of *Tenuirostres* by the length, slenderness, and downward curvature of the bill. He adds that it exhibits at first sight a decided discrepancy with the succeeding family of *Hirundinidæ*, where the bill is short and wide; and that if we examine only the typical species of each we must admit that in respect to these particulars there is a manifest distinction between them. Independently however of the general characters in which both families approach each other, such as the breadth of the rictus of the bill, the short and feeble legs, the strength of the wing, and the consequent habit of using that member chiefly in seeking their support, a gradual approximation is found to take place even in their bills; those of some of the extreme species of *Merops* becoming shorter as they approach *Hirundo;* while those of some of the latter group partially desert their own type, and by degrees assume the lengthened form of the bill of the Bee-Eaters. The tail of *Merops* again is equally found to desert the typical characters of the group, namely, the greater length of the two middle feathers, in order to become even in some species, then slightly forked, and at length to be identified with the fully-forked tail of *Hirundo*. Mr. Vigors is further of opinion that among the *Tenuirostres* the genus *Promerops* approaches nearest to the fissirostral group by means of *Merops*, the curved bill of which approaches the structure of its own. (Vigors, 'On the Natural Affinities that connect the Orders and Families of Birds,' in 'Linn. Trans.,' vol. xv.)

Mr. Swainson ('Classification of Birds') is of opinion that the *Meropidæ*, or Bee-Eaters, succeed the Swallows, and says of the *Merops Apiaster* [BEE-EATER], that it annually visits Italy in flocks of 20 or 30, and may be seen skimming over the vineyards and olive-plantations with a flight much resembling the swallow, though more direct and less rapid. He observes that their bill is indeed considerably longer and more slender, but remarks that this difference is softened down by the intervention of the genus *Eurystomus*, containing the Swallow-Rollers of India, Africa, and Australia, which have this organ very short. To these, he thinks, succeed the true Rollers (*Coracias*, Linn.), which arrive in Italy at the same time with the Bee-Eaters, and associate also in small flocks. "These two genera of Rollers," continues Mr. Swainson, "are so indissolubly united, that nothing but the strongest prejudice in favour of a preconceived theory could ever have induced certain naturalists (whose labours in other respects have been of much advantage to science) to have placed them in two different orders. The whole structure of the Rollers, their lengthened pointed wings, and their firm and often forked tail, at once induce the idea that they feed upon the wing; while their very short legs, scarcely longer than their hind toe, might have shown their incapacity to alight and walk, like the Crows, upon the ground; but this question is at once decided by a knowledge of their economy, which, from personal observation, we have every reason to believe is much like that of the Bee-Eaters. The intervention of the Rollers at once lessens the abrupt transition, which would otherwise be apparent, from the perfect-footed Swallows to the zygodactyle Bee-Eaters; and we are thus prepared for all those birds whose toes, as it were, are soldered together, like those of the *Meropidæ*. Here perhaps we may notice that most beautiful and rare genus *Nyctiornis*, or Night-Feeder, as being in all probability that particular link by which nature connects this family with the Trogons, thereby uniting the three aberrant groups of the *Fissirostres* into one primary circle. M. Temminck, overlooking its particular structure, placed this genus with *Merops*, to which indeed it has a close resemblance; while its connection to *Prionites* (Illiger) in other parts of its organisation is no less obvious. Its precise situation in short requires further investigation." [HALCYONIDÆ; MELIPHAGIDÆ.]

Mr. Swainson gives the following character as distinguishing the family:—

Wings long, pointed; the first quill as long, or nearly so, as any of the others.

He arranges the following genera under it:—

Merops (Linn.).—Bill very long, slender, slightly curved, compressed; the culmen carinated; the tip entire, sharp, and not bent downward. Wings long, pointed; the tips of the lesser quills emarginate. Tail lengthened. Feet gressorial. (Sw.)

M. apiaster [BEE-EATER] is an example.

Nyctiornis (Sw.).—Bill considerably curved, very long; the culmen with a parallel groove on each side. Wings rounded, convex. Plumage lax. Feet short, insessorial, resembling those of *Prionites*. (Sw.)

N. amictus is green; crown (in the adult) lilac; front of the throat and breast bright red. (Sw.) Total length about 13 inches; wings 5½ inches; tail (beyond) 3 inches; tarsi hardly half an inch. (Sw.)

It is a native of India.

Coracias (Linn.)—Bill moderate, straight; the sides broad, but much compressed. The tip of the upper mandible bent over that of the lower, which is obliquely truncate; nostrils basal, oblique, linear; gape very wide, extending beneath the eye; the sides bristled. Feet insessorial, very short; all the toes cleft to their base; inner toe much the shortest. Wings moderate, pointed. (Sw.)

C. Abyssinica has white round the bill; body aquamarine-green; back and wing-coverts cinnamon-colour; shoulders, rump, and quills blue; tail green, the two middle feathers blue; two long loose processes terminating the two external quills.

Sub-genus, *Eurystomus* (Vieill.).—It resembles *Coracias*, but the bill is shorter and wider, and the wings longer; nostrils very long; rictus smooth. (Sw.)

E. Orientalis. Colour aquamarine-green; throat and point of the

Nyctiornis amictus. Swainson.

Coracias Abyssinica.

wing (fouet de l'aile) azure; quills and tail-feathers black; a white stripe upon the wing.

It is a native of Java, South Australia, and all the Polynesian Islands. It is the Natay-Kin of the natives of the neighbourhood of Sydney; Dollar-Bird of the colonists; and Tiong-ba-tu of the inhabitants of Sumatra. It is the *Coracias Orientalis* of Linnæus.

Chloropygia (Sw.).—General form between *Tamacia* and *Coracias*. Bill short; the tip not abruptly bent; rictus bristled; nostrils basal, linear, oblique. Wings, short, convex, reaching only to the rump; the two first quills much graduated; the four next nearly equal and longest. Tail elongated, rounded, and broad. Feet as in *Coracias*.

The species are natives of Madagascar. (Swainson.)

C. Leptosomus (Lesson; Ill., 'Zool.,' pl. 22) is an example.

Leptosomus (Vieill.).—Bill about the length of the head, robust; the upper mandible curved and notched near the tip; gonys straight; nostrils oblong, oblique, the margins elevated, naked, and placed towards the middle of the upper mandible. Feet short; toes in pairs, as in *Tamatia*. Wings lengthened, pointed; the first and second quills longest. Tail moderate, even. (Sw.)

L. viridis is a native of the country of the Kaffirs and the coast of Zanzibar, where it is said to live in the forests on insects and fruits.

Eurystomus Orientalis.

The form is arranged by Lesson and others under the family *Cuculidæ.* [LEPTOSOMUS.]

Leptosomus viridis.

Mr. Swainson makes the family of *Meropidæ* the first of the *Fissirostres.* It immediately succeeds the *Paradisiadæ* and precedes the *Halcyonidæ* in his arrangement.

M. Lesson, in his 'Table Méthodique,' gives the following genera as constituting the family of the *Meropidæ*:—*Merops, Alcedo, Dacelo, Ceyx, Syma, Todiramphus, Momotus,* and *Buceros.* [HALCYONIDÆ; BIRDS OF PARADISE; HORNBILLS.]

MEROPS. [BEE-EATER; MEROPIDÆ.]

MERTENSIA, a genus of Plants belonging to the natural order *Boraginaceæ.* It has a calyx in 5 deep segments; corolla bell-shaped, with a short thick cylindrical tube with 5 minute protuberances in its throat; stamens protruded beyond the throat; filaments elongate; style simple; nuts smooth, inflated, rather drupaceous, attached laterally near their base by a flat surface; seeds free.

M. maritima has a procumbent branched stem; leaves ovate-acute, rough, with callous dots, glabrous, fleshy, glaucous; nuts smooth; flowers in racemes, purplish-blue; protuberances in throat of the corolla yellow; leaves with a flavour resembling that of oysters; nuts free, forming a pyramid longer than the calyx; pericarp membranous; seed smaller than the cavity. It is found on the northern sea-shores in Great Britain.

(Babington, *Manual of British Botany.*)

MERULA. [BLACK-BIRD.]

MERU'LIDÆ, the Thrushes, a family of Dentirostral Birds, placed by Mr. Vigors between the *Laniadæ*, or Shrikes, and the *Sylviadæ*, or Warblers. In the former family, he is of opinion that *Vanga*, Cuv., together with *Prionops, Laniarius,* and *Thamnophilus* of Vieillot, bring us in contact with the Thrushes, and that the extremes of the family will be found in *Graucalus* and *Ceblyperis* of Cuvier, which last has been latterly arranged with the Thrushes, and both of which, by their bills, in some degree depressed at the base, lead back to *Tyrannus,* and the other broad-billed groups which commence the family. Mr. Vigors feels inclined rather to leave *Ceblyperis* in its original station among the Shrikes, from the peculiarity of its tail-coverts, which form themselves into a kind of puffed-out cluster on the back.

"The family of *Merulidæ,*" contiuues Mr. Vigors, "connected as above with the *Laniadæ,* comprises a considerable number of species and many natural genera; but which, like most of the Insessorial groups, have hitherto received but partial examination. The general views by which they seem to be allied among themselves, as far at least as can be judged from their present unorganised condition, may be stated as follows; but with that expression of doubt which ever attends inquiries like the present, where the absence of accurate information to the economy of the subjects before us, and of extensive knowledge of the forms connected with them, leaves us uo better foundation for our inferences than partial conjecture. The genus *Myiothera,* Ill., seems to be the first group of the present family which is connected with the *Laniadæ,* where it is met by some of the smaller species of *Thamnophilus.* This group seems to lead by *Pitta,* Vieill., and perhaps *Cinclus,* Bechst., through some intervening forms, to the true Thrushes, or the genera *Turdus* of authors and *Merula* of Ray, which form the type of the family. To these we may add that portion of the Linnæan Orioles, which, possessing the curved aud notched bill of the Thrushes, constitutes the genus *Oriolus,* or true Oriole, of the present day. Here we meet several groups, generally arranged without order in the Linnæan genus *Turdus,* and hitherto entirely uncharacterised, which gradually lead from the typical groups to those which possess a more generally delicate conformation; until the comparatively strong form and robust bill of the Thrushes is lost in the weaker body and more slender bill of the Warblers. Here again the group of Rock Thrushes, of which the *Turdus saxatilis* is the type, appear to bring us round, by their general habits and assimilating characters of bill and tarsi, to *Myiothera,* where we entered the family. Those birds which constitute the groups which we denominate Chatterers, and which form the genus *Ampelis* of Linnæus, are usually assigned a place near this family; and I must confess that, from the geueral affiuity which they appear to bear to it, I have felt, and still feel, considerable doubt whether this be not their natural station. A strong affinity however on the other hand seems to unite them with the wide-gaped *Dipræ,* and some of those other groups which, by their bill, broad and depressed at the base, appear to come in contact with the earlier divisions of the present tribe, and the extreme of the *Fissirostres* which precede it. The general rule of placing groups in a conterminons situation, according to what appears to be tho predominance of their more important characters, has inclined me to arrange the birds of which I speak provisionally among the *Pipridæ,* at the extreme termination of the tribe before us. In my present view of the case, the characters in which they accord with that family and approximate the extreme groups of the preceding tribe appear to predominate. More accurate knowledge on these subjects will clear away these and similar difficulties. But I caunot too often insist upon the point, that whatever alterations may take place hereafter in our ideas respecting the disposition of these subordinate groups, they cannot interfere with the general principles which it is the object of this inquiry to illustrate. Instead of impugning our general views, they will merely remove those doubts on minor points in which our present limited acquaintance with nature involves us."

In Mr. Swainson's 'Classification of Birds,' the reader will fiud elaborate details of his views respecting the affinities and aualogies of this extensive family, which our limits do not permit us to give. The following arrangement is from the 'Synopsis,' where the family is placed between the *Laniadæ* and the *Sylviadæ*:—

MERULIDÆ.

Sub-Family *Brachypodinæ.*

Feet very short; hind toe almost as long as tarsus; claws short, much curved; bill distinctly notched; wings short, rounded; feathers on the rump very long and thick-set. (Swainson.)

Micropus (Sw.).—Bill as long as the head, straight, somewhat conic, but the culmen gradually arched; tarsus remarkably short, feathered beyond the knees; lateral toes unequal; hinder as long as the tarsus. Wings moderate, the first quill almost spurious; tail even. (Sw.) Ex., *M. chalcocephalus,* 'Pl. Col.,' 453.

Sub-Genus, *Hypsipetes* (Vig.).—Tail forked. Ex. *H. psaroides* (Gould, 'Cent. Himala Birds').

Brachypus (Sw.).—Bill shorter than the head; the base broad; the sides compressed; culmen elevated and curved from the base; rictus generally furnished with bristles. Feet very short, strong; tarsal scales entire; tarsus longer than the hind toe; claws curved, broad, acute, wings and tail rounded. (Sw.)

Sub-Genera.—*Brachypus* (Sw.).—Bill short; rictus bristled. Feet small, weak, lateral toes equal, hinder toe as long as the tarsus. Ex. *B. dispar,* 'Pl. Col.,' 137. *Chloropsis* (Jard. aud Selb.).—Bill more lengtheued; the tip much hooked; the notch of the upper mandible forming a small distinct tooth; rictus of gape smooth. Feet small, lateral toes unequal, the hinder toe rather shorter than the tarsus. (Sw.) Ex. *C. Malabaricus*, 'Pl. Col.,' 512, f. 2. *Jora*, or *Iōra* (Horsf.).—Bill nearly as long as the head, lengthened, somewhat conic, and rounded; rictus smooth; tarsus rather lengthened, the anterior scales divided; middle and hinder toe of equal length; tarsus much longer than either; tail very short, fasciculated; the tips truncate and even. Ex. *J. scapularis*, Horsf., Java. *Andropadus* (Sw.).—Bill very short, resembling that of *Brachypus*, but the upper mandible crenated near the tip; neck with setaceous hairs; rictus bristled. Wings, tail, and feet as in *Brachypus*. (Sw.) Ex. *A. vociferus*, 'Ois. d'Afr.,' 106, f. 2. *Hæmatornis** (Sw.).—Head crested; bill short; rictus bristled. Feet short, lateral toes unequal, hinder toe shorter than the tarsus, which is equal to the middle toe. Wings and tail rounded. (Sw.) Ex., *H. chrysorrhœus*, 'Ois. d'Afr.,' 111, pl. 107, f. 2.

Tricophorus (Temm.).—Culmen gradually arched; nostrils and base of the bill surrounded with lengthened slender hairs; gape very strongly bristled; margins of the mandibles white; feathers of the crown and chin elongated. Nape of the neck with several conspicuous lengthened bristles, considerably exceeding the surrounding feathers. Feet short. Tarsus longer than the hind toe, and feathered beyond the knees; inner toe shortest. Wings and tail moderate, the former with the three first quills much graduated. Ex., *T. olivaceus*. (Swainson, 'Birds of West Africa,' i. 264.)

Phyllastrephus (Sw.).—Bill as long as the head, strong, the tip rather hooked; rictus strongly bristled: frontal feathers small, compact, directed forwards, and compressed on the base of the bill. Wings and tail moderate, rounded. Feet short, strong, robust; tarsus and middle toe of the same length; lateral toes unequal, the inner shortest: hinder toe shorter than the inner one; anterior tarsal scales divided. (Sw.) Ex. *P. Capensis*, 'Ois. d'Afr.,' 112, f. 1.

Icteria (Vieill.).—Bill with the general form of that of *Brachypus*, but the culmen more elevated and arched, and both mandibles entire. Wings and tail rounded; tarsus considerably lengthened and strong. Inner toe the shortest; middle toe very long. Natives of America. Ex. *I. polyglotta*. (Wilson, pl. 6, f. 2.)

Sub-Family *Myotherinæ* (*Myiotherinæ*), Ant-Thrushes.

Bill straight, somewhat cylindrical; the tip suddenly bent down or hooked.

Dasycephala (Sw.).—Bill as long as the head, straight; tip abruptly hooked, base wide, the rest somewhat cylindrical; gonys strong, ascending; nostrils and front defended by stiff feathers and bristles, pointing in different directions; rictus strongly bristled. Tarsus lengthened, slender; lateral scales numerous, small, oval; toes and claws slender; inner toe shortest; outer toe connected to the middle as far as the first joint; hind claw large. Wings and tail rounded. Ex. *D. rufescens*. ('Birds of Brazil,' pl. 76.)

Myiothera (Ill.).—Feet lengthened, rather stout; lateral scales of tarsus in an entire piece; claws not broad, nor greatly curved. Bill as in the small *Thamnophili*. Wings short. Tail moderate, rounded.

Sub-Genera.—*Myiothera*.—Inner toe longer than the outer, and cleft to its base; outer toe with its first joint united to that of the middle toe; the tarsus with the anterior scales divided. *Drymophila* (Sw.).—Inner toe shorter than the outer, which is only slightly connected to the middle; tarsus (typically) very smooth; all the scales entire. (Sw.) Ex. *D. longipes*. ('Zool.,' Ill., ii. 23.) *Brachypterix* (Horsf.). [BRACHYPTERYX.] *Myiocincla* (Sw.).—Legs strong; inner toe longer than the outer; all the tarsal scales divided; anterior claws small; hinder claw nearly straight, and as long as the toe. (Sw.) Ex. *M. Colma*, 'Enl.' 821. *Pithys* (Vieill.).—Feet syndactyle; the inner lateral toe shortest; the outer united by its first and second joint to the middle toe; all the tarsal scales entire. Ex. *P. albifrons*. (Vieill., 'Gal.,' pl. 129.)

Mr. Swainson remarks that *Urotomus*, *Formicivora*, and all the other small *Myiotheræ*, having the feet weak and the tarsal scales and claws similar to those of *Thamnophilus*, he thinks it better to refer them to that group; but, as it has not been analysed, he does not, in the 'Classification of Birds,' incorporate those two sub-genera, although proposed by himself some years ago. ('Zoological Journal,' vol. i. p. 301; 'On the natural Affinities that connect the Orders and Families of Birds,' by Mr. Vigors.)

Mr. Vigors observes that the line of connection between *Thamnophilus* and *Myiothera* is fully established by the intervention of several forms gradually passing into each other, such as *Formicirora*, *Urotomus*, and *Drymophila*. ('Linn. Trans.,' vol. xv.)

Pitta (Temm.).—Bill strong, thrush-like; the culmen gradually curved; nostrils nearly naked: wings moderate; the first and second quills but slightly graduated. Tail remarkably short, almost hid by the covers. Feet very long, pale, the scales nearly entire; inner toe slightly shorter than the outer. India and Australia. (Sw.) Ex. *P. gigas*. ('Pl. Col.,' 217.)

Sub-Genera.—*Chlorisoma* (Sw.).—Bill as in *Pitta*, but somewhat thicker; nostrils protected and nearly covered by incumbent feathers; rictus bristled. Wings rounded; the four first quills much graduated. Tail moderate or lengthened, graduated. Feet strong, rather lengthened: the inner toe scarcely shorter than the outer. India. (Sw.) Ex. *C. thalassina*. 'Pl. Col.,' 401. *Grallaria* (Vieill.).—Bill thrush-like, as in *Pitta*. Wings rounded; the two first quills graduated, the first half as long as the second, the three next nearly equal. Tail short and rounded. Legs very long: the tarsus slender, pale; the anterior scales divided, the lateral scales (typically) entire; lateral toes nearly equal. Ex. *G. Rex*. 'Enl.,' 702.

* This name is pre-occupied. [FALCONIDÆ.]

Mr. Swainson remarks that it appears to him that *Chamæza* (Vig.) is more an aberrant species of *Grallaria* than a distinct type in the genus *Pitta*, the only species known chiefly differing in having the tail longer and the lateral scales divided.

Cinclus (Bechst.).—Bill moderate, rather slender, very straight, considerably depressed; tip absolutely notched; gonys ascending. Nostrils naked, membranaceous; the aperture very small and linear. Wings moderate, rounded; the first quill spurious. Tail very short, even; feet large, very strong, pale; the lateral toes equal; tarsal scales entire and smooth. (Sw.)

The *Cincli* haunt the banks of clear streams, rejoicing in the vicinity of some tumbling cascade hurrying over a rocky declivity. They go into the water till they are quite submerged, walk on the bottom of the stream, and there seek their insect food. M. Temminck states that when in this situation they open their wings and constantly agitate them. Their feathers are, he says, furnished with an oily matter for this purpose, like the feathers of ducks; and adds, as an 'on dit,' that when thus walking they appear surrounded with air-bubbles, which render them very brilliant.

C. aquaticus, *C. melanogaster*, and *C. Pallasii* are natives of Europe. M. Temminck expresses a doubt whether the second is a distinct species; and refers, with some slight doubt, *C. Pallasii* of the Himalaya Mountains to the third. He states the geographical distribution of *C. Pallasii* to be the Crimea and other parts of European Russia, and says that it is very common in Japan, where it is named Kawagaras.

C. aquaticus, the Water-Ouzel. It is the Lerlichirollo and Merlo Aquatico of the Italians; Tordo de Agua of the Spaniards; Merle d'Eau and Aguasière à Gorge Blanche of the French; Watnstare of the Swedes; Povodni Koss of Scopoli; Fosse Fald, Fosse Kald, Quærn Kald, Stroem-Stær, and Bække Engl, of the Norwegians; Wasser-Amsel, Bach-Amsel, and Der Hochkörfige mittlere und Nordische Wasserschwätzer, of the Germans; Waterspreeuw of the Netherlanders; Mwyalchen y Divir of the Welsh; and Water-Crow, Water-Pyet, Water-Piet, Dipper, and Bessy-Ducker, of the British.

Water-Ouzel (*Cinclus aquaticus*). Adult and Young of the Year.

Male.—Upper parts deep brown, tinted with ash-colour; throat, front of the neck, and breast pure white; belly rusty; bill blackish; iris pearl-gray; feet horn-colour. Length rather more than 7 inches.

Female.—Upper part of the head and back part of the neck ash-brown; less white upon the breast; lower parts yellowish rusty.

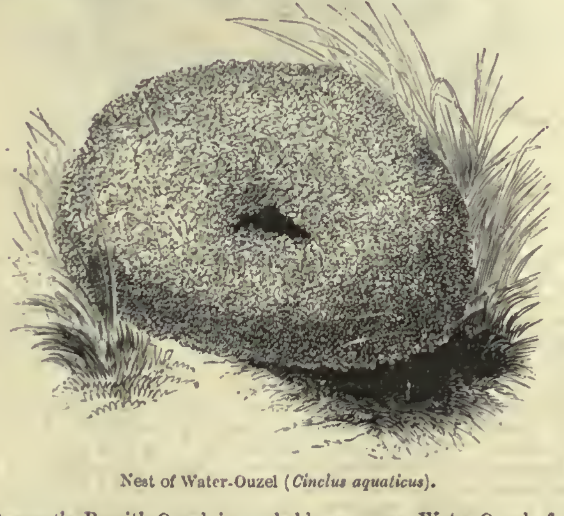
Young of the Year distinguished by the gray feathers which cover the head and the nape; feathers of the back and rump fringed with blackish; those of the wings with white towards the end; the white of the lower parts extends to the middle of the belly and towards the abdomen; but all these white feathers are finely varied with brown and ash-colour.

It is found in Sweden, Scandinavia, Siberia, Russia, Germany, the Alps, the Pyrenees, Holland (rare), Spain, Italy, Englaud, Scotland, Wales, and Ireland, and in the vicinity of Trebizond, in Asia Minor.

With regard to its habits, Mr. Gould says :—"As far as the fact of its submersion goes, we have ourselves many times witnessed it; but have never been able to mark unobserved the actions of the bird under water, so as to say whether it is by a powerful effort that it keeps itself submersed, or whether it is completely at its ease, as some have asserted. The Water-Ouzel is a spirited and restless little bird, full of life and activity, flitting from stone to stone along the borders of the streams; and it is especially fond of perching upon any rock that happens to be elevated in the centre of the current, where, conspicuous by its white breast, it may be observed dipping its head and jerking its tail in a manner not unlike that of the wren, at one moment pouring forth a lively twittering song (and that even in the depth of winter, when the earth is covered with snow), and at the next diving down, and rising again at a considerable distance. When so disposed, its flight is straight, low, and rapid; in fact, much like the Kingfisher; and it is equally solitary in its habits. It is however seldom seen in the same situations as the Kingfisher, the latter being a frequenter of streams which flow through a fertile country, while the Water-Ouzel is peculiar to the rapid and limpid streams which descend the mountain sides and run through glens at their base." ('Birds of Europe.')

The food of this species consists of land and water insects and their larvæ, *Ephemeræ*, *Phryganeæ*, &c., and fresh-water Testaceous Molluscs. Mr. Macgillivray fouud in their stomachs beetles and the animals of *Lymnææ* and *Ancyli*. The Scotch persecute it under the impression that it feeds on the spawn of the salmon. The justice of this persecution has been doubted.

Fissures of rocks, crags, and rough stones are selected as the locality for the curious nest, which is domed, and similar with regard to materials to those which compose the nest of the wren. "It builds early," observes Mr. Yarrell, "and conceals its large nest with great art. If a cavity in a moss-covered rock is chosen, the nest is formed of a mass of closely interwoven moss, 7 or 8 inches deep, and 10 or 12 inches in diameter, with a hollow chamber in the centre lined with a few dry leaves, to which access is gained by a small aperture through the moss on one side. Sometimes the nest is placed under a projecting stone, forming part of a cascade, and behind the sheet of water that falls over it. The eggs are from four to six in number, measuring one inch in length by nine lines in breadth, pointed at the smaller end, and white." ('British Birds.')



Nest of Water-Ouzel (*Cinclus aquaticus*).

Pennant's Penrith Ouzel is probably a young Water-Ouzel of the first year.

Mr. Gould, in his 'Birds of Europe,' states that, since the publication of his 'Century of Birds from the Himalaya Mountains,' he had received specimens of the young as well as of the adult, in consequence of which his plate in the 'Birds of Europe' is rendered more complete. He adds that M. Temminck had favoured him with specimens of the Japan Water-Ouzel, which differed so slightly from those killed in India, as not, in Mr. Gould's opinion, to admit of their being separated.

There is an American species, *Cinclus unicolor* (Bonap.), *C. Mexicanus* (Sw.)

Sub-Family *Merulinæ* (True Thrushes).—Wings more lengthened and pointed. Bill notched, with the culmen gradually curved to the tip, which is bent, but not hooked over the lower mandible. Feet formed both for perching and walking. (Sw.)

Petrocincla, Vig. (Rock Thrushes).—Bill thrush-like: tip of the upper mandible abruptly bent down and nearly entire. Wings moderate; the first quill spurious; the second shorter than the three next, which are equal and longest. Tail even; anterior scales divided; lateral toes equal; claws small, but slightly curved.

P. saxatilis, the Rock-Thrush, Merle de Roche of the French, *Turdus saxatilis* (Gould), is a native of Europe. It inhabits rocky and mountainous countries. It is found in the Uralian Mountains, the Alps, and Pyrenees. It also inhabits Germany, France, Switzerland, and the Tyrol, Spain, Sicily, Turkey, the Grecian Archipelago, and Algeria. It has occasionally been shot in England, and on that account is mentioned by Yarrell in his 'British Birds.'

Sub-Genus *Petrophila* (Sw.)—Bill thrush-like: the culmen and tip of the upper mandible gradually bent and entire. Wings and tail as in the last. Legs pale; anterior scales entire; lateral toes unequal; inner shortest; claws moderate and fully curved. (Sw.) Ex. *P. cyanocephala*. (Gould, 'Cent. of Himal. Birds.')

Merula (Willughby). [BLACKBIRD.]

Orpheus (Sw.).—General structure of *Merula*. Bill more curved in the culmen; the notch small, or nearly obsolete; rictal bristles rather strong. Wings rounded; the three first quills graduated. Tail lengthened, graduated, or rounded. Inner toe manifestly shorter than the outer. Ex. *O. Polyglottus*. (Wilson, pl. 10, f. 1.)

Sub-Genus *Cossypha* (Vig.).—General structure of *Orpheus*, but the wings more rounded, and the tail less so; rictus smooth. Africa only. Ex. *C. leucoceps*. (Sw., 'Birds of West Africa,' 1, pl. 32.)

Chætops (Sw.).—Bill moderate, thrush-like, notched; nostrils basal, large, naked, membranous, the aperture lateral and linear; frontal feathers rigid, the shafts composed of bristles; chin-feathers the same, but weaker; rictus bristled. Wings very short and rounded. Tail rather lengthened, broad, convex, soft, and slightly rounded. Tarsi very long and strong; anterior scales divided; lateral toes unequal; claws small, obtuse, and slightly curved, the three anterior of equal size. Africa. (Sw.) Ex. *C. Burchellii*. (Pl. 'Col.,' 385.)

Sub-Family *Crateropodinæ*, Babblers.—Legs remarkably long and strong, with the claws but slightly curved. Wings short and rounded. Tail large, broad, graduated, and very soft. Plumage lax. Bill compressed, straight, hard, the tip nearly entire. (Sw.)

Pellorneum (Sw.).—Bill moderate, straight, somewhat conic; tip notched; gonys ascending; frontal feathers, small, rigid, directed forwards; rictus bristled. Wings very short, much rounded. Tail moderate, graduated. Tarsus and middle toe of equal length; lateral toes much shorter and equal; hinder toe shorter than the tarsus; anterior claws very small, and but slightly curved; tarsal scales hardly divided. (Sw.) Ex. *P. ruficeps*.

Crateropus, Sw. (*Ianthocincla*, part).—Bill nearly as long as the head, more or less straight from the base, much compressed, obsoletely notched; rictus bristled; frontal feathers rigid. Wings short, rounded. Tail large, broad, soft, and rounded. Feet very large and strong; tarsus lengthened, the anterior scales divided; lateral toes nearly equal; hind toe large, nearly as long as the middle toe. Plumage lax, soft. (Sw.) Ex. *C. Reinwardii*. ('Zool.,' Ill., i. 30.)

Grallina (Vieill.).—Bill slender, straight, rather cylindrical above; the sides very little compressed; base broader than high; tips of both mandibles distinctly notched; nostrils naked, basal; rictus with a few bristles. Wings very long; first and second quills graduated, four next longest. Tail lengthened, even. Feet strong, formed for walking, black; anterior toes divided, the rest entire; lateral toes equal; middle toe and claw short, very little longer than the hind toe. Australia. Ex. *G. melanoleuca*. (Vieill., 'Gal.,' pl. 150.)

Sub-Genus *Cinclosoma* (Horsf. and Vig.).—Bill very straight; culmen and gonys equally curved towards the point, which is slightly notched. Wings very short; the two first quills graduated; the three next longest, and of equal length. Tail lengthened, broad, graduated, the feathers narrowed towards their tips; under tail-coverts very long. Feet moderate; inner toe longer than outer. Australia. Analogous to *Accentor* among the *Sylviadæ*. (Sw.) Ex. *C. punctata*. (Shaw, 'Zool. of Nat. Hist.,' pl. 9.)

Malacocircus (Sw.).—Bill more or less curved, by being elevated at the base, having the sides much compressed, and the culmen high and arched; the tip almost entire, aud not suddenly bent over the lower. Feet very large. Tail soft, graduated, generally lengthened. (Sw.) Ex., *M. striatus*. ('Zool.,' Ill., ii. pl. 127.)

Sub-Genera.—*Megalurus* (Horsf.).—Bill slender; rictus bristled. Wings very short; the two first quills graduated, the four next all of the same length, and longest. Tail lengthened, graduated; the feathers narrow. Feet very large and strong; toes lengthened; the inner toe rather longer than the outer; claws slender, and but slightly curved; anterior scales divided, lateral, entire. Ex. *M. palustris*. *Pomatorhinus* (Horsf.).—General structure of *Crateropus*; but both mandibles of the bill curved and entire, and the wing shorter and much more rounded; four first quills graduated. Tarsal scales entire; inner toe rather shorter than the outer. Ex., *P. montanus*.

Timalia (Horsf.).—Plumage lax. Bill straight, rather short, much compressed; culmen high and arched gradually; tip obsoletely notched or entire; commissure curved. Wings short, rounded. Tail more or less lengthed, graduated. Feet strong; lateral toes nearly equal. India, Australia, Africa. (Sw.) Ex. *T. thoracica*. ('Pl. Col.,' 76.)

Pteroptochus (Kittlitz).—Feet of extraordinary size and thickness; all the anterior toes nearly equally long; claws long, slender, slightly curved. Tail consisting of fourteen feathers, rounded and carried erect. Wings very short. Representing *Menura* and *Orthonyx*. Western tropical America only. (Sw.) Ex. *P. megapodius*. (Kittl., pl. 4; 'Zool.,' Ill., ii. pl. 117.)

Sub-Family *Oriolinæ*, Orioles.—Bill thrush-like, as long as the head, broad at the base, compressed beyond; the base and gape devoid of bristles; nostrils naked, aperture large. Wings lengthened. Rump-feathers thick. Lateral toes unequal. (Sw.)

Donacobius (Sw.).—Habit and general structure of the *Crateropus*. Bill lengthened, slender; the culmen arched from the base; the tip hooked and notched; nostrils large, naked, membranaceous; the aperture large, oval, terminal. Wings remarkably short and rounded. Tail moderate, broad, cuneated. Feet very large and strong; lateral toes equal; claws slender, acute, slightly curved. America only. (Sw.) Ex. *D. vociferans* ('Zool.,' Ill., ii. pl. 72.)

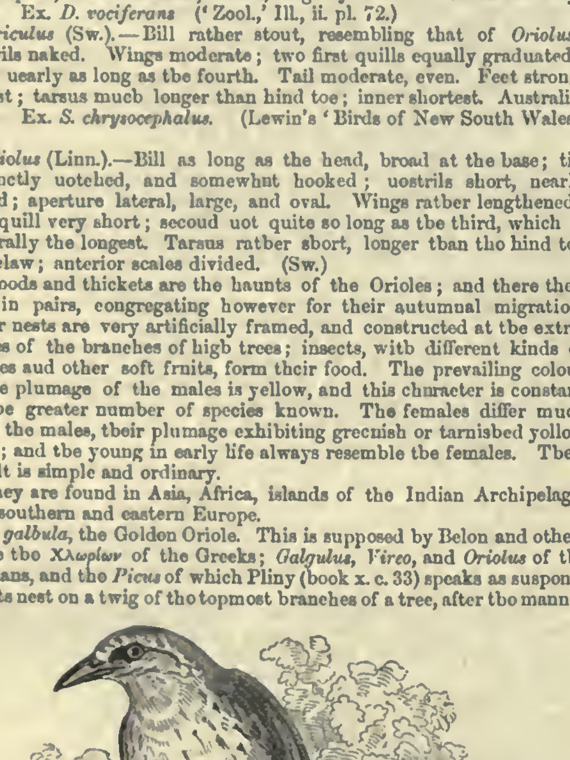
Sericulus (Sw.).—Bill rather stout, resembling that of *Oriolus*; nostrils naked. Wings moderate; two first quills equally graduated; third nearly as long as the fourth. Tail moderate, even. Feet strong, robust; tarsus much longer than hind toe; inner shortest. Australia. (Sw.) Ex. *S. chrysocephalus*. (Lewin's 'Birds of New South Wales,' p. 1.)

Oriolus (Linn.).—Bill as long as the head, broad at the base; tip distinctly notched, and somewhat hooked; nostrils short, nearly naked; aperture lateral, large, and oval. Wings rather lengthened; first quill very short; second not quite so long as the third, which is generally the longest. Tarsus rather short, longer than the hind toe and claw; anterior scales divided. (Sw.)

Woods and thickets are the haunts of the Orioles; and there they live in pairs, congregating however for their autumnal migration. Their nests are very artificially framed, and constructed at the extremities of the branches of high trees; insects, with different kinds of berries and other soft fruits, form their food. The prevailing colour of the plumage of the males is yellow, and this character is constant in the greater number of species known. The females differ much from the males, their plumage exhibiting greenish or tarnished yellow tints; and the young in early life always resemble the females. Their moult is simple and ordinary.

They are found in Asia, Africa, islands of the Indian Archipelago, and southern and eastern Europe.

O. galbula, the Golden Oriole. This is supposed by Belon and others to be the Χλωρίων of the Greeks; *Galgulus*, *Vireo*, and *Oriolus* of the Romans, and the *Picus* of which Pliny (book x. c. 33) speaks as suspending its nest on a twig of the topmost branches of a tree, after the manner



Golden Oriole (*Oriolus galbula*).
Lower figure, male; upper figure, female.

of a cup. It is the Becquafiga, Brusola, Galbedro, Garbella, Giallone, and Gravolo Gentile, of the Italians; and Rigogolo Commune of the 'Stor. degl. Ucc.'; Turiol of the Spanish; Loriot, Compère Loriot, and Orio, of the French; Gelbe Racbe, Gelber Pirol, Der Pyrold, Wiedewal &c., of the Germans and Netherlanders; Goutmerle of the Dutch; Witwall of Willughby and Ray; and Fwyalchen Felen of the Welsh.

Male.—Golden yellow, a blackish brown spot between the eye and the bill; wings and tail black; a yellow spot on the quills, not far from the middle of the wing when closed; and the tail-feathers terminated with yellow; bill reddish maroon; iris red; feet bluish gray. Length rather more than 10 inches. Mr. Hoy agrees with Mr. Yarrell that the male does not obtain its brilliant yellow and black till the third year.

Female.—Greenish olive above; grayish white with a yellowish tint below, where the plumage is marked by somewhat distant grayish brown short stripes or dashes disposed longitudinally; wings brown bordered with olivaceous gray; tail olivaceous tinged with black; yellowish beneath with a brownish black mark, somewhat in the form of an irregular Y; no dark streak behind the bill and the eye.

The Young of the Year resemble the female; but the longitudinal stripes of the lower parts are more numerous and deeper in colour; bill blackish gray and iris brown.

Variety, with black spots on a brilliant yellow ground.

The Golden Oriole is, upon the whole, a shy bird, haunting lonely groves and thickets on the skirts of woods, excepting in the fruit season, when it always frequents orchards, to the no small loss of the owner. It is difficult to get near them, though they are sometimes approached by the sportsman under the deception of his imitative whistle; but it requires great accuracy both of lips and ear to perform this fraud, for the least mistake, or one false note, will send the bird off at once. The food consists of insects and their larvæ, berries, and fruits, among which figs, grapes, and cherries are favourites. The whistle of the Oriole is loud but flute-like, and Bechstein expresses the sound by the word 'publo.' The cup, or rather saucer-shaped nest, is formed of wool and slender grass-stems, and placed in the fork of a branch, usually towards its extremity. The old French quatrain says:—

"On dit qu'un homme one le nid ne trouva,
Du Loriot, lequel ne fust pendu,
A un rameau, aussi est suspendu,
Voylà pourquoy ce dire on controuva."

Nest of Golden Oriole (*Oriolus galbula*).

The eggs are generally four or five, purplish white with a few ash-gray and claret spots; and the female watches over them with such maternal care, that it is said she will suffer herself to be taken rather than abandon them. In this country nests have been taken in Suffolk and Norfolk.

This bird is found in Sweden, where it occasionally breeds; some of the districts of Russia, Germany, Holland, France, Spain, and Italy; Malta (on the southward migration to Africa), Greece, Egypt, Tunis, Tripoli, and the whole north coast of Africa; Trebizond and Smyrna. In a note to Pennant's 'British Zoology,' by J. L., it is stated that it is common in India under the name of Pilluck or Peeluck, and that drawings of both sexes were sent from Oude to Lord Valentin; but these were probably specimens of *O. aureus* so often received from India, a species which, though in some degree like the *O. galbula*, is distinct from it.

In our own country the Golden Oriole has been found in Hampshire, Devonshire, Cornwall, near Manchester, near Lancaster, near Walton in Surrey, and near Godalming, at Cheshunt (Herts), near Saxmundham in Suffolk, in Norfolk, at Tynemouth in Durham, and in South Wales. It has been seen, though rarely, in Ireland, but never, as far as we can learn, in Scotland.

The bird can only be considered as an occasional summer visitor in Britain, where it first appears in April, returning in September. Prince

C. L. Bonaparte states ('Specchio Comparativo') that it arrives near Rome in the spring, and departs in the summer.

The Golden Oriole gets very fat after its summer feed of fruits. Willughby saw many of them in the poulterers' shops at Naples, and says that "it hath very delicate flesh, and yields wholesome nourishment."

Sub-Genus *Irena* (Horsf.).—Bill of *Oriolus;* but the culmen much raised and considerably arched from the base, rather hooked at the tip. Nostrils partly defended by short plumes, which cover the membrane. Rictus slightly bristled. Wings and tail as in *Sericulus*: feet small; tarsus very short, scarcely longer than the hind toe and claw; anterior and lateral scales entire; inner toe rather shortest: rump-feathers very thick, and slightly spinous. The species inhabit India. Ex. *Irena Puella.* (Horsf., 'Java.' 'Pl. Col.,' 70.)

Dulus (Vieill.).—Bill very short, much compressed, but with the culmen elevated and arched; commissure curved; nostrils as in *Oriolus.* Wings rather short; first quill not half so long as the second; third, fourth, and fifth longest; secondaries with the tips notched; tertials lengthened. Tail moderate, slightly forked. Feet as in *Oriolus*; claws strong, broad, much curved. The species are natives of South America. Ex. *D. palmarum.* ('Enl.,' 156, f. 2.)

Sphecotheres (Vieill.).—Bill rather short, strong, partaking of the structure both in *Dulus* and *Oriolus;* the base broad; commissure straight, gape very wide, extending beyond the eye. Nostrils naked, the aperture large and oval; wings, tail, and feet as in *Dulus*; tarsus hardly longer than the hind toe and claw. The species inhabit Australia. Ex. *S. viridis.* (Vieill., 'Gal.,' pl. 147.)

M. Lesson, in his 'Table Méthodique,' makes the Turdusinées, the fifth family of the Dentirostral Birds, consist of the following genera:—

Turdus (Linn.), including *Merula, Turdus,* and *Ixos; Cinclus; Cinclosoma; Dulus; Sturnella; Timalia; Dasyornis; Jora; Pitta; Myiothera; Brachypteryx; Grallina; Acridotheres; Psaroides; Mimetes; Oriolus;* and *Sericulus.* The position assigned to the family is between the *Ampelidées* and the *Menurées* (*Mænura*).

Prince C. L. Bonaparte, in his 'Geographical and Comparative List of the Birds of Europe and North America' (1838), places the *Turdidæ* between the *Certhidæ* and the *Muscicapidæ,* and assigns to the first the following sub-families and genera.

Sub-Family *a. Calamoherpinæ.*

Cettia (Bonap.); *Pseudo-luscinia* (Bonap.); *Locustella* (Ray); *Calamodyta* (Bonap.); *Cysticola* (Less.); *Erythropygia* (Smith, *Agrobates,* Sw.); *Calamoherpe* (Meyer); *Hippolais* (Brehm.). These are for the most part formed at the expense of the genera *Sylvia* and *Motacilla* (Linn.).

b. Sylvinæ.

Phyllopneuste (Meyer, *Phylloscopus,* Boie); *Melizophilus* (Leach); *Sylvia* (Lath.); *Curruca* (Brisson); *Nisoria* (Bonap.); *Accentor* (Bechst.); *Calliope* (Gould); *Luscinia* (Br., *Philomela,* Sw.).

c. Saxicolinæ.

Dandalus (Boie, *Erythaca,* Sw., *Rubecula,* Br.); *Ruticilla* (Br., *Phœnicura,* Sw.); *Saxicola* (Bechst); *Vitiflora* (Briss., *Œnanthe,* Vieill.); *Sialia* (Sw.); *Petrocincla* (Vig., part); *Petrocossyphus* (Boie).

d. Oriolinæ.

Oriolus (Linn.).

e. Turdinæ.

Merula (Ray); *Turdus* (Linn.); *Oreocincla* (Gould); *Mimus* (Boie, *Orpheus,* Sw.); *Cinclus* (Bechst.).

f. Motacillinæ.

Anthus (Bechst.); *Budytes* (Cuv.); *Motacilla* (Linn.).

g. Parinæ.

Regulus (Ray); *Parus* (Linn.); *Mecistura* (Leach, *Paroides,* Brehm.); *Calamophilus* (Leach, *Mystacinus,* Brehm.); *Ægithalus* (Vig., *Pendulinus,* Cuv.).

h. Sylvicolinæ.

Parula (Bonap.); *Trichas* (Sw.); *Vermivora* (Sw.); *Sciurus* (Sw.); *Sylvicola* (Sw.); *Wilsonia* (Bonap.); *Culicivora* (Sw.).

Mr. G. R. Gray makes the *Turdidæ* (*Turdus,* Linn.) the second family of his third tribe (*Dentirostres*) of his second order (*Passeres*). The *Dentirostres* are placed by him between the *Tenuirostres* and the *Conirostres,* and the *Turdidæ* between the *Luscinidæ* and the *Muscicapidæ.*

The following are the sub-families and genera into which Mr. G. R. Gray divides the *Turdidæ:*—

Sub-Family 1. *Formicarinæ.*

Genera.—*Notodela,* Less.; *Eupetes,* Temm.; *Ajax,* Less.; *Dasycephala,* Sw.; *Pithys,* Vieill.; *Formicivora,* Sw.; *Myrmeciza,* G. R. Gray; *Urotomus,* Sw.; *Malurio,* Less.; *Corythopis,* Sundev.; *Brachypteryx,* Horsf.; *Macronus,* Jard. and Selby; *Tinactor,* Pr. Max.; *Formicarius,* Bodd.; *Chamæza,* Vig.; *Grallaria,* Vieill.; *Cissa,* Boie; *Brachyurus,* Thunb.; *Myiophoneus,* Temm.; *Hydrobata,* Vieill.

Sub-Family 2. *Turdinæ.*

Genera:—*Petrocossyphus,* Boie; *Orocetes,* G. R. Gray; *Larvivora,* Hodgs.; *Bessonornis,* Smith; *Saxicolides,* Less.; *Chaëtops,* Sw.; *Geocichla,* Kuhl.; *Zoothera,* Vig.; *Myiophaga,* Less.; *Oreocincla,* Gould; *Turdus,* Linn.; *Merula* (Ray), Boie; *Mimus,* Briss.; *Toxostoma,* Wagl.

Sub-Family 3. *Timalinæ.*

Genera:—*Donacobius,* Sw.; *Pellorneum,* Sw.; *Aipunemia,* Sw.; *Crateropus,* Sw.; *Garrulax,* Less.; *Actinodura,* Gould; *Cinclosoma,* Vig. and Horsf.; *Suya,* Hodgs.; *Sibia,* Hodgs.; *Tesia,* Hodgs.; *Malacocercus,* Sw.; *Timalia,* Horsf.; *Pomatorhinus,* Horsf.; ——? *Paludicola,* Hodgs.; *Icteria,* Vieill.; *Turnagra,* Less.

Sub-Family 4. *Oriolinæ.*

Genera:—*Dulus,* Vieill.; *Sphecotheres,* Vieill.; *Oriolus,* Linn.; *Mimeta,* Vig. and Horsf.; *Analcipus,* Sw.; *Sericulus,* Sw.; *Oriolia,* J. Geoff.

Sub-Family 5. *Pycnonotinæ.*

Genera:—*Microscelis,* G. R. Gray; *Microtarsus,* Eyton; *Malacopteron,* Eyton; *Trichophorus,* Temm.; *Hypsipetes,* Vig.; *Yuhina,* Hodgs.; *Phyllastrephus,* Sw.; *Hæmatornis,* Sw.; *Pycnonotus,* Kuhl.; *Andropadus* (?), Sw.; *Trichixos* (?), Less.; *Setornis* (?), Less.

Mr. G. R. Gray, with his usual diligence and accuracy, gives the synonyms of all these genera; and observes, with regard to some of them, that *Drymophila,* Sw., has been used in botany; that *Leptorhynchus,* Menestr., was previously employed; *Petrophila,* Sw., used in botany; *Cossypha,* Vig., used in entomology, only the termination is there in *us; Cichla,* Wagl., previously used in ichthyology; *Paludicola,* Hodgs., previously employed in herpetology; and *Micropus,* and *Brachypus,* Sw., previously used in other branches of natural history.

The following true Thrushes belonging to the Linnæan genus *Turdus,* are natives of Europe:—

Black Ouzel, or Blackbird, *Merula vulgaris,* Ray; the Ring Ouzel, *Merula torquata,* Briss.; the Migratory Ouzel, *Merula migratoria,* Sw.; the Black-Throated Thrush, *Turdus atrogularis,* Temm.; the Fieldfare, *Turdus pilaris,* Linn.; the Redwing, *Turdus Iliacus,* Linn.; the Missel-Thrush, *Turdus viscivorus,* Linn.; the Song-Thrush, or Throstle, *Turdus musicus,* Linn.; Naumann's Thrush, *Turdus Naumanni,* Temm.; the Pallid Thrush, *Turdus pallidus,* Pall.; White's Thrush, *Turdus Whitei,* Eyton; the Siberian Thrush, *Turdus Sibericus,* Pall.; the Water-Ouzel, or Common Dipper, *Cinclus aquaticus,* Bechst.; the Black-Bellied Water-Ouzel, *Cinclus melanogaster,* Brehm; Pallas's Water-Ouzel, *Cinclus Pallasii,* Temm.; the Rock-Thrush, *Petrocincla saxatilis,* Vig.; and the Blue Thrush, *Petrocincla cyaneus,* Vig.

Of these, the Water-Ouzel, or Common Dipper; the Missel-Thrush; White's Thrush (occasional only); the Song-Thrush; the Fieldfare; the Redwing; the Blackbird; and the Ring-Ouzel, or Ring-Blackbird, are British.

T. musicus, Throstle or Song-Thrush; Mavis of the Scotch. It is the Grive and Petite Grive of the French; Tordo, Tordo Commune, and Tordo Bottaccio, of the Italians; Sing-Drossel, or Weiss-Drossel, of the Germans; and Aderyn Bronfraith of the Welsh.

This charming songster inhabits every country in Europe, haunting gardens and woods near streams or meadows. Bechstein says that in Germany, as soon as the autumnal fogs appear, the Throstles collect in large flights to seek a warmer climate, the principal time of passage being from September 15th to October 15th, and the return about the middle or end of March, when each pair seeks its own district. In Great Britain it is permanent, and spread over England, Wales, Ireland, Scotland, and its islands. Russia, Denmark, Swedon, and Norway possesss it. In the south, besides Germany, France, Italy, and Greece have it. It has been seen in winter at Smyrna and Trebizond. Professor Nilsson states that it leaves Sweden for the winter, and comes farther south. Mr. Selby observes that such visitors arrive in Britain with a north or north-east wind, and, after staying a few days to recruit, move southward.

Worms, insects, snails, and fruits, form the food of the Throstle. The common Garden-Snail (*Helix hortensis*) and the Wood-Snail (*Helix nemoralis*) are killed and eaten in great numbers by this species. The bird beats and breaks the shells against a stone to get at the animals. The nest is made of green moss generally, and fine root-fibres on the outside, and is lined within with cow-dung and decayed wood, the lining forming a cement so perfectly spread that it will hold water. Eggs four or five, of a light blue, the larger end having a few small black specks or spots. Time of incubation thirteen days. The first hatch generally comes forth in April, but the young have been known to be out at the end of March. There are generally two broods in the year. Both the cock and the hen sit, but the former less than the latter. He often feeds her on the nest. A holly, a thick bush (a tall one is mostly preferred), a dense and somewhat high shrub, or a fir is usually selected; but the bird has been known to breed in an open shed or tool-house, and does not seem to shun the neighbourhood of man. In 1833 a pair built their nest in a low tree at the bottom of Gray's Inn Gardens, near the gates, where passengers are going by all day long. The hen laid her complement of eggs, and was sitting on them, when a cat climbed up, and killed her on the nest. The cock immediately deserted the place.

Bechstein states that in captivity the Throstle is easily taught to perform airs. For taking it he recommends a perch with a limed twig as the best mode of capturing a fine-toned male: but in September or October he says that they may be caught in the water-traps, where they repair at sunrise and sunset, so late that they sometimes cannot be seen, and the bird-catcher is only guided by his ear. He observes that when the birds enter the water there must be no haste on the part of the fowler, because they like to bathe in company, and assemble sometimes to the number of ten or twelve at once, by means of a peculiar call. Bechstein tells us that the first which finds a convenient stream, and wishes to go to it, cries in a tone of surprise or joy, 'sik, sik, sik, siki, tsac, tsac, tsac': then all the thrushes in the neighbourhood immediately reply in concert and repair to the place. The bath is entered however with a good deal of circumspection on their parts, and they seldom venture till they have seen a Redbreast bathe without danger. But the first that bathes is soon followed by others, and they begin to quarrel among themselves if the bath is not large enough to accommodate all satisfactorily. Bechstein further remarks that it is a good plan to have a tame bird running and fluttering on the banks of the stream as a decoy to attract them.

T. viscivorus, the Missel-Thrush; Merle Draine of the French; *Merula viscivora* of Selby. It is also called in various parts of Great Britain, Mistle-Thrush, Gray Thrush, Holm-Thrush, Screech-Thrush, Stormcock, and Shrite. The male and female of this bird exhibit little difference. The beak is dark brown; the under mandible pale yellow at the base; the irides hazel; the top of the head and almost all the upper surface of the body nearly uniform clove-brown; wings and wing-coverts umber-brown; the latter broadly edged with wood-brown; the wing-feathers with a narrow edge of the same colour; upper surface of the tail-feathers umber-brown; the broad inner web of each outside tail-feather with a patch of dull white; the second feather on each side with a smaller patch at the tip; the tail slightly forked; all the under surface of the body white tinged with yellow, and covered with numerous black spots, those on front of the neck triangular in shape, with one angle pointing upwards; the spots on the breast, belly, and sides round; under surface of the wings and tail gray; tarsi and toes pale brown; the claws dark brown. The whole length of the adult bird is about 11 inches.

This is one of the largest of the British species, and although not very common anywhere it is very generally diffused. It is rather a shy bird, frequenting small woods and the high trees in hedges bounding large meadows. It remains in this country all the year, and the male commences his song frequently as early as February. The name Stormcock is given him from his habit of singing during storm and rain. It begins to build in April, and fixes its nest in the fork of a tree. The eggs are four or five in number, of a greenish white-colour, spotted with red-brown; sometimes the ground-colour is reddish-white spotted with dark red-brown. Two broods are produced in the season. It feeds on worms, slugs, &c., also fruits, especially those of the mistletoe, from which it derives its English name. It has been found in Scandinavia, Russia, and India. It is common in Germany, France, Provence, and Italy.

T. Whitei, White's Thrush. This very rare bird is a native of Japan and Java, and has been taken a few times in the British Islands. It was first killed in Hampshire, and named by Mr. Eyton after White, the naturalist of Selborne. It is the *T. varius* of Temminck.

T. pilaris, the Fieldfare, or Gray Thrush, has the head, hind neck, and wings gray; fore part of the back chestnut; space before the eyes brownish-black; a whitish line over the eye; fore neck and breast reddish-yellow; the feathers tipped with a brownish-black elongated triangular spot; those of the sides with large dusky spots, and margined with white; lower wing-coverts and axillary feathers pure white. Young of the year with duller tints, the feathers of the sides light, with a pale brown or dusky border within the white margin. (Macgillivray.)

This bird is migratory in the British Islands. It comes from the north, and is one of the latest species that makes its appearance. It seldom appears much before the beginning of November, and returns again at the end of April. In very severe weather they leave these Islands and go farther south; they are known to go as far south and to the east as Minorca, Sicily, Malta, Smyrna, and Erzerum. They seldom breed in this country. In Norway they build their nests on the spruce fir, and several are found near together. They lay five or six eggs, closely resembling those of the Blackbird; they are light blue, mottled over with spots of dark red-brown. This bird is well-known in Sweden, Russia, and Siberia, where it is found only in the summer; in Poland, Russia, and Austria it remains the whole year, but in France and the south of Europe it is only a summer visitant.

T. iliacus, the Redwing; *Merula iliaca*, Selby; Merle Mauvis of Temminck; the Red-Sided Thrush, Wind-Thrush, and Swine-Pipe, of the English. Like the last this is a winter visitant; it arrives in flocks about the middle or end of October, departing in the middle of May. It has a beautiful note, and has been called the Nightingale of Norway. It feeds on worms, slugs, and berries. Mr. Yarrell says it feeds on berries injurious to man.

T. torquatus, the Ring-Ouzel; *Merula torquata* of Selby and Gould. It is also called in this country Rock-Ouzel, Tor-Ouzel, Mountain-Blackbird, Moor-Blackbird, White-Breasted Blackbird, and Ring-Thrush. The male has a yellow bill, the feet olive-brown, the plumage blackish-brown, the feathers margined with gray; a broad semilunar patch of white on the fore part of the breast. Female similar, but of a duller and lighter tint.

This bird is a summer visitor to the British Islands; it arrives from the south in the month of April, and departs in October. They are seen chiefly in the counties of Surrey, Kent, Essex, Suffolk, and Norfolk. It only occasionally breeds in this country, and then more especially in the north; it builds its nest on or near the ground, and lays four or five light-blue eggs, speckled and spotted with reddish-brown. Its food consists of snails, insects, fruit, hawberries before it leaves for the winter, and ivy berries when they return in the spring.

T. aurigaster, Gold-Vented Thrush; Le Culdor of Le Vaillant; *Hæmatornis chrysorhæus* of Swainson; *Pycnonotus chrysorhæus*, Thompson. This bird is a native of Africa, and little is known of its habits. One specimen has been shot in Ireland, and it therefore takes its rank as a British visitant. (Yarrell.)

T. erythrogaster is a native of the Himalaya, and may be taken as an example of an Asiatic species of *Turdus*. The male is gray-cærulescent above; the cheeks, the sides of the neck, and the quills black; breast, abdomen, and rump red; beak and tarsi black. The female differs in being cærulescent-brown, the lower part of the back obscurely banded with brown; neck in front whitish, marked with dark-brown; breast, abdomen, and rump reddish-white marked with undulations. Length 8½ inches.

Turdus erythrogaster, male and female. Gould.

Mr. Gould ('Century of Birds from the Himalaya Mountains') states that this beautiful species exhibits a marked departure in the style of colouring from its more typical congeners; and were it not that its form dictated the situation in which it is retained, it would otherwise seem to be allied in many respects to the genus *Petrocincla*.

T. strepitans, Smith (*Merula Letsitsirupa* of the same), is a native of Africa. The male has the front and top of head brownish-gray; occiput, upper aspect of neck, interscapulars, scapulars, and shoulders deep yellowish-gray, faintly shaded with brown; back, rump, and upper tail-coverts dirty ash-gray. Under parts white, tinted in places with ochre-yellow; sides of the neck, whole of the breast, flanks, and belly variegated with blackish-brown pyriform spots, one on each feather, the large end reaching nearly to its point. Sides of the head white, slightly tinted with ochre-yellow, variegated below the eyes with three blackish-brown bands; the foremost proceeds from the base of the lower mandible, the second from the middle of the under eyelid, and the third from the outer angle of the eye; the first extends nearly horizontally, and the two others obliquely downwards and backwards till they unite with the horizontal one. Primary wing-coverts and primary quill-feathers deep hrownish-red, the latter tipped and edged externally with yellowish-wbite; the first two-thirds at least of tbe inner vanes of these feathers are of a clear buff-colour, darkest towards the shafts; secondary wing-coverts and secondary and tertiary quill-feathers dark grayish-brown, the outer vanes lightest, all margined externally and tipped with dirty white. Eyes reddish-hrown; upper mandible and tip of lower inferiorly as well as tbe claws liver-hrown; lower mandible elsewhere pale saffron-yellow, as well as the cutting edge of upper mandihle. Feet and insides of the hill deep straw-yellow.

Figure rohust and rather short. Bill long and moderately strong; upper mandible broad and slightly depressed towards tbe hase, narrow and distinctly notched near the tip; culmen between nostrils elevated and rounded, towards the point of the bill strongly curved; nasal fossæ large and membrauous, the nostrils narrow longitudinal slits near to the edges of the mandihle; wings short and rounded, and when folded they reach over the first half of the tail; the first quill-feather rudimentary, the third rather tbe longest; the second and fourth of equal lengtb, and scarcely shorter than the third; the fifth a little shorter than the fourth, and the remaining primaries diminish in length successively. Tail short and slightly forked. Legs long, tarsi robust, anteriorly indistinctly scutellated, posteriorly entire; toes strong, the inner and outer toes of the same lengtb; claws strong, much curved and pointed. Length from point of bill to tip of tail 8 inches 6 lines.

The female differing hut little in colour, if at all, from the male. (Smitb.)

Turdus strepitans, male. Smith.

Dr. Smith states that immediately upon reaching Kurichane this thrush hegan to appear in the thickets, and he continued to acquire occasionally a specimen even in the vicinity of the tropic. It seeks, he says, its food upon the ground, and, when so occupied, its resort is readily discovered by the natives from the noise it makes in scratching the ground, or in displacing rubbish and decayed leaves which conceal the insects it is seeking. The name by wbich it is known in tbe country it inhabits is, he informs us, characteristic of the vigour with which it employs its feet, and the nearest translation he can give is 'Ground-Scraper.'

Dr. Smith further remarks that the form of its hill, particularly towards the hase, tbe length of its legs, and the shortness of its tail, are all characters which remove it from the more typical species of the genus *Turdus;* hut yet there is in its structure and habits what necessarily constitntes it a true thrush. ('Illustrations of the Zoology of South Africa.')

T. mustelinus (Gm.) is an American Thrush. It appears to he the *Turdus melodus* of Wilson and Tawny Thrush of Pennant, and is generally known as the Wood-Thrush. It is of a hright cinnamon-brown above, hrightening into rufous on the head, and inclining to olive on the rump and tail; beneath whitisb, thickly marked with pencil-shaped dusky spots; vent pure white; orbits of the eye white; bill dusky-hrown, slightly notched, lower mandible flesh-coloured towards the base; legs and claws very pale flesh-colour; iris dark chocolate. Lengtb 8 inches; alar extent 13 incbes. (Nuttall).

Nuttall states tbat this solitary and retiring songster inhahits, during summer, the whole continent from Hudson's Bay to Florida, and, according to his friend Mr. Ware, breeds as far south as the vicinity of Natchez, in the State of Mississippi. He remarks tbat it is not satisfactorily ascertained wbether the species quits the houndaries of the United States in winter, because the hird is then silent, and always difficult of access. He thinks it probahle that this Thrush may winter in the Southern States, as a young hird, gleaning insects and herries, had heen caught in a garden in Boston on the 26th of Octoher.

But, wherever the Wood-Thrush may winter, it arrives in the Middle States from the 1st to the 15th of April. Nuttall thus describes its song and habits:—

"At the dawn of morning he announces his presence in the woods, and from the top of some tall tree rising through the dark and shady forest he pours out his few clear and harmonious notes in a pleasing reverie, as if inspired by the enthusiasm of renovated nature. The prelude to this song resembles almost the double tonguing of the flute, hlended with a tinkling, shrill, and solemn warble, which re-echoes from his solitary retreat, like the dirge of some sad recluse who shnns the busy haunts of life. The whole air consists usually of four parts or hars, which succeed, in deliberate time, and finally blend together in impressive and soothing harmony, becoming more mellow and sweet at every repetition. Rival performers seem to challenge each other from various parts of the wood, vying for the favour of their mates, with sympatbetic responses and softer tones; and, some wageing a jealous strife, terminate the warm dispute by an appeal to combat and violence. Like the Rohin and the Thrasher, in dark and gloomy weather, when other hirds are sheltered and silent, the clear notes of the Wood-Thrush are heard through the dropping woods, from dawn to dusk, so that, the sadder the day, the sweeter and more constant is his song. His clear and interrupted whistle is likewise often nearly the only voice of melody heard hy tbe traveller, to mid-day, in the heat of summer, as he traverses the silent, dark, and wooded wilderness, remote from tbe haunts of men. It is nearly impossible by words to convey any idea of the peculiar warble of this vocal hermit, hut amongst his phrases the sound of ''airŏee,' peculiarly liquid, and followed by a trill, repeated in two interrupted bars, is readily recognisable. At times their notes bear a considerable resemblance to those of Wilson's Thrush, such as ''eh rhehu 'vrehu,' tben varied to ''eh villia villia, 'eh villia vrehu,' then, ''eh villa villu,' high and shrill.

"The wood-thrush is always of a shy and retiring disposition, appearing alone, or only in single pairs, and, while he willingly cbarms us with his song, he is content and even solicitous to remain concealed. His favourite baunts are low shady glens by watercourses, often rendered dark with alder-husbes, mantled with the trailing grape-vine. In quest of his insect prey he delights to follow the meanders of tbe rivulet, through whose leafy sbades the sunheams steal only in a few uninterrupted rays over the sparkling surface of the running brook. So partial is this bird to solitude, that I have known one to sing almost uniformly in the same place, though nearly half a mile from his mate and nest. At times, indeed, he would venture a few faltering low notes in an oak near his consort, but his mellowest morning and evening warble was always delivered from a tall hickory, overtopping a grove of hemlock firs, in which the dimness of twilight prevailed at noon. The Wood-Thrush, like the nightingale, therefore, feels inspired in darkness, hut, instead of waiting for the setting sun, he chooses a retreat where the beams of day can seldom enter. These shady retreats have also an additional attraction to our thrush; it is here that the most interesting scene of his instinctive labour begins and ends, here he first saw the light, and breathed into existence, and here he now hestows his nest in a sapling oak, or in the next thick laurel or blooming alder, whose berries afford him su ample repast in the coming autumn. Outwardly it presents a warm hed of witbered beach or oak leaves, above these a layer of coarse old grass and leaf-stalks is laid, tempered with a mixture of mud and decayed wood smoothly plastered, so as to form a crust like the nest of the rohin. The whole is then surmounted hy a thin lining of the hlack fihrous radicles of the fern."

Wood-Thrush (*Turdus mustelinus*).

The same autbor states that the eggs, which are four or five in number, are scarcely distinguishable from those of the robin, and of an uniform bright greenish-blue, destitute of spots. Beetles, caterpillars, and other insects, and in autumn berries, constitute the principal food of the species. Nuttall further states that the young remain for weeks around gardens in quest of berries, and that they are particularly fond of those of the various species of cornel and *Viburnum*. At this season, he says, they occasionally leave their favourite glens, and in their devious wanderings, previous to their departure, sometimes venture to visit the rural suburbs of the city. The young, it appears, are easily reared, and, like our Throstle, sing nearly as well in the cage as in their native wilds. ('Manual of the Ornithology of the United States and of Canada.')

MERULITE. [OPAL.]

MERU'LIUS, a genus of *Fungi*, deriving its name from *Merula*, a Blackbird, some of the species being black. The character of the genus is to have a veiny or sinuous plaited hymenium, with the folds confluent with the pileus, and forming angular unequal perforations. Its only interest is derived from one of the species being a common cause of dry-rot. This plant, the *M. lachrymans* of Fries, and the *Boletus lachrymans* of Sowerby's 'Fungi,' t. 113, is very common on rotten wood in vaults and cellars, among the timbers in ships, and in similar damp situations where there is not a free circulation of air. In general it is found without fructification, its thallus, or spawn, being the only part developed, and resembling a white, dry, cottony matter, consolidated into a substance like leather. The fructification is composed of fine yellow orange or reddish-brown plicæ, so arranged as to have the appearance of perforations, and occasionally producing "pendent processes like inverted cones:" it usually forms a circle varying from 1 to 8 inches in diameter, and when perfect the cavities contain drops of clear water, which have given rise to the specific name. The means of preventing the attacks of this and other *Fungi* upon timber is a free circulation of dry air, or the impregnation of wood with corrosive sublimate, chloride of zinc, or creasote. [DRY-ROT.]

MERYCOTHE'RIUM, the name applied by M. Bojanus to a genus of Fossil *Mammalia*, founded on three fossil teeth, according to the authority of the person who sold them to him. Bojanus records one species under the name of *M. Sibiricum*.

Cuvier ('Oss. Foss.') remarks that if these teeth are really fossil, and from Siberia, this would be the first authentic example of such remains belonging to the genus *Camelus*. He observes that their size, their form (which is longer than it is wide), and the absence of an 'arête,' or small cone, between the columns, leave no doubt as to their generic character. Those of the Giraffe are more square, and with a small point, as in the stags; while those of the Ox have a cylindrical 'arête,' or ridge. Cuvier further states that Bojanus, who has very well remarked this general resemblance, has also noticed some differences which have appeared to him sufficient to justify a new name for the animal; but the French zoologist observes that Bojanus proposes this distinction with doubt, and declares his readiness to renounce it, if it should be established that these teeth belonged to a camel, a gigantic sheep, or an antelope (the only genera in fact which want ridges between the columns).

Cuvier thinks that the differences of which Bojanus speaks are owing to the skulls of the Camels examined by the latter, as points of comparison, being the heads of individuals much older than that to which the teeth in question belonged. A Dromedary only a little older, and whose teeth were nearly in the same state of detrition, appeared to Cuvier to present no difference, save that of individuality. He remarks that they are, as Bojanus truly pointed out, the penultimate and antepenultimate molars of the left side of the upper jaw, and that it remains to show in what beds they were found, and to search for other bones of the animal, in order to see whether they will furnish any specific character. Cuvier concludes by stating that M. Marcel de Serres, professor of mineralogy at Montpellier, had just communicated to him a drawing of a fossil femur from the environs of that city, which resembled much, in the parts of it which were preserved, that of a Camel. [CAMELUS.]

Notwithstanding Cuvier's opinion, which is worthy of all respect, there are those who still think that *Merycotherium* is a distinct genus. See Bojan., 'Nov. Act. Acad. Leop. Nat. Cur.,' xii. tab. 21, f. 1-8.

MESEMBRYA'CEÆ, *Ficoids*, a natural order of Polypetalous Exogens, consisting of herbaceous and shrubby Plants inhabiting various parts of the world, in very dry temperate climates, but especially the Cape of Good Hope, where the species are extremely numerous. They are succulent plants, with an inferior many-celled polyspermous ovary, numerous narrow petals, indefinite stamens, and a fruit splitting into regular stellate valves. Some of the plants are esculent, others furnish alkaline matter, while a few are diuretic. Only four genera seem admissible into the order; the others referred to it under the name of *Ficoideæ* chiefly belonging to *Tetragoniaceæ*; but *Mesembryanthemum*, one of the admitted genera, alone comprehends more than 300 species. [MESEMBRYANTHEMUM.]

MESEMBRYANTHE'MUM, a genus of Plants belonging to the natural order *Mesembryaceæ*, or *Ficoideæ*. It has a calyx of 5 sepals, rarely of 2 or 8, the sepals united to themselves and to the ovarium; lobes unequal, usually leaf-formed; petals innumerable, in one, but more often in many series, united among themselves at the base; stamens indefinite, disposed in many series, inserted with the petals at the top of the calyx; ovarium adnate to the calyx, many-celled inside; stigmas 4-20, but usually 5; capsule many-celled, opening stellately at the apex, adnate to the permanent calyx; seeds numerous; embryo curved, at the side of a mealy albumen; cotyledon thick, very blunt. The species are sub-shrubs, rarely herbs, almost all natives of the Cape of Good Hope. The leaves are usually opposite, thick, fleshy, flat, terete, or trigonal. Flowers terminating the branches white, yellow, or purple, the greater part of which open in the heat of the sun, very few of them opening in the evening. The species are all known by the name of Fig-Marigolds.

Mesembryanthemum albidum.
1, a ripe fruit; 2, a vertical section of a flower.

M. nodiflorum has an erectish stem; leaves opposite and alternate, nearly terete, obtuse, ciliated at the base; flowers axillary, nearly sessile; lobes of the calyx very unequal, exceeding the petals, which are small. It is a native of Egypt, Barbary, Corsica, and Naples, in sandy places by the sea-side. It is used in Egypt for obtaining barilla from its burnt ashes, and also in the manufacture of morocco leather. This and other species afford a grateful food to the cattle in the arid desert districts where they are found.

M. crystallinum, Ice-Plant, is diffusely procumbent, herbaceous; covered with large glittering papulæ on every part, which makes the plant appear as if covered with ice; leaves ovate, alternate; stem clasping, undulated; flowers axillary, almost sessile. It is a native of the Cape of Good Hope, Canary Islands, and of Greece about Athens, in the sand by the sea-side. There are two varieties of this plant, one a biennial, which is said to be the true *M. crystallinum*, and the other an annual, which is the Common Ice-Plant of the gardens, called by some botanists *M. glaciale*. The whole plant is covered with glittering white papulæ that shine in the sun, whence it is called Ice-Plant; others name it the Diamond-Plant. Large quantities of the burnt ashes of this plant are imported by the Spaniards for use in their glass-works, under the name of Barilla Moradera. *M. emarcidum*, according to Burnett, is fermented by the Hottentots, when it becomes narcotic, and is chewed by those people like tobacco. *M. albidum* is a sweet-scented species from the Cape.

Don, *Dichlamydeous Plants*; Lindley, *Vegetable Kingdom*.)

MESENTERIPORA. [POLYZOA.]

MESENTERY is that portion of the Peritoneum by which the intestines are attached to the posterior wall of the abdomen. It consists of a double layer of fine cellular and adipose tissue, which is attached to the abdominal wall by a comparatively narrow origin, and becoming gradually wider, spreads out like a fan, to be attached to the whole length of the canal of the small intestines. Between its layers the arteries pass to the intestines, and the veins and lacteals return from them.

The other abdominal organs are attached to the walls of that cavity and to each other by layers of membrane similar to the Mesentery. Those which belong to the colon are called the meso-colon; those of the rectum the meso-rectum, &c.; while those which connect the stomach with the spleen and liver are named respectively the gastro-splenic and the gastro-hepatic, or lesser omentum. [PERITONEUM.]

MESITINE SPAR, *Brünnerite*, a native Carbonate of Iron and Manganese. It occurs in yellowish rhombohedrons. Its hardness is

4·0, and its specific gravity 3·3 to 3·6. It includes much that is called Rhomb-Spar, or Brown Spar, which becomes rusty on exposure to the atmosphere. (Dana.)

MESODESMA. [CONCHACEA.]

MESODESMA, M. Deshayes's name for a genus of *Mollusca* (*Erycina*, Lam.) [VENERIDÆ.]

MESOLE. [NATROLITE.]

MESOMPHYX, Rafinesque, a genus of Pulmoniferous *Mollusca* separated from *Helix*.

MESOPHLŒUM. [BARK.]

MESOTYPE. [NATROLITE.]

ME'SPILUS, a genus of Plants belonging to the natural order *Rosaceæ*, and to the sub-order *Pomeæ*. It has the calyx 5-cleft, the segments foliaceous; the petals nearly orbicular; the disc large, full of honey; the styles 2-5, glabrous; the pome turbinate, open, 5-celled; the endocarp bony. The species are trees, natives of Europe, and in a wild state are furnished with spines, which all disappear on cultivation. The flowers are large, nearly sessile, and white.

M. Germanica, the Common Medlar, has lanceolate undivided leaves, downy beneath, and solitary flowers. This plant is a native of Europe and Siberia. It is found in Great Britain in hedges and thickets, in Surrey, Sussex, and Cheshire. It is cultivated on account of its fruit, which is eaten in a state of decay. Its taste and flavour are peculiar, and greatly esteemed by some persons. De Candolle describes three wild varieties of this species of Medlar. The following are the garden or cultivated varieties :—

1. Blake's Large Medlar.
2. The Dutch, Common, Large Dutch, Broad-Leaved Dutch, or Large German Medlar. It bears the largest fruit of any of the cultivated medlars
3. Stoneless, or French Medlar, has small obovate fruit, not much esteemed.
4. Nottingham, Common, Small-Fruited, or Narrow-Leaved Dutch Medlar. It has an obovate middle-sized fruit, and is the best of all the medlars.

M. Smithii, Smith's Medlar, has oblong elliptic serrated leaves, pubescent on the nerves beneath, the flowers usually solitary. The native country of this plant is unknown, but it seems to have the characters of a true species. It has white flowers, which are one-half smaller than those of the common Medlar. The stipules of the sterile branches are large and foliaceous.

The Medlar may be propagated by seeds or by layers, or by grafting upon seedling stocks of their own species or any kind of *Pomaceæ*. Forsyth remarks that the kinds of *Mespilus* do better by grafting on their own stocks. The soil best adapted to the growth of the Medlar is a loamy rich earth, rather moist than dry, but not on a moist bottom. It may be grown either as a standard or an espalier. The general horticultural treatment should be similar to that of the apple-tree. For a further account of the pomaceous genera of *Rosaceæ*, see POMEÆ.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Loudon, *Arboretum et Fruticetum Brit.*)

METALS are elementary bodies constituting the great bulk of mineral substances on the surface of the earth. They are seldom found as minerals in their pure form, but united with various other elements. Different opinions are entertained as to their number, which arises from the circumstance that a few substances are regarded as metallic in their nature by some chemists, while by others their claim to this title is either doubted or denied. Thus by Berzelius a substance which he discovered and called 'selenium' is regarded as a metal, but it is not so ranked by other chemists; again, the base of silica is by some classed as a metal, under the term 'silicum;' whereas many consider it as more nearly allied in nature to boron, and call it 'silicon.'

Independently of these, the metals, including those which have been longest known, as well as some whose claims are even yet somewhat doubtful, amount to 48; they are as follows :—

Potassium	Titanium	Lead
Sodium	Tantalium	Iron
Lithium	Niobium	Cobalt
Barium	Pelopium	Nickel
Strontium	Tungsten	Copper
Calcium	Molybdenum	Mercury
Magnesium	Vanadium	Silver
Lantharium	Chromium	Gold
Didymium	Uranium	Platinum
Cerium	Manganese	Palladium
Yttrium	Arsenic	Rhodium
Erbium	Antimony	Iridium
Terbium	Tellurium	Ruthenium
Glucium	Bismuth	Osmium
Aluminum	Zinc	Ilmenium (?)
Thorinum	Cadmium	Norium (?)
Zirconium	Tin	

The two last are doubtful.

The following are the general properties of the metals. With the single exception of mercury, they are all solid at the usual temperature of the air, and the colour of most of them is grayish-white. Silver is of a pure white; tin, cadmium, platina, palladium, mercury, and iridium, are white, with a slight shade of gray; antimony is white, with a slight bluish tint; cobalt, nickel, iron, manganese, and rhodium, are more gray; lead and zinc are of a bluish-gray; chromium, molybden, and tungsten, are of a pure gray colour; uranium is brown; gold, yellow; copper and tellurium, yellowish-red; &c.

The lustre of metals is great and peculiar, and is well known by the name of the 'metallic lustre;' they differ however very considerably in the degree in which they possess this property. Professor Leslie arranges them as follows, the first possessing the greatest lustre:—Platina, silver, mercury, gold, copper, tin, and lead. When reduced to a state of minute division, as by filing, or by any other means, the metallic lustre is lost, but the colour remains. The metals are generally reckoned perfectly opaque, even when reduced to thin leaves; but it is found that gold-leaf, which is 1-200,000th part of an inch thick, suffers light to pass through it, and it has a green colour; it is therefore extremely probable that all metals, if they could be rendered equally thin, would also be translucent. There are some metals, such as lead, tin, copper, and iron, which, when rubbed, emit a peculiar and disagreeable smell. There are others which yield a peculiar odour when heated and vaporised; this is especially the case with arsenic, and it occurs also with antimony; the greater number of the metals are however inodorous; a few of them possess taste, but it is in all cases disagreeable.

Formerly great density and a specific gravity superior to that of other bodies were considered as among the principal characteristics of metals. But the brilliant discoveries of Sir H. Davy have proved that substances which are even lighter than water—potassium and sodium for example—possess every property which belongs to metals. The density of all the metals has not been ascertained. Beginning with the lightest, their specific gravities are as follows :—

Potassium	0·865	Cadmium	8·694
Sodium	0·972	Copper	8·958
Titanium	5·300	Uranium	9·000
Columbium	5·610	Bismuth	9·830
Arsenic	5·884	Silver	10·474
Chromium	5·900	Rhodium	10·649
Tellurium	6·115	Lead	11·445
Antimony	6·702	Palladium	11·860
Manganese	7·050	Mercury	13·568
Zinc	7·191	Tungsten	17·600
Iron	7·770	Iridium	18·680
Cobalt	7·834	Gold	19·361
Nickel	8·279	Platinum	21·530

The following metals are ductile or malleable, arranged alphabetically :—

Cadmium	Mercury	Potassium
Copper	Nickel	Silver
Gold	Osmium (?)	Sodium
Iridium (?)	Palladium	Tin
Iron	Platinum	Zinc
Lead		

The following metals are so brittle that the greater number of them may be reduced to powder :—

Antimony	Cobalt	Tellurium
Arsenic	Columbium	Titanium
Bismuth	Manganese	Tungsten
Cerium	Molybden	Uranium
Chromium	Rhodium	

The degrees of ductility and malleability of those metals which possess those properties are very different; and some metals are so totally devoid of them that they may be broken by the hammer, and even reduced to powder. Ductility is that property by which metals are susceptible of being drawn into wire, and malleability is that by which their form is changed, so that they are beaten into thin leaves under the hammer or extended by pressure. The annexed tables show that the metals mentioned in them do not follow in the same order as to those properties.

Order of Ductility.	Order of Malleability.
Gold	Gold
Silver	Silver
Platina	Copper
Iron	Tin
Copper	Platinum
Zinc	Lead
Tin	Zinc
Lead	Iron

The ductility and malleability of metals are in general considerably increased by heat, but only to a certain extent. There are some metals which are malleable only between two very near degrees of temperature; such, for example, is the case with zinc.

The degree of tenacity of metals is indicated by the powers of their wires in supporting a given weight. The following weights are capable of being sustained by wires of the annexed metals about 0·840 of a line in diameter :—

	lbs. avoirdupois.
Iron	549·259
Copper	302·278
Platinum	274·320
Silver	187·137
Gold	150·753
Zinc	109·540
Tin	34·630
Lead	27·621

There are only few metals which are very hard when they are pure. The following table exhibits some of them arranged according to the degree in which they possess this property, according to Professor Brande:—

Titanium	Nickel	Zinc
Rhodium	Platinum	Antimony
Tungsten	Copper	Cobalt
Palladium	Silver	Tin
Manganese	Bismuth	Arsenic
Iron	Gold	Lead

M. Dumas however arranges the metals somewhat differently: his statement is as follows:—

Manganese	Harder than tempered steel.
Chromium, Rhodium	Not scratched by glass.
Nickel, Cobalt, Iron, Antimony, Zinc	Scratched by glass.
Palladium, Platinum, Copper, Gold, Silver, Tellurium, Bismuth, Cadmium, Tin	Scratched by carbonate of lime.
Lead	Scratched by the nail.
Potassium, Sodium	Soft as wax.
Mercury	Liquid.

In this list Titanium is omitted, which is even harder than Manganese.

The elasticity and sonorousness of metals are generally associated with their degrees of hardness. There are not however any metals which are by themselves either very elastic or sonorous; but there are alloys which possess these properties in a high degree, as for example those of copper and tin.

The structure of metals is sometimes lamellar, sometimes granular, and frequently crystalline; indeed, some of them, and more especially copper, occur crystallised in the form of the cube and its varieties. Bismuth is a metal which may be artificially crystallised in cubes with great facility.

The metals are good conductors of heat; they differ however greatly in the celerity with which it pervades them. According to M. Despretz, assuming the conducting power of gold as a standard, that of the undermentioned metals is as follows:—

Gold	10·000
Silver	9·730
Platinum	9·810
Copper	8·932
Iron	3·743
Zinc	3·638
Tin	3·039
Lead	1·796

Messrs. Petit and Dulong have determined with great care the calorific capacity of a great number of metals for 1° of the centigrade thermometer, that of water being taken as unity. Their results are—

Bismuth	0·0288
Lead	0·0293
Gold	0·0298
Platinum	0·0314
Mercury	0·0330
Tin	0·0515
Silver	0·0557
Zinc	0·0927
Tellurium	0·0912
Copper	0·0949
Iron	0·1000
Nickel	0·1038
Cobalt	0·1498

Messrs. Petit and Dulong deduce from their experiments the important conclusions that the atoms of all substances have the same capacity for heat, or at least that this capacity bears a very simple relation to the weights of the atoms.

Immediately that heat pervades the metals, and before it fuses them, it expands them in all directions. This dilatation is different in each metal; it varies also in the same metal with every degree of the thermometric scale; but from the freezing to the boiling point of water it may however be regarded as nearly constant; between these points the linear dilatation for the following metals is such as stated by the authorities named:—

	Laplace and Lavoisier.	Dalton and Davy.
Zinc	—	0·00296
Lead	0·00285	—
Tin	0·00217	0·00278
Silver	0·00191	0·00238
Copper	0·00172	0·00170
Gold	0·00147	0·00194
Steel (tempered)	—	0·00112
Steel (not tempered)	0·00108	—
Platinum	0·00086	0·00087
Mercury	—	0·00835

The fusing point of metals varies extremely, as will appear from the following table from Turner:—

		Fahr.		Authorities.
	Mercury	−39°		Different Chemists.
Fusible below a red heat	Potassium	136°		Gay Lussac, and Thenard.
	Sodium	190°		
	Tin	442°		Crichton.
	Bismuth	497°		
	Lead	612°		
	Tellurium, rather less fusible than lead			Klaproth.
	Arsenic, undetermined			
	Zinc	773°		Daniell.
	Antimony, a little below red heat			
	Cadmium, about	442°		Stromeyer.
Infusible below a red heat.	Silver	1873°		Daniell.
	Copper	1996°		Daniell.
	Gold	2016°		Daniell.
	Cobalt, rather less fusible than iron			
	Iron, cast	2786°		Daniell.
	Iron, malleable; Manganese		Require the highest heat of a smith's forge.	
	Nickel, nearly the same as cobalt			
	Palladium			
	Molybdenum; Uranium; Tungsten; Chromium		Almost infusible, and not to be procured in buttons by the heat of a smith's forge.	Fusible by the oxy-hydrogen blowpipe.
	Titanium; Cerium; Osmium; Iridium; Rhodium; Platinum; Columbium		Infusible in the heat of a smith's forge.	

Metals also differ in regard to volatility. Some metals are volatilized at moderate degrees of heat; among these are mercury, cadmium, arsenic, tellurium, zinc, potassium, and sodium; but there are others which may be exposed to the most intense heat of a wind-furnace without being at all vaporised.

Becquerel has given the following table of the relative conducting powers of the metals for electricity, the wires of the several metals being of equal diameter:—

Copper	100·00
Gold	93·60
Silver	73·60
Zinc	28·50
Platinum	16·40
Iron	15·80
Tin	15·50
Lead	8·30
Mercury	3·45
Potassium	1·33

According to Pouillet, each of the following metals is positive with relation to that which follows it:—zinc, lead, tin, iron, antimony, bismuth, copper, mercury, silver, gold, tellurium, palladium, platina.

There are two metals only which are capable of beiug rendered permanently magnetic, namely, iron and nickel; the former of these only is met with poseessing this property in nature; it is an oxide of iron, and commonly called the Loadstone. Most of the metals combine with each other, and form compounds differing very materially in properties from their constituent metals. [ALLOYS.]

All metale unite with oxygen, but with different degreee of facility and affinity; most of them combine with more than one proportion of oxygen, and some of them with several proportions. The nature of the compounds formed is extremely various; thus some metals form with oxygen comparatively inert compounds or mere oxides, euch as iron and zinc; others, such as potassium and sodium, when oxidised become alkalis; while arsenic and chromium form acids with this element. It hae been already observed that some metale unite with eeveral proportione of oxygen, and these may be mere oxides, as in the case of iron; or oxides and acids, as occurs with manganese; but there is no case of any metal forming a mere oxide and an alkali with different proportions of oxygen, or an acid and an alkali under the same circumstancee.

Chlorine and metals combine with great facility, and the compounds are extremely important. Every metal is indeed susceptible of this combination; but chlorine poseesses the remarkable property of forming in general volatile compounds with the metals. Bromine, sulphur, iodinc, and phosphorue, combine with moet of the metals.

The action of the air, of water, and the acids, upon the metals, is extremely various, and depends greatly upon their respective affinity for oxygen. Few of them are oxidised in dry air, but many of them tarnish and eome oxidise readily in it when moist, of which iron is an example. Some metals, as potassium, sodium, and manganeee, decompose water even at common temperatures, combining with its oxygen and evolving the hydrogen; others, as iron and zinc, require to be etrongly heated, or the presence of an acid, to effect this decomposition.

Most of the metals are dissolved by acids, but platina and gold are exceptione, these and some others requiring chlorine, and that generally in the nascent state called aqua regia. Few metals however are acted upon by acide without the presence of water, and in eome inetancee the water, in others the acid, and often both, suffer decomposition; and it ie to be observed that no metal dissolvee in acid unleee it be either previouely oxidised or acquire oxygen from the mixture of acid or water in which the eolution takee place. The eelte formed are in many casee of the higheet importance in chemical investigations, iu the chemical arts, and in medicine.

Metals are found either native or mineralised by combination with other eubstances. The common ores are compounds of the metals with oxygen, eulphur, arsenic, carbonic acid, or silica. For example, the oxidee and carbonate of iron are the common workable iron-ores; eulphuret of lead (called galena) ie the lead-ore of the arte; arsenical cobalt is the principal source of cobalt and arsenic. Only a few of the metals occur native in the rocks: of these gold, platinum, iridium, and rhodium are, with a rare exception, found only native. The bismuth of the shope is obtained from native bismuth. Native eilver, native mercury, and native copper are sometimee abundant, but are far from being the main sourcee of these metale. The other native metals are mineralogical rarities. Perhaps we should except from this remark native iron, which constitutee large meteoric masses, though very rarely, if ever, seen of terrestrial origin. The oree of the metale are often mnch disguised by mixture with one another or with earthy materiale. Thus a large part of the iron-ore worked in Great Britain is so mixed with clay of eilica that ite real character might not be euspected without some experience in ores.

Occasionally oree contain phosphate of iron, or eome arsenical ores, or certain eulphurete, scattered through them, and on account of the difficulty of eeparating the phosphorue, sulphur, or areenic, the ore is rendered comparatively useless. By this intimete mixture of epeciee the difficulties of reducing ores are much increased. When different oree are not intimetely commingled they are frequently cloeely diesemi-nated together through the rock. We find ores of lead and zinc often thus aseociated; also of cobalt end nickel; of iron and manganese; the ores of eilver, lead, and copper, and often cobalt and antimony; platinum, iridium, palladium, and rhodium.

Metals and their ores occur in the rocks in differeut ways:—

1. In beds or layers between leyers of rock, ae some iron-ores.

2. Disseminated through rocks in grains, nests, or crystals, or extended masses, as is the case with iron pyrites, cinnabar, or mercury-ore, and much argillaceous iron.

3. In veins intersecting different rocks, as oree of tin, lead, copper, and nearly all metallic ores.

4. Very frequcntly metallic ores, instead of occurring in true veine, are found in rocks near their intersection with a mass or dyke of igneous rock, as in the vicinity of a porphyry or trap dyke. This is tho case with much of the copper-ore in Connecticut and Michigan, as well as with much eilver-ore and mercury in South America, and elsewhere; and often the igneous rock itself contains the same metals disseminated through it.

The rock immediately enveloping tbe ore is called the Gangue. A Vein often consiste for the most part of the rock material called the gangue; and the ore either intersects the gangue in a continued band, or more commonly is partly disseminated through it in eome places, and is continuous for long distances in others. Often a good vein gradually loses its character, the metal disappears, and the gangue is left; but by following on for some distance it will often resume ite former character. The usual gangue in metallic veins is either quartz, calc-epar, or heavy spar; less frequently fluor-epar. Calc-spar is the gangue of the Roesie lead-ore; heavy spar of much of the lead-ore of the Mississippi Valley; fluor-spar, in eomo places, of the lead of Derbyehire, England. (Dana, 'Mineralogy.')

The metals which are found pure, as well as tbe various compounds of metals which occur as minerals, will be found described in tbis work under the names of the metels. The artificial compounds produced by the chemist, and the properties of the metals in relatiou to one another, are treated of in the ARTS AND SCIENCES DIVISION of this work.

METAMORPHOSIS, a term employed in netural history to denote those changes which plants and animals and their various organs undergo in passing from their simpler and elementary conditions to those which are more complex and compound. Thus the changes which an insect undergoes in passing from its egg-state through its caterpillar and chrysalis stages are called its metamorphosee. [INSECT.] Another remarkable instance of changes of form to which this term is applied is found in the Barnacles and Sea-Acorus. [CIRRIPEDIA.] All animale exhibit tbese changes to a greater or less exteut, and as far as they have been observed in particular familiee or epecies they are noticed in this work. [AMPHIBIA; CRUSTACEA; ACALEPHÆ; MOLLUSCA; MARSUPIATA.]

The general results of these changes as exhibited in the forms which every epecies of plant or animal assumes at the period of its highest development, are called the laws or ecience of Morphology. [MORPHOLOGY.]

The eame general changes are observable in plants as in animals. In plants however neither their organs nor conditions of existence are eo numerous and complicated as thoee of animels, and consequently their metamorphoses are fewer. In animals each great group and each eyetem, as well as each organ, has its peculiar mode of development and law of change, whilst in plants we find all parts resolvable into the two great elements stem and leaves. Out of these two fundamental organs all the modifications of bracts, etipules, eepals, petals, stamens, fruit, and eeed, are produced.

Although the development of the organs of plants is now recognised ae a part of the history of the structure of each organ, this subject has an interesting history, and has been frequcutly treated of as an independent branch of botanical inquiry. The tracing back the history of an organ to its elementary condition is of modern origin. It seeme first to have occurred to Linnæus, who in the eecond volume of the tenth edition of the 'Syetema Naturæ,' publisbed in 1759, thus expressee himeelf:—"Leaves are the creation of the present year, bracts of the second, calyx of the third, petals of the fourth, stemens of the fifth, and the stamene are succeeded by tho pistil. This is apparent from Ornithogalume, luxuriant and proliferous plants, double flowers, and Cardui."

In December, 1760, these propositions were sustained by Linnæue in a thesis called the 'Prolepsie Plantarum.' He commences by remarking that "as soon as leaves have expanded themeelves in epring, a bud is observable in the axil of each. This bud ewells as the year advancee, and in time becomes manifeetly compoeed of little ecales: in the autumn the leaves fall off, but the bud remains, aud in tbe succeeding spring swells, disengages itself from its envelopee, and becomee lengthened: when ite outer ecales have dried up and fallen off, the inner ones are expanded iuto leaves, which are separated by a gradual extension of the young branch, and presently each new leaf is found to contain in its bosom a little scaly bud, which in the following season will aleo be developed as a branch, with other leaves aud other bude. Now, when we see a tree adorned with leaves, end in the bosom of theee leaves provided with its little buds, we neturally inquire—of whet do these buds consist? Can it be of rudimentary leaves, each with its budlets, the latter of other leaves and buds, and so on to infinity, or at leest as far ae the extension of the plant is likely to proceed? Neture organises living beings out of such minute particles, and even from fluide themeelves, that the best eye may in vain seek to penetrate far into her mysteries. I shall however endeavour to show that the composition of buds doee not extend further at one time than provision for six years; just as, among animals, wo find the little *Volvox globator* containing within the mother ite children, grandchildren, great-grandchildren, and great-great-grandchildren down to the sixth generation."

The defects of thie thcory consisted, firstly, in its not accounting for the modificatione of the pistil; and, secondly, in the fanciful eupposition that the organs of fructification are prepared six years beforehand, and that their peculiar appearance is owing to the time of this development beiug anticipated by some unkuown but ever-acting causc. It was this which probably caused the whole theory to be generally neglected. It was however maintained by Ludwig and Wolff; the latter of whom in particular improved so much upon the speculation of Linnæus, by rejecting what was fanciful and eupplying to a certain exteut an explanation of the origin of the pistil, that hie paper in the 'Novi Commentarii Academiæ Petropolitanæ' for

1768 would undoubtedly have deserved to be considered the beginning of a new era in botanical philosophy if it had been known to botanists. But as it was introduced into a paper upon the formation of the intestines of animals, it does not appear ever to have attracted attention until it was discovered by Miquel a few years ago.

It is in reality to the celebrated poet Göthe that the honour justly belongs of having brought before the world in a clear and philosophical manner the doctrine of all the parts of a plant being reducible to the axis and its appendages, and consequently of having proved, to use his own words, that vegetables "develop themselves out of themselves progressively." By this means he led to the discovery of the real laws of structure, and of the analogies which exist between one thing and another in different tribes of plants; thus laying the foundation of vegetable comparative anatomy by "establishing a principle in harmony with all the laws obeyed by millions of isolated facts."

A perfect plant consists of branches successively produced out of each other from one common stock, and each furnished with exactly the same organs or appendages as its predecessor. When the fructification is produced, an alteration takes place in the extremity of the fructifying branch, which is incapable, generally speaking, of further prolongation; but as the branches, before they bore fruit, were repetitions the one of the other, so are the branches bearing fruit also repetitions of each other. If a thousand sterile or a thousand fertile branches from the same tree are compared together, they will be found to be formed upon the same uniform plan, and to accord in every essential particular. Each branch is also, under favourable circumstances, capable of itself becoming a separate individual, as is found by cuttings, budding, grafting, and other horticultural processes. This being the case, it follows that what is proved of one branch is true of all other branches.

It is also known that the elementary organs used by nature in the construction of vegetables are essentially the same; that the plan upon which these organs are combined, however various their modifications, is also uniform; that the fluids all move, the secretions all take place, the functions are all regulated, upon one simple plain; in short, that all the variations we see in the vegetable world are governed by a few simple laws, which, however obscurely they may be understood by us, evidently take effect with the most perfect uniformity.

Hence it is not only true that what can be demonstrated of one branch is true of all other branches of a particular individual, but also that whatever can be shown to be the principles that govern the structure of one individual, will also be true of all other individuals. Whatever can be demonstrated to be true with regard to one single individual is true of all other individuals: whatever is proved with reference to one organ is proved by implication as to the same organ in all other individuals whatsoever.

Moreover, the fact of one organ being readily transformed into another organ is in itself a strong presumption of the identity of their origin and nature; for it does not happen that one part assumes the appearance and functions of another if they are originally different. Thus, while the functions of the hand may be performed by the feet, as we know they occasionally are in animals, nothing leads the heart to perform the function or assume the appearance of the liver, or the liver of any other organ. This is one of the arguments of Linnæus.

The first of the organs which are formed by a modification of leaves are the Bracts; these bodies are intermediate between the leaves and the calyx. Their nature is extremely various; sometimes they have a greater resemblance to the leaves, and sometimes to the calyx. In some roses, as *Rosa canina*, they are obviously dilated petioles, to which a leaflet now and then is attached; in other species, as *R. spinosissima*, they differ in no respect from the other leaves. In the tulip a bract is occasionally present upon the scape, a little below the flower; this is always of a nature partaking both of the leaf and the flower. In *Abies excelsa* the purple scale-like bracts often become gradually narrower, and acquire a green colour like leaves. It has been stated by some botanists, that bracts are distinguishable from leaves by not producing buds in their axils; but the inaccuracy of such a distinction is apparent from a variety of cases. In *Polygonum viviparum*, and all viviparous plants, the flowers themselves are converted into buds within the bracts. There is a bud in the axil of every bract of the rose. The common daisy often bears buds in the axils of the bracts of its involucre; in which state it is commonly known in gardens by the name of 'hen and chickens.' In the permanent monster called *Muscari monstrosum* a small cluster of branches covered with minute imbricated coloured leaves resembling bracts is produced in lieu of each flower. Here all the parts of the fructification, instead of remaining at rest to perform their functions, are attempting, but in vain, to become organs of vegetation; or, in other words, to assume that state from which, for the purpose of perpetuating the species, they had been metamorphosed by nature. Hence it is clear that bracts cannot be essentially distinguished from leaves. [INVOLUCRUM.]

With the Calyx begins the flower properly so named; it forms what some morphologists call the outer whorl of the fructification, and with it commences a new order of leaves, namely those of the fructification, said to be distinguished from the leaves of vegetation by their constantly verticillate arrangement, and by the want of buds in their axils. With the leaves of the fructification all power of further increase ceases: the energies of the plant being diverted from increasing the individual to multiplying the species. The general resemblance of the calyx to the ordinary leaves of vegetation is well known: its green colour, and tendency to develop itself into as many leaves as it consists of divisions, especially in double roses, is so notorious that it need not be insisted on. In the case of *Mesembryanthemum barbatum*, noticed by Linnæus, there is no difference whatsoever between the leaves of the calyx and those of the stem. The resemblance however between the calyx and the stem-leaves is often not apparent; but the identity of the calyx and bracts is usually more obvious. In *Cereus* the transition from the one to the other is so gradual that no one can say where the distinction lies; and in numberless Ericas the resemblance of the bracts and calyx is perfect. The divisions of the calyx are also occasionally gemmiferous. A case is mentioned by Röper, in which one of the sepals of *Caltha palustris* was separated from the rest, and furnished with a bud. And Du Petit Thouars speaks of a specimen of *Brassica napus* on which branches were produced within the calyx. A monster of *Herreria parviflora* has been seen of the same nature. (Lindley, 'Introduction to Botany,' ed. 2, p. 533.) From this it is apparent that the divisions of the calyx are not only not distinguishable from bracts, but that there is often a strong tendency in the former to assume the ordinary appearance of leaves. There is however another point to which it is necessary to advert, in order to complete the proof of the identity of calyx and leaves; this is, the verticillate arrangement of the former. Leaves are either opposite, alternate, or whorled; and these differences depend wholly upon their greater or less degree of approximation. If the leaves of a plant are rightly considered, they will be found to be inserted spirally round a common axis; that is to say, a line drawn from the base of the lower leaf to that of the one above it, thence continued to the next, and so on, would have a spiral direction. When leaves become approximated by pairs, the spire is interrupted, and the leaves are opposite; let the interruption be a little greater, and the leaves become ternate; and if the interruption be very considerable, what is called a whorl is produced, in which several leaves are placed opposite to each other round a common axis, as in *Galium*. Now a whorl of this nature is exactly of the nature of a calyx, only it surrounds the axis of the plant instead of terminating it. As we know that such approximations often take place in the stem in the direct line of growth, where the propulsion of the matter of vegetation exists in its greatest activity, there is no difficulty in comprehending the possibility of such an approximation constantly existing at the end of the system of growth, where the propulsion of the matter of vegetation ceases. But the calyx and more inner whorls of the fructification do not always retain their verticillate position; on the contrary, they occasionally separate from each other, and assume the same position with regard to the axis of vegetation as is naturally proper to the leaves. This is particularly striking in a very common permanent monster of *Lilium album*, known in the gardens by the name of the Double White Lily. In this plant the whole verticillation of the parts of fructification is destroyed; the axis is not stopped by a pistil, but is elongated into a stem, around which the white leaves of the calyx are alternately imbricated; and in double tulips, the outer whorl, representing the calyx, frequently loses its verticillate arrangement, and becomes imbricated like the leaves of a stem. The same structure also occurs in the double white *Fritillaria meleagris*. Hence it cannot be doubted that the calyx consists of leaves in a particular state.

The Corolla forms the second line or whorl of the fructification. It consists of several divisions, usually not green, and always alternate with those of the calyx. It is a series of leaves arising within those of the calyx, from which it is sometimes indeed very easy to distinguish it; but from which it is so often impossible to discriminate it, that the difference between the calyx and corolla has been one of the most debateable subjects in botany. No limits can be found in *Cereus;* the same is true of *Illicium*, and several similar plants. In all *Liliaceæ*, *Orchidaceæ*, and *Zingiberaceæ*, the only distinction that can be drawn between the calyx and corolla is, that the one originates within the other; they are alike in figure, colour, texture, odour, and function. Whatever therefore has been proved to be true of the calyx is also true of the corolla. There are also cases in which the petals have actually reverted to the state of leaves. In a *Campanula Rapunculus*, seen by Röper, the corolla had become five green leaves like those of the calyx; the same was found in a *Verbascum pyramidatum*, described by Du Petit Thouars; proliferous flowers of *Geum* and *Rosa*, in which the petals were converted into leaves, are adduced by Linnæus. [FLOWER.]

The third whorl or series of fructification is occupied by the Stamens. These often consist of a single row, equal in number to the divisions of the corolla, with which they are in that case alternate. The exceptions to this in flowers with a definite number of stamens are not numerous; and such as do occur are to be considered as wanting the outer row of stamens, and developing the second row instead. Thus in *Primulaceæ*, in which the stamens are opposite to the petals, and therefore belonging to a second whorl, the first makes its appearance in *Schwenckia* in the form of clavate or subulate processes arising from the sinuses of the limb. These, and similar processes, which are far from uncommon in plants, and which are known by various names, such as scales of the orifice of the corolla, glands, nectary, cup, &c., are in most cases metamorphosed stamens.

In *Narcissus* the cup is formed of three stamens of the first row, become petaloid and united at their margins; while the six which form the second and third rows are in their usual state and within the tube. This is shown, firstly, by the frequent divisions of this cup into three lobes, which then alternate with the petals; secondly, by a distinct tendency in double *Narcissi*, particularly *N. poeticus*, to produce abortive anthers on the margin of the lobes of the cup; and thirdly, by the genus *Brodiæa* and its allies. In that genus the crown of the original species consists of three petaloid pieces, not united into a cup, as in *Narcissus*, but wholly separate from each other: in *Leucocoryne ixioides* these pieces are not petaloid, but clavate; and in *L. odorata* the species have the same figure as in *L. ixioides*, but almost constantly bear more or less perfect anthers. That the anthers are mere alterations of the margins of the petals there is no difficulty in demonstrating. In *Nymphæa* the passage from the one to the other may be distinctly traced. In double roses the precise nature of this metamorphosis is shown in a very instructive way. If any double rose is examined it will be seen that those petals which are next the stamens contract their claw into the form of a filament, and a distortion of the upper part, or limb, also takes place; the two sides become membranous, and put on the colour and texture of the anther; and sometimes the perfect lobe of an anther will be found on one side of a petal, and the half-formed misshapen rudiment of another on the opposite side. In *Aquilegia vulgaris* this transformation is still more curious, but equally distinct: the petals of that plant consist of a long sessile purple horn or bag, with a spreading margin; while the stamens consist of a slender filament, bearing a small oblong two-celled yellow anther. In single and regularly-formed flowers nothing can be more unlike than the petals and stamens; but in double flowers the transition is complete; the petals, which first begin to change, provide themselves with slender ungues; the next contract their margin, and acquire a still longer unguis; in the next the purple margin disappears entirely; two yellow lobes like the cells of the anther take its place, and the horn, diminished in size, no longer proceeds from the base, as in the genuine petal, but from the apex of the now filiform unguis. In the last transition the lobes of the anther are more fully formed, and the horn is almost contracted within the dimensions of the connective, retaining however its purple colour: the next stage is the perfect stamen. The conversion of stamens into green leaves is far more uncommon: this indeed very rarely occurs. It was seen by Röper in the *Campanula Rapunculus* already referred to; and Du Petit Thouars found the stamens of *Brassica napus* converted into branches bearing verticillate leaves. In *Plantago major* and *Sieversia montana* permanent instances are known of a conversion of the stamens, with all the other floral organs, into leaves. Thus it appears that the stamens, like the petals, calyx, and bracteæ, are merely modified leaves. [Stamens.]

The Disc is so freqnently absent, and is of so obscure a nature, that few morphologists take it into their consideration. It many plants it consists of a mere annular fleshy ring encompassing the base of the ovary; in others it forms a sort of cup, in which the ovaries are inclosed, as in certain Pœonies, and it very frequently makes its appearance in the form of hypogynous glands or scales: it is almost always between the stamens and pistil. That it is not an organ of a distinct nature may be inferred from its having no existence in a large number of flowers; but if it is not an organ of itself it must be a modification of something else, and in that view, from its situation, it would be referrible either to the stamens or pistil. It has so little connection with the latter, from which it always separates at maturity, that it can scarcely belong to it. With the stamens it has a stronger relation: it consists of the same cellular substance as the connective of the anthers, is very often of the same colour; whenever it separates into what are called hypogynous glands or scales these always alternate with the innermost series of stamens. In the Pœony the disc may in some measure be compared to the inner row of scales which exist between the stamens and pistil of the nearly-related genus *Aquilegia*. Dunal has noticed half the disc of a *Cistus* bearing stamens; and a variety of instances may be adduced of an insensible gradation from the stamens to the most rudimentary state of the organ.

The fifth and last series of the fructification is the Pistil. The simple pistil, that of the pea for instance, consists of an ovary, bearing its ovules on one side in two parallel contiguous rows, aud at its upper extremity tapering into a style, which terminates in a stigma. If this organ be further examined, it will be found that there is a suture running down each edge from the style to the base; it will be also seen that the ovules are attached to one of these sutures, and that the style is an elongation of the other: further, it will be perceived that the two sides of the ovary are traversed by veins emanating from the suture that terminates in the style, and that these veins take a slightly ascending direction towards the suture which bears the ovules. Now if, when the pod of the pea is half grown, it be laid open through the latter suture, all these circumstances will at that time be distinctly visible; and if it then be compared with one of the leaflets of the plant, it will be apparent that the suture that bears ovules answers to the two edges of the leaf, the suture without ovules to the midrib, and the style to the mucro. Hence it might, without further evidence, be suspected that the ovary is an alteration of the leaf; but if the inquiry be carried further in other plants, this suspicion becomes converted into certainty. In the first place, the suture without ovules, which has been said to be the midrib, is always external with respect to the axis of fructification, as would be the case with the midrib of a leaf folded up aud terminating the fructification. In the next place, nothing is more common than to find the pistil converted either into petals or into leaves. Its change into petals is to be found in numerous double flowers, as for example double *Narcissi*, *Hibiscus Rosa-sinensis*, Wall-Flowers, Ranunculuses, Saxifrages, and others. These however only show its tendeucy to revert to petals as the representatives of leaves. The cases of its reverting to other organs are much more instructive. In the double *Ulex Europæus* the ovary is extremely like one of the segments of the calyx; its ovuliferous suture is not closed; in the room of ovules it sometimes bears little yellow processes like miniature petals, and its back corresponds to what would be the back of the calyx; no style or stigma is visible; sometimes two of these metamorphosed ovaries are present: in that case the sutures which should bear ovules are opposite to each other, just as the inflexed margins of two opposite leaves would be. In *Kerria Japonica*, which is only known in our gardens in a double state, the ovaries are uniformly little miniature leaves, with serrated margins corresponding to the ovuliferous suture of the ovary, and an elongated point representing the style; their interior is occupied by other smaller leaves. Nothing is more common among roses than to find the ovaries converted into perfect leaves; in such cases the margins uniformly occupy the place of the ovuliferous suture, and the midrib that of the sterile suture. But the most instructive and satisfactory proof of the pistil being merely a modified leaf is to be found in the common double cherry of the gardens. In this plant the place of the ovary is usually occupied by a leaf altogether similar to those of the branches, but much smaller: it is folded together; its margins are serrated, and, in consequeuce of the folding, placed so as to touch each other; and they occupy the place of the ovuliferous suture of a real pistil. The midrib of this leaf corresponds to the station of the sterile suture of the ovary, and is not only lengthened into a process representing a style, but is actually terminated by a stigma. There is thus a greater identity of function between the pistil and the other series of the fructification than would at first appear probable. The pistil is seldom indeed found converted into stamens; but it often takes upon itself the form of petals, as has been shown above; and although cases are very rare of pistils bearing pollen, yet several instances are known of ovules being borne by the stamens. This occurs continually in *Sempervivum tectorum*.

It appears then that there is not only a continuous uninterrupted passage from the leaves to the bracts, from bracts to calyx, from calyx to corolla, from corolla to stamens, and from stamens to pistil, from which circumstance alone the origin of all these organs might have been referred to the leaves, but that there is also a continual tendency on the part of every one of them to revert to the form of a leaf.

The pistil in a state of composition differs much in appearance from its simple form. At section 78 of 'Die Metamorphose der Planzen' of Göthe, are the following remarkable words:—"Keeping in view the observations that have now been made, there will be no difficulty in discovering the leaf in the seed-vessel, notwithstanding the variable structure of that part and its peculiar combinations. Thus, the pod is a leaf which is folded up and grown together at its edges, and the capsule consists of several leaves grown together; and the compound fruit is composed of several leaves united round a common centre, their sides being opened so as to form a communication between them, and their edges adhering together. This is obvious from capsules, which, when ripe, split asunder, at which time each portion is a separate pod. It is also shown by different species of one genus, in which modifications exist of the principle on which their fruit is formed: for instance, the capsules of *Nigella orientalis* consist of pods assembled round a centre, and partially united; in *Nigella damascena* their union is complete."

As it may thus be proved that all the parts of a flower are merely modified leaves, the following propositions may be stated to constitute the basis of Vegetable Morphology:—

"Every flower, with its peduncle and bracteolæ, being the development of a flower-bud, and flower-buds being altogether analogous to leaf-buds, it follows as a corollary, that every flower, with its peduncle and bracteolæ, is a metamorphosed branch.

"And further, the flowers being abortive branohes, whatever the laws are of the arrangement of branches with respect to each other, the same will be the laws of the arrangement of flowers with respect to each other.

"In consequence of a flower and its peduncle being a branch in a particular state, the rudimentary or metamorphosed leaves which constitute bracteæ, floral envelopes, and sexes, are subject to exactly the same laws of arrangement as regularly formed leaves." (Lindley, 'Outline of the First Principles of Botany.')

Engelmann has ('De Antholysi Prodromus') attempted to classify the principal aberrations from normal structure, and has collected a very considerable number of cases under the following heads:—

1. Retrograde Metamorphosis (Regressus), when organs assume the state of some of those on the outside of them, as when carpels change to stamens or petals, hypogynous scales to stamens, stamens to petals

or sepals, sepals to ordinary leaves, irregular structure to regular, and the like. 2. Foliaceous Metamorphosis (Virescentia), when all the parts of a flower assume more or less completely the state of leaves. 3. Disunion (Disjunctio), when the parts that usually cohere are separated, as the carpels of a syncarpous pistillum, the filaments of monadelphous stamens, the petals of a monopetalous corolla, &c. 4. Dislocation (Apostasis): in this case the whorls of the flower are broken up by the extension of the axis. 5. Viviparousness (Diaphysis), when the axis is not only elongated, but continues to grow and form new parts, as in those instances where one flower grows from within another. And, finally, 6, Proliferousness (Ecblastasis), when buds are developed in the axils of the floral organs, so as to convert a simple flower into a mass of inflorescence. A very considerable number of instances are adduced in illustration of these divisions, and the work will be found highly useful as a collection of curious or important facts.

(Göthe, *Die Metamorphose der Pflanzen*; Miquel, *Commentatio de Organorum in Vegetabilibus Orta et Metamorphosi*; Röper, *De Organis Plantarum*; Lindley, *Introduction to Botany*; Balfour, *Class-Book of Botany*; Schleiden, *Principles of Scientific Botany*, translated by Dr. Lankester.)

METAPOCEROS. [IGUANIDÆ.]

METEORIC IRON. [IRON.]

METEORIC STONES. [AEROLITES.]

METEORS. [AEROLITES.]

METOPIA. [PIPRIDÆ.]

METOPTOMA, a genus of Fossil *Mollusca*, from the Mountain Limestone of the north of England.

METRIORHYNCHUS, Dr. Hermann von Meyer's name for a genus of Fossil *Crocodilidæ*, found, according to him, in the Lias, the Oxford Clay, at Honfleur, and in the Kimmeridge Clay at Havre.

METROSIDEROS (from μήτρα, the heart of a tree, and σίδηρος, Iron), a genus of Plants belonging to the natural order *Myrtaceæ*. It is distinguished from allied genera by the tube of the calyx not being angular, adhering to the ovarium, the limb 6-cleft; the stamens 20-30, free, very long, and exserted; the style filiform, and stigma simple; the capsule 2- or 3-celled, the cells many-seeded; the seeds wingless. The species are trees or shrubs, with opposite or alternate leaves, with the flowers pedicellate, not adnate to the branches, as they are in the genera *Melaleuca* and *Callistemon*. The last genus, with *Angophora*, has been recently separated from *Metrosideros*.

M. vera, true Iron-Wood, has opposite ovate-lanceolate acuminated quite glabrous leaves, seated on short petioles; the cymes axillary, pedunculate, many-flowered. It is a native of Java and Amboyna, among rocks. The Chinese and Japanese value the wood of this tree, which they apply to many purposes, as the making of rudders, anchors, &c., for their ships and boats. The bark is used in Japan as a remedy in mucous discharges, diarrhœa, and dysentery. It is usually mixed with some aromatic, as penang, cloves, or nutmeg.

M. polymorpha has opposite coriaceous leaves, of various forms, glabrous on both surfaces, but covered with a little silky tomentum beneath; the peduncles 3- or many-flowered, terminal and axillary, corymbose; the calyxes and branchlets glabrous or clothed with silky tomentum. This species is a tree, and grows in the Sandwich Islands, and is said to be the plant from which are made the clubs and other weapons employed in warfare by the South Sea Islanders. "The Aki, or Lignum Vitæ of New Zealand, the Rata and the Pohutu Kawa of the same country, are all hard-wooded trees belonging to the genus *Metrosideros*." (Lindley.)

Several other species of *Metrosideros* have been described, natives of Australia and the South Sea Islands. *M. lucida*, a beautiful tree, occurs as far south as Lord Auckland's Islands, in lat. 50½° S. The *M. buxifolia* of Allan Cunningham is the New Zealand plant called Aki, and is a rambling shrub, adhering to trees, and climbing by means of its lateral roots to the summits of the loftiest trees in the forests of Wangaroa and the Bay of Islands. In cultivation these plants may be grown in a mixture of loam, peat, and sand. They may be propagated by seeds or cuttings. Ripe cuttings will root in sand under a hand-glass.

(Don, *Dichlamydeous Plants*; Lindley, *Vegetable Kingdom*; Burnett, *Outlines of Botany*.)

MEUM (from μείων, smaller), a genus of Plants belonging to the natural order *Umbelliferæ* and to the tribe *Seselineæ*. It has an obsolete calyx; entire elliptical petals, acute at both ends, with an incurved point; the fruit elliptical, terete, or slightly dorsally compressed; the carpels with 5 sharp somewhat winged ridges; the interstices and commissures with many vittæ. There are two species of this genus.

M. Athamanticum, Common Bald-Money, has bipinnate leaves with multipartite leaflets, the segments thread-shaped, acute. This is a highly aromatic plant, with numerous white and yellow flowers. It is a native of Europe, in dry mountain pastures, and is found in England and the mountains of Scotland. The roots, seeds, and every part of the plant are aromatic, and are used in the countries where it grows as stomachics and carminatives. This and the other species, *M. Mutellina*, the Swiss Bald-Money, which is a native of the subalpine pastures of Europe, enters into the composition of the compound called Venice Treacle.

(Babington, *Manual of British Botany*; Lindley, *Vegetable Kingdom*.)

MEW. [LARIDÆ.]

MEZEREON. [DAPHNE.]

MICA, a Mineral belonging to the extensive series of Silicates of Alumina. It occurs in oblique rhombic prisms of about 120° and 60°. The crystals usually with the acute edge replaced. The cleavage is very decided, yielding easily thin elastic laminæ of extreme tenuity. It is found usually in thinly foliated masses, plates, or scales: sometimes in radiated groups of aggregated scales or small folia. The colour is from white, through green, yellowish, and brownish shades, to black. The lustre is more or less pearly. Transparent or translucent. Tough and elastic. Hardness 2·0 to 2·5. Specific gravity 2·8 to 3·0.

The composition of mica is as follows:—

Silica	46·3
Alumina	36·8
Potash	9·2
Peroxide of Iron	4·5
Fluoric Acid	0·7
Water	1·8
	99·3

A variety in which the scales are arranged in a plumose form is called Plumose Mica; another in which the plates have a transverse cleavage, has been termed Prismatic Mica.

Mica resembles externally talc, and some forms of gypsum. From talc it differs in affording thinner laminæ, and being elastic. It also has not the greasy feel of talc. The same characters except the last distinguish it from gypsum, besides it does not crumble so readily on heating.

Mica is one of the constituents of granite, gneiss, and mica-slate, and gives to the latter its laminated structure. It also occurs in granular limestone. It is found abundantly in the United States, in Russia, in Great Britain, and other parts of the world. It is not often found in large isolated masses, but filling up the veins and fissures of rocks, into the composition of which it enters. It occurs in the oldest rocks, as well as in those which are new and possess a crystalline character.

In Russia it is used extensively as a substitute for glass, and hence it is called Muscovy Glass. The very thin laminæ are employed for examining objects under the microscope. Haüy states that these laminæ are sometimes not more than the 1-300,000th part of an inch in thickness.

Lepidolite, or *Lithia Mica*, occurs in crystals or laminæ of a purplish colour, and often in masses consisting of aggregated scales. It occurs in the Ural. According to Rosales, as quoted by Dana, it consists of the following analysis:—

Silica	47·7
Alumina	20·3
Lime	6·1
Protoxide of Manganese	4·7
Potash	11·0
Lithia	2·8
Soda	2·2
Fluorine	10·2
Chlorine	1·2
	106·2

Fuchsite is a green Mica from the Zillerthal, containing nearly 4 per cent. of oxide of chromium.

From the crystallisation of Mica two species have been made out of the old species so called. The common Mica has an oblique prism for its primary, but many micas when in perfect crystals have the form of a hexagonal prism. This species has been called hexagonal mica, the dark-coloured micas of Siberia, and the brilliant hexagonal crystals of Vesuvius. There are also hexagonal crystals which have been found by Dové to have two axes of polarisation, indicating that the lateral axes of the primary are unequal, and that the form is a rhombic prism with the acute edges truncated. This species is called *Rhombic Mica*, or *Phlogophite*.

Margarite, or *Pearl Mica*, occurs in hexagonal prisms, having the structure of mica, and also in intersecting laminæ. It has the appearance of talc, but differs from that mineral in being a silicate of alumina instead of magnesia. It is found at Sterzing in the Tyrol, associated with chlorite.

Margarodite, another schistose talc of Zillerthal, is a variety of common mica.

Emerylite and *Euphyllite* are new species, somewhat related to *Margarite*. They are found in Pennsylvania, United States.

Nacrite resembles talc, but contains no magnesia. It is whitish and soft, and has a greasy feel.

Lepidomelane is a black iron mica, occurring in 6-sided scales or tables aggregated together.

Ottrelite is an allied mineral occurring in black scales.

Oderit is probably a black mica. It can be split into thin leaves. It is opaque, black, and has very little lustre. It occurs in Sweden.

MICA-SCHIST, one of the earliest groups of Stratified Rocks known to geologists, and very extensively distributed throughout the mountain regions of the globe, often in contact with granite, but more frequently superposed on gneiss. It is frequently interstratified with gneiss, primary limestone, quartz rock, chloritic schist, and clay-slate, and is deficient in organic remains. There are however certain more recent assemblages of strata more or less allied to mica-schist in composition, of very limited area, adjacent to granitic elevations, in Dauphiné, &c., which do contain organic remains of the secondary periods.

To the British geologists the southern Highlands of Scotland and the mountains of Donegal offer abundant and striking examples of mica-schist, with its associated limestones, quartz rocks, &c., while round the granites of the Isle of Man, Cumbria, Devon, and Cornwall, hardly a trace of gneiss or mica-schist has been observed.

Mica-schist, in its most typical state differs from gneiss by the absence of felspar, but among the early stratified rocks the gradations and permutations of ingredients are so frequent as to confound all merely mineral distinctions, from hand specimens. The mica is usually spread through the rocks of this series in continuous surfaces overspreading the quartz portions, whereas in gneiss this seldom happens. In respect of the magnitude, relative abundance, and crystalline aspect of the ingredients of mica-schist, there is every possible variation, so that some specimens approach obscurely to granite, others to well defined gneiss, and others to clay-slate.

Dr. M'Culloch proposed the following synopsis of Micaceous Schist:—

Division I.—Consisting of mica and quartz.
- Subdivision 1.—Simply laminar or foliated.
  - *a.* Composed principally of continuously laminar mica.
  - *b.* Composed principally of continuously laminar quartz.
  - *c.* The mica discontinuous, the quartz granular.
  - *d.* The mica greenish, approaching to chloritic schist.
  - *e.* Mica gray, approaching to talcose schist.
  - *f.* Approaching to clay-slate.

The rocks of this subdivision are frequently and remarkably contorted.

- Subdivision 2.—Granularly laminar.
  - *a.* Granular quartz, with scales of laminar mica.
  - *b.* Laminar quartz, with mica in scattered spots.
  - *c.* Laminar quartz, with distinct scales of mica.
  - *d.* Laminar quartz, with mica in parallel lines, so as to appear fibrous on splitting. (*Avanturine* seems to be of this nature.)
  - *e.* The mica bent and contorted round the grains of quartz.

Division II.—Compounded of three or more ingredients.
- *a.* With hornblende.
- *b.* With felspar (passing to gneiss).
- *c.* With chlorite or talc (passing to talcose or chlorite schist).
- *d.* With more than one of these ingredients.
- *e.* With carbonate of lime.

Division III.—Conglomerated, or containing superadded fragments of granite, gneiss, limestone, &c. It occurs in Isla, Garveloch, Rannoch, &c.

Besides the minerals above noticed, many others occur in mica-schist, so as universally to modify its aspect. This is particularly the case with garnet, which is often perfectly crystallised amidst the mass of fragmentary mica and quartz, and is so frequently met with in mica-schist, that it seems to mark a particular condition, through which the rock has passed since its first deposition.

The circumstance which perhaps more than any other deserves attention in studying these rocks, is the character of their stratification. Where limestones or clay-slates alternate with the mica schist, its strata are easily traced; but in cases where entire mountains are formed of laminated mica and quartz, the contortions to which the whole is subject render it very difficult to determine the prevalent dip of the beds.

It is difficult to avoid the belief that the smaller contortions of gneiss and mica-schist are due to causes quite distinct from violent movement; they are characteristic of a peculiar mode of deposition, or marks of a subsequent modifying process. Whether the great contortions may be thus explained, or require the supposition of great disturbances of position, is not easy to determine. [GEOLOGY; ROCKS.]

MICIPPA. [MAIIDÆ.]

MICO, or Fair Monkey, one of the common names for that species of *Ouistiti* (*Hapale* of Illiger) known to zoologists as the *Jacchus argentatus*, Geoff., *Simia argentata*, Linn. It is a very pretty little species, perhaps the prettiest of the genus. [JACCHUS.] The head is small and round, the face and hands of a deep flesh-colour; indeed the face and ears are of so lively a vermilion, that the animal, when in full health, looks almost as if it had been painted with that colour. The body is covered with long silvery-white hair, and the tail is of a shining dark chestnut, sometimes almost black.

MICRASTERIAS. [DESMIDIEÆ.]

MICROCE'BUS, M. Geoffroy's name for a form among the *Lemuridæ; Lemur* (*Galago*) *Guineensis*. [LEMURIDÆ.]

MICRODACTYLUS. [ÇARIAMA.]

MICROGLOSSUS. [PSITTACIDÆ.]

MICROLITE. [PYROCHLOR.]

MICROLOPHUS. [IGUANIDÆ.]

MICROPO'GON, M. Temminck's name for a genus of Scansorial Birds which has the general structure of *Bucco*. The gape however is smooth. The first three quills only are graduated. Mr. Swainson arranges it under the *Buccoinæ*, or Barbuts, a sub-family of his *Picidæ*. [PICIDÆ.]

MICRO'PTERUS, a name assigned by Messrs. Quoy and Gaimard to a genus of *Anatidæ*, remarkable for the shortness of their wings.

Two species are recorded, namely:—*M. brachypterus* (Quoy and Gaimard, *Oidemia Patachonica*, King, *Anas brachyptera*, Lath., Race-Horse of Cook and Byron, and Steamer-Duck of King), and *M. Patachonicus*, King, which is smaller in the body than the first, and is able to fly.

M. brachypterus is above lead-colour, inclining to gray; abdomen whitish; the beauty-spot on the wings white, at the bend a blunt spur; bill yellow, the nail black; legs fuscous yellow. Length from tip of the bill to end of tail, 40 inches; of bill, 3 inches; of wing, from carpel joint to apex of second quill-feather, 11 inches; of tail, 5 inches of tarsi, $2\frac{3}{4}$ inches. (King.)

Race-Horse or Steamer-Duck (*Micropterus brachypterus*).

Captain Philip Parker King, R.N., who has described both species, one in the 'Zool. Journal,' and the second in the 'Zool. Proceedings,' first fell in with the larger species at Eagle Bay, beyond Cape San Isidro (Point Shut-up of Byron), in the Strait of Magalhaens. "Here," writes Captain King, "we saw, for the first time, that most remarkable bird the Steamer-Duck. Before steam-boats were in general use, this bird was denominated, from its swiftness in skimming over the surface of the water, the Race-Horse, a name which occurs frequently in Cook's, Byron's, and other voyages. It is a gigantic duck, the largest I have met with. It has the lobated hind toe, legs placed far backwards, and other characteristics of the oceanic ducks. The principal peculiarity of this bird is the shortness and remarkably small size of the wings, which, not having sufficient power to raise the body, serve only to propel it along, rather than through the water, and are used like the paddles of a steam-vessel. Aided by these and its strong broad-webbed feet, it moves with astonishing velocity. It would not be an exaggeration to state its speed at from 12 to 15 miles an hour. The peculiar form of the wing and the short rigid feathers which cover it, together with the power this bird possesses of remaining a considerable time under water, constitute it a striking link between the genera *Anas* and *Aptenodytes*. It has been noticed by many former navigators. The largest we found measured 40 inches from the extremity of the bill to that of the tail, and weighed 13 lbs.; but Captain Cook mentions, in his second voyage, that the weight of one was 29 lbs. It is very difficult to kill them, on account of their wariness and thick coat of feathers, which is impenetrable by anything smaller than swan-shot. The flavour of their flesh is so strong and fishy, that at first we killed them solely for specimens. Five or six months however on salt provisions taught many to think such food palatable, and the seamen never lost an opportunity of eating them. I have preferred these ducks to salt beef, but more as a preventive against scurvy than from liking their taste. I am averse to altering names, particularly in natural history, without very good reason; but in this case I do think the name of Steamer much more appropriate and descriptive of the swift paddling motion of these birds than that of Race-Horse. I believe, too, the name of Steamer is now generally given to it by those who have visited these regions."

The same author informs us that *Pecten vitreus*, whose shell is found attached to the leaves of *Fucus giganteus*, together with other

Mollusca, is the food of the Steamer-Ducks *M. brachypterus*, and *M. Patachonicus.*

('Narrative of the Surveying Voyages of H.M.S. Adventure and Beagle,' vol. i.)

Micropterus comes very near to *Microptera*, Gravenhorst's name for a genus of Coleopterous Insects, and to Microptère of Lacépède, who uses the term to designate a genus of Acanthopterygious Fishes.

MI'CROPUS (Swainson), a genus of Birds belonging to the family *Brachypodinæ*, the first sub-family of the *Merulidæ*, according to his arrangement. [MERULIDÆ.]

M. chalcocephalus; Ixos chalcocephalus, Temm. The male has the whole head covered with a sort of hood of metallic black with violet reflections; the neck, the shoulders, the back, and wings, dull gray or lead colour; breast deep gray, which becomes brighter on the other lower parts of the body; wings black, but the secondaries gray, bordered with whitish on the exterior barbs; tail gray, with a transverse black band, and terminated with a broad white border. Length 6 inches 4 lines. Female: less lively in colour.

It inhabits Java, where Van Hasselt found it in the wild and woody district of Bantam.

Micropus chalcocephalus (male).

MICROSCOPE, USES OF THE. There are few instruments that have rendered such important aid in scientific search as the Microscope. The chief advances that have been made in the natural history sciences, embracing physiology, during the latter portion of the first half of the 19th century, have been effected by its agency. The structure of this instrument has been gradually rendered more perfect as the science of optics advanced; and its nature and arrangement can only be understood by the study of the principles of this science. In the articles LIGHT, LENS, ACHROMATIC ABERRATION, MICROMETER, and MICROSCOPE, in the ARTS AND SCIENCES DIVISION of this work, the student will find the principles and plan on which this instrument is constructed fully elucidated. We purpose here referring to its use as an instrument of natural history and physiological research, and of those general arrangements and applications by which its utility can alone be fully secured. It is not alone sufficient that a man possesses eyes in order to observe accurately, nor is it the possession of a costly microscope that will enable a person to confirm the observations of others or make discoveries of his own. The use of the microscope by uninstructed and incautious observers has given rise to many absurd errors. "The fruit of the mulberry has been mistaken for *Entozoa*; calcareous corpuscles have been regarded by several observers as ova, and the appearance arising from the presence of concentric lamina has been interpreted to be the coils of an inclosed embryo; similar corpuscles have also been regarded as nucleated cells, and again as blood-corpuscles; minute fossils in chalk have been strung together with portions of vegetable tissue, and (perhaps) the spores of *Algæ*, to constitute different stages of a fungus: minute hairs projecting on the surface of a membrane have been declared to be spiculæ within subjacent cells; and quite recently one writer states, that certain minute bodies which he has examined are either blood-corpuscles or the spores of fungi, but which is doubtful! while another recounts, how by fortunate accident he discovered that corpuscles, which he had regarded at first as consisting of fat, were afterwards found accidentally to consist of calcareous salts!

"Again, we read in physiological works of the yolk-cells, and the coloured oil-globules of the yolk; and a beautiful function of assimilation has been attributed to them; but they exist only in the imagination of the authors, who have regarded the one as cells, simply because they are round, and the other as consisting of fat, because they are highly refractive. Since the publication of Schleiden's cell-doctrine, almost everything round has been regarded as a cell; any single body within this, or where there are several, the largest has been regarded as a nucleus, and any spot within the nucleus has been viewed as a nucleolus. Whereas many of the so-called cells are homogeneous spheres, many of the nuclei are vacuoles, and a true nucleolus is very rarely found except in books." ('Micrographic Dictionary.')

Against such errors as these a long-continued and careful use of the microscope can alone preserve the young observer. They are not the result of imperfect or inferior instruments, but the consequences of hasty and imperfect observation. They have been made by persons using the most costly instruments and their erroneousness demonstrated by those who have used the simplest and most economical arrangements.

In microscopic observations two things must be remembered—1st, That in the microscope, especially with high powers, we see surfaces, not bodies. It frequently happens that in looking upon surfaces, we get a glance into the depths of transparent objects by changing the adjustment, without altering the position of the object; it more often happens however that in looking upon such objects, we are unable to make them out to be bodies until we have changed their position, and ascertained their dimensions in three different directions; this, in many cases, from the nature of the object itself, is a matter of great difficulty. 2nd, That we seldom see the objects under the microscope in their natural condition; that we consequently must take into consideration the changes which we ourselves partly produce, either by the medium in which the object is placed, or by the use of the knife or other influences. Long and thorough practice with the microscope secures the observer from deceptions which arise, not from any fault in the instrument, but from a want of acquaintance with the microscope, and from a forgetfulness of the wide difference between common vision and vision through a microscope. Deceptions also arise from a neglect to distinguish between the natural appearance of the object under observation, and that which it assumes under the microscope.

To these difficulties must be added those originating in the eye itself, through the so-called 'Mouches volantes,' and those also which arise from the observer being unacquainted with the appearance, under the microscope, of the common things which are dispersed throughout the air and water, such as small particles of dust, &c. Lastly, deceptions are also caused by air-bubbles, by molecular motion, and by the currents which arise upon the stage of the microscope from the evaporation of water, or from the intermingling of two fluids. The observer must learn to know and distinguish all these things thoroughly, and then no further deception can arise from these causes.

The proper use of the microscope is always the principal thing to be considered. Hedwig with the microscope of his time, promoted the advancement of science to a greater extent than many observers with incomparably better instruments have done.

In order to use the microscope properly, the observer must be skilful in handling the instrument and the objects, and above all things, his mode of proceeding must be conducted with accuracy and judgment, and he must be able to give a sufficient reason for every thing that he does. His progress in research will be slow, but sure; he must endeavour to obtain objects from every possible source, and must examine them thoroughly; he must verify his own observations as scrupulously as possible, and so, progressing step by step, he will attain the desired end. Work without method will seldom lead to any result; the finest sections of wood made only in one direction, or in a wrong direction, do not lead to any knowledge of the wood under observation. Single observations (of wood, for instance), irregularly made from time to time, only show the condition of the wood at the time of that particular observation, and throw no light on its condition at an earlier or later period; whilst sections made in a proper manner, and well-preserved specimens of the successive conditions of the wood, furnish irrefragable proofs, the one of the construction, and the other of the development in the growth of the wood under observation. (Schacht on the 'Microscope.')

Before speaking of the methods of examining and preserving bodies for microscopic observation, it will be better to draw attention to the natural objects, to the examination of which it has been applied with so much success. In both the inorganic and organic worlds the microscope is made subservient to observation. To speak first of inorganic substances and materials not under the influence of vital action, it has been found of great use in determining the forms of minute crystals. In this way it aids the analytical chemist. In the examination of the saline contents of water, if a small quantity of the water is allowed to evaporate upon an ordinary glass slide, its contents may be judged of by the forms which the crystalline matters assume. In fluids obtained from organic bodies this plan of examination has been lately applied with the most interesting results. A series of the most beautiful illustrations of the microscopic characters exhibited by crystals obtained by the evaporation of the blood and other fluids, will be found in Dr. Otto Funke's 'Atlas of Physiological Chemistry,' and also in the 'Micrographic Dictionary,' by Dr. Griffiths and Mr. Henfrey. Not only are the natural crystalline constituents dissolved up in liquids thus obtained, but new combinations obtained by the addition of re-agents. This mode of inquiry is equally applicable to the excretions of the human body, and is rapidly becoming one of the most important means of diagnosis in the hands of the physician.

Although dealing with the disposition of large masses of matter, of which the earth's surface is composed, important knowledge is obtained by the geologist by examining minute portions of them with the aid of the microscope. It is by the aid of this instrument alone that the question of the manner in which an extensive series of rocks has been deposited can be determined. Many rocks which present a homogeneous surface, when sections are made of them and placed under the microscope, are found to consist of the remains of the minutest forms of organic beings. [DIATOMACEÆ; INFUSORIA.] Whilst, on the other hand, rocks which, like the Oolites, present to the naked eye the appearance of being composed of various forms of organic beings, on close examination with the microscope are found to present appearances due to purely physical causes. Each of the little egg-like bodies seen in these rocks is found to contain a particle of sand surrounded by carbonate of lime. [MAGNESIAN LIMESTONE; OOLITIC SYSTEM.] It frequently happens that the fossilised parts of the higher animals which are left in the solid rock are too small or shapeless to indicate the characters of the family to which they belonged; but by the aid of the microscope this question can be determined in multitudes of instances. It has been found by the recent researches of Dr. Carpenter and others, that the microscopic characters afforded by the structure of shells are frequently so distinct as to afford the means of distinguishing between allied species of *Mollusca.* This is a subject of the highest interest to the geologist; for of all the remains of animal life those of the *Mollusca,* from the hard nature of their shells, are those which are furnished to him in greatest abundance for distinguishing the character of different strata, and determining their relative age. Amongst the vertebrate animals, next to the teeth, the bones are the parts which are most frequently left in rocks. When the form of the bone is no guide, its microscopic structure will determine the family to which it belongs. The forms presented by the lacunæ, or bone-cells [BONE], which are only visible by the aid of the microscope, are found to differ so much in fish, reptiles, birds, and mammals, as to afford the means of distinguishing each class. The teeth are only modified bone, and although they present most frequently a very definite external form, and are usually better preserved than any other part of an animal body, they afford still more definite characters by the modifications of the internal portions of their structure. It is thus that the internal structure of the tooth presents a better character than any other part of its structure in the gigantic extinct frog, the *Labyrinthodon.* [AMPHIBIA.]

Among the earlier fishes which inhabited the seas of the earth were principally those which have a cartilaginous skeleton; but with this perishable skeleton they were endowed with hard scales, which have resisted all decomposing agencies, and these scales, frequently scattered, are the only record of their existence. From microscopic examination of the structure of these scales, Professor Williamson has shown that the species of those fishes can be detected.

Numerous are the forms of *Zoophyta, Polyzoa,* and *Echinodermata* that have left remains in the strata of the earth which the naked eye can by no means distinguish, but whose differences are immediately revealed when sections of their fossilised remains are placed under the microscope. Examples of these will be found in the second volume of Professor Quekett's 'Lectures on Histology.'

We pass from this glance at the use of the microscope to the chemist and geologist, to point out its value in researches connected with living organised beings. We begin with plants. It is in the vegetable structure that the ultimate cells, of which all organised beings are composed, are most easily discerned. The earliest microscopic observers were aware of this. It was left however for Schleiden to perceive the full significance of this fact in 1838, when he drew attention to the cytoblast as the source of the growth and life of the cell. [CELLS.] He was followed by Schwann, who pointed out that the cell was of equal importance in the animal as the vegetable kingdom. The ultimate cell of the plant or animal is only visible by the aid of the microscope; hence whatever importance is attached to the discovery of cells and the formation of tissues by their agency is due to the use of the microscope.

The unceasing labours of microscopic observers during the last quarter of a century have developed a new branch of science called histology [HISTOLOGY], which embraces a knowledge of the ultimate structure of the tissues of which all parts of plants and animals are composed.

One of the most interesting facts connected with the history of the microscope is the discovery of the existence of minute animals and plants, inhabiting more especially water, and which are perfectly invisible to the naked eye. The earliest observations on these minute beings were made by Leeuwenhoek in the middle of the 17th century; but it was left for Ehrenberg, during the present century, to make known to its full extent the immense variety of forms assumed by these microscopic beings. [DIATOMACEÆ; DESMIDIEÆ; INFUSORIA.] Since the publication of the 'Infusionsthierchen,' these minute organisms have been a source of increasing interest to microscopic observers. Representing the entire animal or plant in its simplest form, the observations of their growth, structure, and functions have thrown light on some of the most complicated problems of animal and vegetable physiology. Small as they are, they make up for want of size by the prodigious numbers in which they occur, and the important functions they seem to perform in the universe. The unveiling this world of life is entirely due to the agency of the microscope.

It is not however alone in revealing the minute structure of plants and animals, as the existence of organic beings of minute size, that the naturalist and physiologist are indebted to the microscope. By its aid they have been enabled to investigate the functions performed by cells. If the tissues of plants and animals are built up of cells it was a natural inference that these cells performed an important part in the functions of these tissues. It was soon found that the animal and plant increased in size by the multiplication of these cells; that the tissues were renewed by their agency; that the function of secretion was performed by them; in short, that it was by the aggregate of their functions that plants and animals lived. Hence the cell theory, or cell doctrine, has been to the explanation of the phenomena of living beings what the law of gravitation was to the phenomena of the physical universe. Till the application of the microscope the mysterious function by which new beings in plants and animals were produced was only imperfectly apprehended; but since its extended employment the laws which regulate this process have become perfectly obvious, and but little remains to complete our knowledge of the subject. [REPRODUCTION IN PLANTS AND ANIMALS.]

Having pointed out the objects of the use of the microscope, we now proceed to give some general directions for examining them. In giving these directions we shall follow Dr. Schacht, whose work on the microscope has been translated into English by Mr. Currey.

One of the principal requisites for microscopical investigation, besides a good instrument, is a proper supply of light. When the position and nature of the apartment can be selected at pleasure, a room should be chosen having windows facing the west or the north, or, what is better, a room with windows towards both those quarters of the heavens. The windows must be as high as possible, since the light received from the horizon is the most favourable; light reflected from a white wall, or the light of white clouds, is often very advantageous. The light of scudding clouds fatigues the eye by the rapid change in the intensity of the light, besides rendering necessary a continual change in the position of the mirror. No ordinary observation is possible in direct sunlight; this light is, in the first place, far too dazzling for the eye to bear; and, in the second place, it causes appearances which give rise to the grossest deceptions. In working with the microscope in the forenoon and in the middle of the day, a room lying to the east or to the south must therefore be avoided: by means of white blinds, or curtains, the inconvenience may, to a certain extent, be avoided.

Many objects are seen very beautifully by lamp-light, but this light is far more glaring than daylight. When the light is made to pass through blue glass before reaching the mirror, it bears a greater resemblance to daylight, and is pleasanter to the eye. A piece of white ground-glass, fastened in a wooden frame, and placed before the lamp, will have the same effect. By regulating the light of the lamp in this manner, objects already prepared may be shown very well by night, but it is hardly possible to make fine preparations with such an illumination; for exact observation, therefore, the day-time only must be selected. In order to intercept the light of the horizon by means of the mirror, the latter is placed at least three feet from the window, the microscope is turned with the mirror towards the light, and the whole instrument, but especially the mirror, is placed in different positions whilst the observer looks through the eye-glass; the light is, in fact, sought after: when the field of view appears clearest and brightest, the object which is to be observed is pushed under the microscope.

When it is wished to examine opaque objects with incident or reflected light, the microscope may often be advantageously brought nearer to the window. Since for this kind of illumination a much larger quantity of light is necessary, direct sunlight is sometimes desirable; in the absence of this, the condensing lens is used, by means of which the greatest possible quantity of light is concentrated upon the object. In this kind of illumination, the access of light from below, which would interfere with the observation, is prevented by closing the diaphragm. For objects which are altogether opaque, a background which is white, but not glittering, is often advantageous.

The table at which microscopical observations are undertaken must be sufficiently large, and very firm; it must be so arranged that all the apparatus which is ever wanted shall be at hand. Much time is spared by attention to this, and in microscopical investigations time passes only too quickly; moreover, in a very confined space it is impossible to make effectual preparations with the simple microscope. Every object intended for investigation should be examined in the first instance with a low magnifying power, since by that means a far larger portion of the object is seen, and thus a better impression with regard to the whole is obtained. Should the light be too strong, the plane mirror may be used instead of the concave one. When the observer has gained as much information as he can with the low-magnifying power, for instance, one of 50 diameters, or, in some cases, even a less magnifying power, the object-glass is changed for a more powerful one. When the most powerful object-glass has been used, and a still stronger magnifying power is found desirable, then a stronger eye-glass is taken. As a general rule, the eye-glass of lowest power should be used, and, if necessary, the magnifying power should be increased by passing from the object-glasses of lower power to those of higher power; but, nevertheless, for seeing with convenience, and especially for drawing, the use of a powerful eye-glass is often not without advantage. As long as the magnifying power can be increased by means of an object-glass, recourse should never be had to the eye-glass, since both the light and the sharpness of outline of the image are necessarily diminished by the use of a powerful eye-glass, which is not the case in using a more powerful object-glass.

In some cases, it is a good plan to shade with the left hand, the eye which looks into the microscope. When an object is thin enough to be seen with transmitted light, it is first illuminated with light transmitted directly, and is examined with different, and gradually increasing, magnifying powers; should any details of the image remain undefined, obliquely transmitted light is used, which is insinuated into all the different corners of the object. In some microscopes this is attained by turning the stage round its axis; where this arrangement is wanting, the position of the object must be changed by moving it with the hand. Lines always stand out most clearly when oblique light falls upon them at a right angle: where, therefore, a line is suspected to exist, or is only dimly seen, particular attention must be paid to this circumstance. In submitting objects to incident light, the same rule generally holds good, and particular care must be taken, by turning either the stage or the object itself, to concentrate the light in all possible directions upon the object. Object-glasses of very high power cannot be used with incident light, inasmuch as the shortness of their focal length prevents the light from falling on the object; in this case recourse must be had to less power object-glasses, and more powerful eye-glasses. As a general rule, low-magnifying powers are sufficient when incident light is used.

Objects are frequently examined by polarised light. In order to effect this an instrument called a polariscope is employed. That most frequently used is the arrangement proposed by Mr. Nichol. It consists of two prisms of Iceland spar, one of which is fitted beneath the stage, the other is attached to the eye-piece. Tourmaline is also used for the same purpose. Large crystals of iodide of quinine have also been shown by Dr. Herapath to be applicable in polarising light for the microscope. ('Quarterly Journal of Microscopical Science,' vol. ii.) By the use of polarised light objects frequently exhibit their structure in a more perfect manner. Various objects, especially crystals of a spherical or oval form, exhibit a beautiful variety of colour in this way. In some cases it may be made the means of testing the nature of an object.

In most instances, objects are examined under water: it is but seldom, as, for instance, in examining pollen or spores, that it is necessary to observe them in different media, and also when dry. In the case of incident light, water often operates injuriously, especially when the object is not quite covered by it: it is therefore advisable, for certain particular objects, as, for instance, the embryoes of grasses, to observe them first without water, and afterwards under water; by placing them under a cover, and adding water with a camel's-hair brush, the object is generally sufficiently and fully immersed. When low-magnifying powers are used, it is not necessary that the objects should be placed under a glass cover, in fact, in many cases where it is wished to have the power of turning the object round, or when it is thought that the object may be improved by any additional cutting or preparation, it is very advantageous not to cover it; when object-glasses of very high power are used, the focal distance is so short, that in order to prevent striking the lens against the object, or dipping it in the fluid upon the object plate, it is necessary to make use of glass covers. When these are used, the fluid in which the object lies frequently becomes lessened by evaporation during the observation, in which case a fresh drop is added at the edge of the glass cover by means of a glass rod, or a clean camel's-hair brush, which may be used when it is wished to add a solution of iodine, or of chloride of zinc and iodine, to objects which are already immersed in water.

When any chemical re-agents are used, whether iodine, caustic potash, or an acid, the object should always be covered with a thin plate of glass; in using volatile acids, such as nitric acid and hydrochloric acid, too much care cannot be taken. The vapour of sulphuretted hydrogen has a very injurious effect upon flint glass, which is used by some opticians for the under side of the object-glass.

When the microscope is in daily use, it is a good plan to keep it under a high bell-glass, or an ornament shade.

The greatest cleanliness and accuracy are indispensable for microscopical investigations: it must be laid down as a rule always to use the cleanest water, in the cleanest vessels, for moistening the slides. Even with this precaution it is impossible entirely to protect the object from becoming soiled with particles of dust. Extraneous things of this kind will not easily deceive a practised observer; a beginner however may be easily misled by them. Water which has been left standing should never be used, since it too frequently contains the inferior sorts of animals and plants; and when different objects are examined one after another, fresh water should be taken for every new object, in order that no particles of the objects which have been previously examined may be mixed with the water upon the slide. Many errors may be traced to a neglect of small precautions of this sort.

In order to be able to recognise extraneous objects as such, it is advisable to gain an acquaintance with those things which, notwithstanding all precautions, cannot always be avoided. To this class of things belong—1st, Air-bubbles, which, with transmitted light, generally appear in the form of circles of larger or smaller diameter, with a dark, black-looking rim: with incident light, on the contrary, their rim appears of a white colour. When the object is under a glass cover and in contact with it, the larger air-bubbles frequently assume a very irregular shape; the above-mentioned optical fact is generally however by far the best proof of the presence of air, and by it the presence of air may be detected both in and between the cells of plants. 2nd, Colourless or coloured fibres of paper, or of linen, woollen, or silk-textures, left behind upon the object-glasses, from the cloths with which they have been cleaned, and also the hairs which have been detached from the brush. 3rd, Granular particles of dust of irregular shape, which are frequently coloured, and are probably produced by the decay of organised bodies. If it is wished to examine plants, or parts of plants, which grow either in or upon the earth, or in water, great attention must be paid to the many organised bodies which are likely to be met with: pains must be taken by careful observation to become acquainted with the lower forms of animals and plants: it is necessary, for instance, to be able to distinguish the common forms of *Infusoria*, both those which are provided with siliceous coatings, and those that are not; also with the yeast plant, the different forms of mould, the *Oscillatoria*, and such like things, in order to be able to separate them from the particular object under consideration.

The epithelial cells of the mucous membrane of the mouth are also objects which may deceive the observer. They occur when the brush is drawn through the mouth previously to bringing an object upon the object-plate. It is advisable never to pass the brush through the mouth. When in cutting small objects, the latter are held between the thumb and forefinger, or upon the forefinger alone, it often happens that small fragments of the skin of the finger are cut off at the same time. The observer must learn to distinguish these fragments, as well as the small pieces of cork which he will meet with in sections made between that substance.

Appearances of motion, either usual or accidental, may also give rise to mistakes, and these must therefore be learnt. Molecular motion is peculiar to all very small bodies, contained in a thin fluid medium; it consists of a somewhat trembling motion of these small bodies; it is frequently seen in the interior of pollen grains; it may be observed still better in certain fluids, for instance milk, when a small quantity is mixed with water, and placed under the microscope, with a magnifying power of from 200 to 400 diameters. When acquaintance is once made with this phenomenon no further deception can be caused by it. The same result follows from accidental currents upon the object-plate, which may take place either by evaporation or by the mingling of two fluids of unequal specific gravity, or by the dissolving of any salt existing in the fluid.

Observations are made less frequently with reflected than with transmitted light, but since the latter can only be used for very thin objects, the principal point to be attended to in dealing with opaque objects, is to make such an arrangement of them, as to enable the observer clearly to make out their details. The manner in which the object is divided must be regulated and altered according to the nature of the object itself, and the information which it is wished, by the help of the microscope, to obtain respecting it. Firm homogeneous textures, such as wood, must be treated quite differently from delicate objects composed of different organs, such as buds and blossoms; in the case of wood it is sufficient to take as thin a slice as possible, cut in a certain fixed direction; in the case of buds and blossoms, attention must be paid not only to the direction, but also, particularly, to the point at which the section is made; it is necessary to exhibit an accurate longitudinal section through the middle of the whole bud or blossom, and an equally accurate transverse section made at different heights, in order to ascertain the arrangement of the organs with respect to one another; moreover, the different parts of the organs must be separated and examined by themselves; in cases like this, and especially in inquiries connected with the development of plants, a dissecting microscope is necessary. The same remarks apply to hard and soft animal tissues.

Succulent or spongy tissues have generally large cells; it is not necessary therefore to have thin sections of such tissues, which are always difficult to make. Delicate animal tissues may advantageously be placed in spirit or pyroligneous acid for some days, provided it is not necessary that the tissues should be examined whilst fresh; but there is little advantage to be derived from treating botanical objects in that manner. It is a good plan however, in many cases, to saturate delicate portions of animals and vegetables with thick gum-mucilage, and to let them dry slowly in the air.

In dissecting, different methods must be adopted, according to the magnitude of the different objects; objects of large size may be held with the left hand, or with the thumb and forefinger of that hand; very small or very thin objects, such as the stems of mosses, thin twigs and roots, leaves, small seeds, and such-like things, may be placed between two pieces of cork, and thin slices of the object cut by means of a sharp knife or razor.

Observations are sometimes disagreeably impeded by the presence of air, which becomes accumulated in the hairy parts of plants, in the intercellular canals, in the vessels, and in wood; it is best removed by placing the object for a few minutes in a small watch-glass filled with alcohol; when taken out of the alcohol it must be put into water, and then transferred to the slide. When it is wished to examine the cell contents, in which the changes are generally produced by the operation of alcohol, the removal of the air may be advantageously effected by the use of the compressorium, which is permitted to operate continuously upon the object, whilst the observer looks into the microscope. In the absence of a compressorium, the fingers may be lightly pressed against the glass cover.

For transferring objects from one fluid into another a very fine camel's-hair brush should be employed; needles and other sharp instruments should never be used for this purpose, since the object may be easily injured by them. When the object is very small it will be more easily found if the watch glass is placed upon a dark back-ground.

The microscope only affords a view of one surface of an object; when, therefore, bodies are subjected to examination, it is not sufficient for a correct understanding of them to examine one side only; a transverse section and a longitudinal section, and, in fact, frequently many longitudinal sections in different determinate directions, must be carefully examined and compared with one another before the observer can be satisfied that he has made out the construction of the body under observation. That which in objects of large size is attained by the help of the knife, is effected, in the case of very small opaque objects, by examining them on different sides. In examining small bodies which are very transparent, as, for instance, the ovules of *Orchideæ*, or grains of pollen or starch, the adjustment of the microscope is varied from time to time, by which means the upper side of the object is first brought into the focus, then the middle (which may be called an optical section, transverse or longitudinal, as the case may be), and, lastly, the under-side. The more perfect the object-glass the more exact is the focal plane, and the more sensitive is the instrument to any small alteration of the focus, on which account the observer should always keep his hand upon the fine-adjusted screw whilst he is employed upon observations requiring much accuracy. The sensitiveness above mentioned increases, in good instruments, in proportion to the magnifying power, and also with the angle of the aperture of the glass.

The accurate adjustment of an object is judged of by the sharpness of delineation of the image. The adjustment is more accurate in proportion to the delicacy and sharpness of the lines seen upon small objects, and also in proportion to the fineness and clearness of the outline, which should be soft, but well-defined. The scales of the *Hipparchia Janira*, a common brown Butterfly, are well adapted for enabling a person to judge of the accuracy of an adjustment; the smallest change of focus causes transverse striæ to disappear.

In examining small round bodies, such as pollen-grains, the position of the objects should be changed, by gently pushing the glass-cover so as to cause the bodies to roll about; by this means different sides of the objects are seen, and from the different images presented to the eye their true form is made out.

Small objects should never be compressed between two glass sides, that being too rough a method of proceeding. If however it is supposed that anything is to be gained by compression, then it is advisable to use the compressorium, which is an instrument consisting of a mechanical arrangement by which the thin glass covering an object may be compressed at will. When the compressorium is cautiously used, the observer, by carefully watching what takes place, can gain a knowledge of the changes produced by pressure during the time the compressorium is permitted to work. In certain cases, where, for instance, the question is whether a particular object is a delicate cell or a drop of some fluid, the compressorium may be of service; since, if a cellular membrane be present, it will burst and discharge its contents as the pressure is increased, whereas the drop, whether it be oil, liquid resin, or any other chemical substance upon the slide, will only change its form.

In examining any object, whether animal or vegetable, it is not sufficient to observe the nature, form, and arrangement of the cells; it is necessary also to pay attention to their contents, which, in the case of plants, are different according to the functions assigned to them by nature. It is necessary, therefore, to distinguish—1st, Whether a cell is empty, that is to say, whether it contains air, as is the case, for instance, with perfect vessels and wood-cells; 2ndly, Whether its contents are fluid with a solid substance contained in the fluid. Another question which arises is as to the nature of the fluid contents, that is, whether they consist of a homogeneous fluid, or of fluids of different consistencies, apparently not intermingling with one another; the manner in which these fluids are affected by chemical re-agents has also to be considered. Lastly, the solid ingredients of the cell-contents, and their physical and chemical nature, must also be attended to. There are some substances dissolved in the juices of the cell, such as sugar, for example, for which no certain chemical re-agents are known. Gum and dextrine are coagulated by alcohol; the presence of nitrogenous substances is proved, by the use of sugar and sulphuric acid, which produce a red colour, or by a solution of iodine, or of chloride of zinc and iodine, and also by nitric acid, with ammonia subsequently added to it; in these three cases an intense yellow colour, almost brown, is produced. When the presence of oil or resin is suspected, the object should be placed in ether or pure alcohol for some hours, which will dissolve both oil and resin. When the juices of the cell hold any salt in solution, some re-agent must be used which operates upon the salt. Starch is detected by being coloured blue by iodine. [STARCH; LIGNIN; CHLOROPHYLE; PROTEIN.]

The following is a list of re-agents which it will be found convenient to have close at hand in the examination of either animal or vegetable substances:—

1. Alcohol, which is used principally for removing air from sections of wood and other preparations, and as a means of dissolving certain colouring matters, &c. It coagulates the albuminous textures of animals.

2. Ether, which is principally used for dissolving resins, fatty essential matters, and other oils, &c. This is also useful for removing air.

3. A solution of caustic potash, which is used for the purpose of dissolving fat, is also useful in certain cases from its effects upon the contents of cells, and upon the thickening layers. It dissolves up substances of an albuminous nature. This solution often works better after warming.

4. A solution of iodine (one grain of iodine, three grains of iodide of potassium, one ounce of distilled water) for colouring the cell-membrane, and the contents of the cell.

5. Concentrated sulphuric acid. This is principally used for examining pollen and spores. In the examination of hairs it renders the cells very distinct.

6. Diluted sulphuric acid (three parts of sulphuric acid and one part water), for colouring the cells of plants which have been previously moistened with the solution of iodine. The object is moistened with the solution of iodine, which is then removed with a fine camel's-hair brush, and by means of a glass rod a drop of sulphuric acid is added, and the object is then immediately covered with a covering-glass. The effect of the sulphuric acid and iodine, as well as that of the iodised solution of chloride of zinc, is not always the same over the whole surface of an object. At the points where the mixture is more concentrated, the colouring is more intense; frequently places remain without any colour. The colour changes after some time; in twenty-four hours the blue is often changed into red.

The iodised solution of chloride of zinc produces generally the same blue colour in cellulose as iodine and sulphuric acid: the former is preferable in many cases, inasmuch as its effect is not so rapid, and it is not injurious to the cells. Both re-agents should in many cases be employed, and their effects compared with one another. Besides maceration, it is advisable, in examining woods, to adopt the plan of boiling thin sections for about a minute with a solution of caustic potash; after this boiling, the wood-cells, which were not previously turned blue by iodine and sulphuric acid, become of a violet or blue colour upon the application of the iodised solution of chloride of zinc.

7. A solution of chloride of zinc, iodine, and iodide of potassium. A drop of this solution applied to an object placed in a little water, produces the same colour as iodine and sulphuric acid. This solution was first recommended by Professor Schultz, of Rostock; it is more convenient to use than iodine and sulphuric acid, and produces almost the same results; it is, moreover, not so destructive as sulphuric acid. The exact prescription for this solution is as follows:—Zinc is dissolved in hydrochloric acid; the solution is permitted to evaporate, under contact with metallic zinc, until it attains the thickness of a syrup; and the syrup is then saturated with iodide of potassium. The iodine is then added, and the solution, when it is necessary, is diluted with water.

8. Nitric acid, or, what is better, chlorate of potash and nitric acid. This is used for separating cells. The method of maceration discovered by Professor Schultz, and which is much to be recommended, is as follows:—The object (wood, for instance), is reduced in size to the thickness of a lucifer-match; it is then thrown into a long and tolerably-wide boiling-tube; to this is added, in a little while, an equal volume of chlorate of potash, and as much nitric acid as is at least sufficient to cover the wood and the potash; the tube is then warmed over a spirit-lamp; a brisk development of gas quickly appears; the boiling-tube is withdrawn from the flame, the oxydising mixture is permitted to work for about a minute and a half or three minutes, and the whole is thrown into a saucer with water: the small pieces which adhere slightly to one another are then collected, placed in the boiling-tube, and boiled repeatedly with alcohol, until the latter appears colourless; they are then boiled once more, for the last time, with water. By the help of the simple microscope the cells are now separated from one another with a needle, and selected. The boiling with nitric acid and chlorate of potash should never be carried on in the room where the microscope is kept, because its glasses might be injured by the evaporation which is developed. Thin sections of plants, for instance, of woods or leaves, are warmed for half a minute, or a minute, in a watch-glass; the boiling is unnecessary in this case; the section is taken out with a little rod, and thrown into a small watch-glass, with water. Nitric acid is one of the best agents for removing animal or vegetable tissues from silica, as in the case of the *Diatomaceæ*.

9. Oil of lemons, or any other essential oil, for examining pollen and spores.

10. A tolerably strong solution of muriate of lime (one part of dry muriate of lime, and three parts of distilled water) for preserving microscopic objects. This is useful for most things, even for delicate objects, unless they contain starch. If it is wished to preserve an object for a few days without mounting it immediately, it is a very good plan to put a drop of this solution upon the object, and to place it under a bell-glass for protection against dust.

11. Glycerine. This is also well adapted for preserving microscopic objects, and especially for cells which contain starch, which latter substance continues unchanged by it. In granules which exhibit lamination, for instance in the potato starch, the lamination is apt to continue invisible for the first few hours; after 24 hours, however, it appears more clearly.

12. Copal varnish, or Canada balsam, also for the preparation of microscopic objects; these are only to be recommended for a few thin sections of wood, such as fossil woods. They both make the object more transparent than the solution of muriate of lime.

13. A tolerably strong solution of carbonate of soda for digesting peat-wood, as well as hydrochloric acid for digesting fossil woods which have been converted into carbonate of lime. It is also recommended for examining the sweat-ducts in the skin.

14. Acetic acid. This is very useful in examining animal tissues. It has the power of making the cell-wall clearer, whilst the nucleus becomes darker and more distinct. It also distinguishes phosphate or carbonate of lime from oxalate of lime, by dissolving the two former, whilst it has no action on the latter.

15. Very dilute chromic acid. It is used for the purposes of hardening tissues. It is especially useful in examining the structure of the retina.

16. Ammonia will be found useful in the same cases where caustic potash and soda are employed.

17. Nitrate of baryta is used as a test for sulphuric and phosphoric acids. Sulphate of baryta is insoluble in acids and alkalies, while phosphate of baryta is readily soluble in acids, but insoluble in ammonia.

18. Nitrate of silver in solution is used as a test for chlorides and phosphates. The white chloride of silver is soluble in ammonia, but insoluble in nitric acid. The yellow phosphate of silver is soluble in excess of ammonia and nitric acid.

19. Oxalate of ammonia is employed as a test for lime, an insoluble oxalate being formed wherever lime is present.

This list of re-agents might be increased, as there is scarcely an operation performed in the laboratory that may not be repeated on a small scale under the microscope. The above list, however, comprises those which will be found most useful.

In addition to the ordinary optical arrangements of the microscope, certain forms of accessory apparatus will be found very useful. Some of these have been already alluded to, and the following will also be found convenient.

1. A spirit lamp, which may be made of brass, tin, or glass, fitted with a ground glass cap. It may be fitted with a stand, and will be found useful for submitting objects to heat. The objection to the employment of candles, or lamps, is the black smoke they produce.

2. A small warm bath. This will be found of use for drying objects previous to being mounted in Canada balsam.

3. Watch-glasses are useful for examining substances in fluids with low powers, as by this means a considerable depth of fluid is obtained for observation.

4. Plate-glass slides, 3 inches long and 1 inch broad, are useful for mounting and examining all kinds of bodies.

5. Thin-glass, called cylinder-glass, of different degrees of thickness, is indispensable for placing over objects, especially those which are soft or fluid when placed upon a slide.

6. Needles of various sizes are used for making minute dissections. Small handles may be attached to them, rendering them more easy to work. Needles or pins may be employed for fastening down minute organic bodies which are about to be submitted to dissection.

7. Scissors of various sizes will be found serviceable. These may be obtained of the surgeon's instrument makers.

8. Knives, scalpels, and razors, for cutting soft or hard objects, should be kept at hand.

9. A pair of thin brass forceps will be found convenient for placing thin glass on the slides, as well as for placing or removing objects from the slides.

10. A glass-cutter's diamond is useful for cutting slips of glass, in the making of cells, and in writing the names of preserved objects on the glass slides.

Cements of various kinds are necessary to the microscopic observer who wishes to preserve the objects he examines. They are used for making glass cells to contain objects, on the glass slide, and for fixing the cover after the preparation has been placed in the cell, and for other purposes. The principal cements used are gold-size, sealing-wax varnish, solution of shell-lac, gum, a French cement composed of lime and Indian-rubber, Brunswick-black, marine-glue, and Canada balsam. These cements are most of them sold at the optician's and directions for making them are found in some books on chemistry and the microscope.

In order to preserve preparations for a length of time it is necessary to place them in an air-tight vessel. These vessels are called cells and are best made of glass. They are also sold where microscopes are procured. With a little practice however the microscopist may make his own cells.

Thin cells may be made of various substances. Even paper answers exceedingly well in some cases, and is well adapted for dry preparations. A thin layer of white lead, which has been allowed to dry, has also been employed for the same purpose. White lead, made into a thick liquid with linseed-oil and turpentine, has been recommended by some observers. Various varnishes have likewise been used; but where it is required to keep the specimen in some preservative solution glass is the substance which in all cases forms the best material for making cells.

Sometimes preparations are of such extreme tenuity that it is only necessary to place them on the slide with a drop of some preservative solution, and then to cover them with a square of thin glass, the edges of which have been anointed with gold size or other appropriate cement. The superfluous fluid is next absorbed with hibulous paper, and the slide allowed to dry for a few minutes. A layer of gold-size or other cement is then applied round the edges of the thin glass in order to fix it to the slide. In this way an excessively thin cell may be formed; but preparations mounted in cells made in this manner can seldom be kept for any length of time without the entrance of air-bubbles. This arises from the outer layers of the gold-size drying more rapidly than the more internal layers. By the contraction thus produced the edges of the cement are drawn off from the glass, to which however it does not adhere with great tenacity in consequence of the surface being highly polished. It is therefore always better to make very thin cells of glass or other material, which can be cemented to the glass slides with marine glue or other cement; or else to make the cell by painting the slide with a ring of varnish, marine glue, or Brunswick black, and allowing this to dry thoroughly before the preparation is placed in it. In this manner the thinnest cells which can be required are readily made.

Perhaps Brunswick black is, for the purpose just mentioned, the best. It is painted upon a glass slide with a fine camel's-hair brush, and allowed to dry perfectly, when, if the cell is not sufficiently thick, another layer may be applied. If the cell be required immediately, it is better to warm the slide slightly before applying the varnish. If too great a degree of heat however be employed the varnish becomes brittle and the cell unfit for use.

Very thin cells may be made of tin-foil. This may be easily accomplished by cutting with a pair of scissors a piece of thin tin-foil the size of the cell which it is desired to make. A hole is cut in the centre of the tin-foil sufficiently large to hold the preparation which is to be preserved, and the tin-foil is then attached to the glass slide with marine glue. When cold the cell may be filed perfectly flat with a very fine file, or rubbed with a little emery upon a piece of plate glass, and the marine glue should be afterwards removed from the centre with a little solution of potash. The cover may be fixed on with gold-size or varnish, as in other cases. Thin cells have also been made of gutta percha, but there is great difficulty in fixing the cell firmly upon the glass slide. This however has been effected by some observers; but in consequence of the difficulty it is a method not generally employed. Preparations however mounted in cells composed entirely of gutta percha keep very well for a length of time.

Cells composed of very thin glass are perhaps the most convenient, and will be found useful for preserving many preparations. They may be obtained of different degrees of thickness, and are made usually by perforating the thin cylinder glass which is used for covering the cells, or by grinding sections of a thick glass bottle to the required tenuity. Round cells of thin glass are made as follows:—A great number of squares of thin glass are cemented firmly together with marine glue, and when cold a hole of the required size is drilled through them all. They are next separated from each other by heat, and, after being cleaned with potash, may be fixed on the glass slides with marine glue in the usual way and kept ready for use. It is a good plan to roughen the surface of these cells, which renders the subsequent entry of air less likely, as the gold-size adheres much more firmly to a ground than to a polished surface. This is readily effected by rubbing the cell, after it has been fixed upon the glass slide, up and down a narrow hone or strip of plate glass on which some moistened emery powder has been placed. In this way also the thickness of the cell may be reduced if required. (Beale.)

Cells of any thickness or depth may be made for larger objects, but those described will be found most convenient.

If it is only required to examine the character of a specimen in a dry state, it may simply be laid upon a glass slide and placed in the field of the microscope; if however the substance be of a very delicate structure, or in a minute state of division, it is better to place a piece of thin glass over it in the usual manner in order to protect it.

Dry objects may be mounted in a thin glass cell, or in a paper cell, or if of extreme tenuity they may simply be placed on a glass slide and covered with thin glass, which should be fixed to the former by a small piece of gummed paper (rather larger than the glass cover), in the centre of which a hole has been cut of sufficient size to permit the entire object being seen. The paper may of course be of any colour, or ornamented according to the taste of the operator.

When objects are to be examined by reflected light they may be placed in little glass or card-board cells, or in pill-boxes, or they may be put up in glass cells. The preparation should be placed upon a dark ground, which may be effected either by cutting a piece of dark blue or black glazed paper of the exact size of the cell and placing it within; or the black paper may be fixed on the posterior surface of the slide; or this surface may be covered with black paint or black varnish.

There are various methods by which preparations may be subjected to examination, and preserved as permanent objects in a moist state, and the different value of the various preservative solutions which are in use entirely depends upon the nature of the substance to be mounted. Distilled water forms a very good fluid for some objects, while for the preservation of most it is necessary to immerse them in water impregnated with some antiseptic agent, which is not volatile at ordinary temperatures. Many again are best preserved in spirit, or in a solution of some salt. It is very difficult to lay down rules which will enable the observer to choose a preservative fluid for any particular specimen. A little experience however will soon enable him to judge which solution is best adapted for the purpose.

We take the following account of several preservative solutions from Dr. Beale's valuable work on the Microscope:—

Spirit and Water.—Mixtures of spirit and water of various strengths are required for preserving different preparations. In diluting spirit distilled water only should be employed; for if common water be treated with spirit, a precipitation of some of the salts dissolved in it not unfrequently takes place, rendering the mixture turbid and unfit for use. Proof spirit will be strong enough for all general purposes, except for hardening portions of the brain or nervous system, when stronger spirit must be used. Two parts of rectified spirit, about specific gravity ·837, mixed with one part of pure water, makes a mixture of sp. gr. ·915-·920, which contains about 49 per cent. of real alcohol, and will therefore be about the strength of proof spirit. One part of alcohol, 60 over-proof, to five parts of water, forms a mixture of a sufficient strength for the preservation of many substances.

Glycerine.—A solution of glycerine adapted for preserving many structures is prepared by mixing equal parts of glycerine with camphor water. The latter prevents the tendency to mildew. It may be used as other preservative solutions.

Glycerine is obtained by boiling oil with litharge. The oleate of lead remains as an insoluble plaster, while the glycerine is dissolved. It may be rendered free from lead by passing a current of sulphuretted hydrogen through it; and the clear solution, after filtration, may then be evaporated to the consistence of a syrup.

Thwaites's Fluid.—This fluid has been much employed by Mr. Thwaites for preserving specimens of *Desmidieæ;* but it is also applicable to the preservation of animal substances.

Water	16 ounces.
Spirits of Wine	1 ounce.
Creasote, sufficient to saturate the spirit.	
Chalk, as much as may be necessary.	

Mix the creasote and spirit, stir in the chalk with the aid of a pestle and mortar, and let the water be added gradually. Next add an equal quantity of water saturated with camphor. Allow the mixture to stand for a few days, and filter. In attempting to preserve large preparations in this fluid, I found it always became turbid, and therefore tried several modifications of it. The solution next to be described was found to answer very satisfactorily. Water may also be impregnated with creasote by distillation. It should be remarked that M. Straus-Dürckheim has succeeded in preserving preparations in camphor-water only.

Solution of Naphtha and Creasote.—

Creasote	3 drachms.
Wood Naphtha	6 ounces.
Distilled Water	64 ounces.
Chalk, as much as may be necessary.	

Mix first the naphtha and creasote, then add as much prepared chalk as may be sufficient to form a smooth thick paste; afterwards add, very gradually, a small quantity of the water, which must be well mixed in a mortar. Add two or three small lumps of camphor, and allow the mixture to stand in a lightly-covered vessel for a fortnight or three weeks, with occasional stirring. Pour off the almost-clear supernatant fluid, and filter it if necessary. Preserve it in well-corked or stoppered bottles.

I have some large preparations which have been preserved in upwards of a pint of this fluid, for more than five years, and the fluid is now perfectly clear and colourless. Some dissections of the nervous systems of insects have kept excellently—the nerves keeping their colour well, and not becoming at all brittle. Two or three morbid specimens are also in an excellent state of preservation; the colour being to a great extent preserved, and the soft character of the texture remaining. I have one preparation mounted in a large gutta percha cell, containing nearly a gallon of this fluid.

Solution of Chromic Acid.—A solution of chromic acid will be found well adapted for preserving many microscopical specimens. It is particularly useful for hardening portions of the nervous system previous to cutting thin sections. The solution is prepared by dissolving sufficient of the crystallised acid in distilled water, to render the liquid of a pale straw colour.

The crystallised acid may be prepared by decomposing 100 measures of a saturated solution of bichromate of potassa, by the addition of 120 to 150 measures of pure concentrated sulphuric acid. As the mixture becomes cool, crystals of chromic acid are deposited, which should be dried and well pressed on a porous tile, by which means the greater part of the sulphuric acid is removed, and the crystals obtained nearly pure.

Preservative Gelatine.—

Gelatine	1 ounce.
Honey	4 ounces.
Spirits of Wine	½ ounce.
Creasote	6 drops.

Soak the gelatine in water until soft, and to it add the honey, which has been previously raised to the boiling-point in another vessel. Next let the mixture be boiled, and after it has cooled somewhat the creasote dissolved in the spirits of wine is to be added. Lastly, filter through thick flannel to clarify it. When required for use, the bottle containing the mixture must be slightly warmed, and a drop placed on the preparation upon the glass slide, which should also be warmed slightly. Next, the glass cover, after having been breathed upon, is to be laid on with the usual precautions, and the edges covered with a coating of the Brunswick black varnish. Care must be taken that the surface of the drop does not become dry before the application of the glass cover; and the inclusion of air-bubbles must be carefully avoided.

Goadby's Solution.—

Bay Salt	4 ounces.
Alum	2 ounces.
Corrosive Sublimate	4 grains.
Boiling Water	4 pints.

Mix and filter. This solution may for most purposes be diluted with an equal bulk of water. For preserving delicate preparations it should be even still more dilute.

Burnett's Solution.—This fluid has been patented. Its preservative properties appear to depend upon the chloride of zinc. A strong solution of chloride of zinc forms a very powerful antiseptic, and also possesses the property of absorbing noxious odours, &c.

Other saline solutions.—Many other saline solutions have been employed by different observers. Of these, a saturated aqueous solution of chloride of calcium, free from iron, has been much recommended for preserving specimens of bone, hair, teeth, and other hard structures, as well as many vegetable tissues (Schacht). A solution of alum in the proportion of 1 part of alum to 16 parts of water has been found to answer pretty well for some substances. Gannal's solution, which consists of 1 part of acetate of alumina dissolved in 10 parts of water; solutions of common salt (1 part to 5 parts of water, with a little camphor), corrosive sublimate, persulphate of iron, arsenious acid, sulphate of zinc, and solutions of several other salts, have been recommended as preservative solutions, but their employment has not been always attended with the most satisfactory results.

Arseniuretted hydrogen gas has also been recommended for the preservation of animal substances, but it is not adapted for microscopical preparations.

Canada balsam forms a most useful agent for mounting various substances; and the structure of many can only be clearly made out when they are examined in this menstruum.

In this method of mounting objects no cells whatever are requisite. The balsam should be pale and old. The glass slides must be warmed before the balsam is put on, and for this purpose the glasses may be held in a pair of wooden forceps, or in a pair of common forceps, the legs of which are covered with cork, and heated over a spirit-lamp, or upon a brass-plate. The latter plan is the most convenient when several preparations are to be mounted at the same time, because they may be arranged in a row along the plate, and the balsam placed upon each slide as it becomes hot.

The Canada balsam may be heated after it is placed upon the slide, in order to allow the air-bubbles entangled in it to rise to the surface before it is applied.

The slide being warm, and the small quantity of Canada balsam sufficient to contain the preparation having been placed upon it, it must be gently moved about while the balsam is hot and quite fluid, until all the air-bubbles have floated to the surface and collected together towards one spot. A pointed wire or needle should then be taken, and all the bubbles either drawn out upon the end of it, which may be readily effected, or broken by the wire after it has been heated. In those cases in which the preparation is not detached from the glass slide upon which it has been allowed to dry, it is only necessary to place the drop of balsam upon it and gently warm it, following the usual precautions; afterwards the thin glass cover may be applied. When the preparation has been dried separately over the water-bath and cleaned, it may be taken in a fine pair of forceps, gently warmed, and carefully placed in the hot and perfectly fluid balsam. After it has been thoroughly wetted by the balsam, and all adhering air-bubbles removed, it may be placed in the position it is intended to occupy. The thin glass cover, adapted to the size of the preparation having been previously cleaned and warmed, may then be taken in a pair of forceps, and, after being held over the warm balsam for a minute, allowed to fall gradually upon the preparation (beginning at one side), until it becomes perfectly wetted with the balsam. The glass may now be slightly pressed in order to force out the superfluous balsam, and the preparation allowed to cool.

We now proceed to give a few directions for the examination of particular objects, more especially animal tissues, as these of all others are the most difficult to manage. In the examination of tissues containing blood-vessels, ducts, or other tubular organs, it is frequently most desirable that injections should be made before they are submitted to the microscope. This operation requires great delicacy. A very small syringe, or small syringes according to the delicacy of the structure, must be employed. The fluid injected consists of size or gelatine, coloured with various substances, as vermilion, sulphuret, and iodide of mercury, chromate of lead, indigo, Prussian blue, white lead, &c., according to the colour wished for.

The following general rules for injection are given by Dr. Beale:— Great attention should be paid to the cleanliness of all the instruments to be used in injecting. The syringe should always be kept scrupulously clean and in good order, and the injecting-cans should be carefully covered, to prevent the ingress of dust. Before commencing the operation, plenty of warm water should be at hand; and the subject should be allowed to soak for some time in a basin of hot water, before it is attempted to inject it, in order that it may be thoroughly warmed through. The temperature of the water must vary according to the degree to which the injection is required to be heated: if size and vermilion be used, the water need only be warm; but if melted wax be employed, the water must be so hot that the hand can scarcely be borne on it. The length of time which the preparation is allowed to soak must depend upon its bulk; and the water should be changed as soon as it becomes at all cool. With respect to the length of time after death that is more favourable for this operation, no absolute rules can be given. Generally, it may be remarked that we should not attempt to inject while the *rigor mortis* lasts. Many days may in some cases with advantage be allowed to elapse, particularly if the weather is cold, while in warm weather we are compelled to inject soon after death. As a general rule, the more delicate the tissue, and the thinner the vessels, the sooner should the injection be performed. Many of the lower animals, annelids, mollusca, &c., and fishes, should be injected soon after death. In making minute injections of the brain, only a short time should be allowed to elapse after the death of the animal, before the injection is commenced. Injections of the alimentary canal of the higher animals should be performed early—not more than a day or two after death.

When the preparation is warmed through, the injection properly strained, and the pipe fixed in the vessel, we may proceed carefully to inject, taking care that the injection is kept at a proper temperature, by allowing it to remain in the warm water-bath during the operation.

The air should be first withdrawn from the upper part of the vessel by means of the syringe, after which the stop-cock is turned off and left attached to the pipe. The syringe is then disconnected, and after being washed out once or twice with warm water, is nearly filled with injection, which must be well stirred up immediately before it is taken. The syringe should not be quite filled, in order that the air in the pipe may be made to rise into the syringe through the injection, by the ascent of the piston, before any of the latter is forced into the vessel. The end of the syringe is then to be pressed firmly into the upper part of the stop-cock, with a slightly screwing movement.

The piston is now very gently forced down by the thumb until the syringe has been nearly emptied, when the stop-cock must be turned off, and the syringe refilled with warm injection as before.

Care must always be taken to keep the syringe in an inclined position, so that any air which may be in it may remain in the upper part; and, for the same reason, all the injection should not be forced out, for fear of the inclosed air entering the vessels, in which case all chance of obtaining a successful injection would be destroyed.

After a certain quantity of fluid has been injected, it will be necessary to use a greater amount of force, which, however, must be increased very gradually, and should only be sufficient to depress the piston very slowly. If too great force be employed, extravasation will be produced before the capillaries are half filled. Gentle and very gradually increased pressure, kept up for a considerable time, will cause the minute vessels to become slowly distended without giving way to any great extent. At the same time it must be borne in mind that extravasation frequently occurs at various points in a successful injection; but the longer this event can be kept off, the more likely are we to succeed.

In order to examine the structure of many tissues, it is necessary to obtain a section sufficiently thin to permit the transmission of the light readily, and so evenly cut, that the minute structure of the tissue may be submitted to examination in every part of the section. The difficulty of making thin sections of many textures is often very great, and, to effect this object satisfactorily, a knowledge of certain mechanical operations becomes necessary. Sometimes we require to cut a thin section of a soft pulpy texture, which can scarcely be touched without injuring its delicate structure, and altering the position of its constituents; while, in other instances, we must obtain a very thin transparent section of a substance so hard that steel tools will scarcely scratch it, such as the enamel of teeth, fossil teeth, &c.

Previous to the examination of a tissue, boiling is frequently of service.

For instance, the fibres of which the crystalline lens is composed are best shown after boiling the lens in water. The branched muscular fibres in the tongue of the frog, and in other situations may be made out very readily by boiling the organ in water for a few moments, and then tearing up small portions with fine needles. Beautiful sections of muscular fibre can often be obtained after the texture has been boiled in water. Various glands and other textures often require to be boiled some time in water, in order to harden them sufficiently to enable us to cut thin sections; but in all cases the microscopical characters of the recent texture should be examined, as well as that which has been hardened by boiling. Small portions of tissue can be readily boiled in a test-tube over the spirit-lamp.

Not unfrequently we wish to get rid of the soft and more pulpy part of a tissue, in order to subject the more dense and fibrous portion to examination. This object is usually effected by soaking the tissue in water for some little time, and then placing it under a running stream of water, by which means the softer portions are gradually washed away. Soaking in water frequently enables us to tear up a tissue very readily with the aid of needles, and thus to demonstrate its structure. Occasionally it is found necessary to press the tissue, and rub parts of it together, before the soft pulpy portions can be got rid of. In this way we may demonstrate the supporting or trabecular tissue of the spleen, and the areolar and vascular tissue of the liver, &c. Thin sections of kidney, liver, and other glandular organs, may be thus treated when the matrix is to be subjected to examination separately.

Thin sections of various tissues can frequently be obtained only by first drying the substance thoroughly, and then cutting off a thin shaving with a sharp knife. In this way specimens of skin, mucous membrane, and many other tissues, are often most advantageously prepared. The tissue is stretched on a board with pins and then allowed to dry, when a very thin section can be cut off and examined in Canada balsam; or it may be placed in water for a short time, in which case, when subject to examination, it will often be found to have regained its first appearance. Portions of muscular fibre, the tongue, skin, and many other tissues, may be allowed to dry in this manner, and then we may with a sharp knife readily obtain exceedingly thin sections, which could not be procured in any other manner. The drying may be effected in a warm room, or in a current of air. A high degree of artificial heat should be avoided.

When the inorganic portion of a tissue which we wish to examine is not altered by exposure to a red-heat, recourse may be had to ignition, in order to get rid of the animal matter. In this way crystals of carbonate and phosphate of lime, and granules of siliceous matter, may be separated from the organic material with which they were combined. The beautiful siliceous shells of the *Diatomaceæ* may be separated from organic matter by a similar process. The ignition should be performed in a small platinum capsule, or upon a small piece of platinum foil. The carbonaceous residue must be exposed to the dull red-heat of a spirit-lamp for some time, until only a pure white ash remains, which will be found to contain the objects of our search in a very perfect state. If the siliceous matter only is wanted, the ash should be treated with strong nitric acid, which will dissolve any carbonate or phosphate. The insoluble residue may then be washed and dried, and subjected to microscopic examination while immersed in turpentine or Canada balsam. In many cases this method is superior to that of boiling in nitric acid in order to remove the organic matter. Both processes may however be employed where only the siliceous residue is wanted, but if we require the salts of lime ignition at a dull red-heat is alone applicable.

In order to subject a portion of tissue or other substance to examination by transmitted light, the following plan is adopted:—One of the glass slides is carefully cleaned, and the thin section of tissue which has been removed by the aid of forceps and scissors, or a scalpel, placed in the centre; a drop of clean water is then added, and the whole covered with a square of thin glass, also perfectly clean. If the under surface of the thin glass be gently breathed upon it becomes wetted more easily. The substance may be unravelled with needles, or, if necessary, any other operation performed before covering it with the thin glass. If the substance be covered with too much soft pulpy matter, it may be slightly washed in water before being placed upon the slide, or a jet of water from the wash-bottle may be forced upon it. Thin sections will require to be laid flat upon the slide, with the assistance of needles and forceps.

Hard tissues require a different treatment. Here the great object is to make sections thin enough for the object to be seen by transmitted light.

Many hard substances, such as nail, horn, and dried animal textures, may be cut with a strong sharp knife, or with a razor; an operation which is easily performed by placing the substance upon a piece of soft deal board, and, after cutting a smooth edge, removing a thin shaving, which may be examined dry or in fluid, or may be placed in Canada balsam, as occasion may require.

Such substances as bone, ivory, and fossilised rocks, should be first cut into very thin sections with the aid of a sharp saw. These sections should then be pared down to the necessary fineness upon a hone or smooth stone. This may be effected in the following manner :—The section, after having been cut off with the saw, requires to be ground thin before it can be subjected to examination. It may perhaps be as much as the tenth of an inch in thickness when the grinding is commenced, but by rubbing it for a short time upon a smooth stone it may be reduced to the proper degree of tenuity. Stones which are well adapted for this purpose are the 'Charley Forest' stones, the Turkey stones, or the Water of Ayr stones, about an inch or more in width, and six inches in length. Each of the four sides should be perfectly smooth. Other stones, or even a piece of slate, answer also very well, and may be procured at much less cost. The stone is wetted with a little water, and the section rubbed up and down with the finger, or with a piece of cork or leather.

A very good plan also is to imbed the section slightly in a piece of warm gutta percha, which should extend only a very short distance beyond the edges. This is to be rubbed up and down on the wet hone, water being added as required, till the surface is perfectly smooth, when the section is to be taken off, turned round, and ground down on the opposite side until it is sufficiently thin. The section may also be ground down expeditiously by rubbing it between two hones. If very thick, it will be better to reduce it somewhat with the aid of a flat file before commencing the grinding. After being ground to what is considered the proper thinness, the section may be placed in the microscope, when numerous dark lines will be found all over the surfaces; these must be removed by polishing. The deepest of the scratches may be obliterated by rubbing the specimen upon a very smooth part of the hone quite dry.

Teeth require a little more attention than other hard substances. They should be first ground down upon a lapidary's wheel or upon a dentist's emery wheel. Sections can also be readily cut with a diamond saw (an iron-wheel, the edge of which is covered with diamond dust).

The thin section is now to be soaked for a short time in ether to remove the fatty matter, and then allowed to dry.

It is to be subjected to examination in the dry way, moistened with water, turpentine, or Canada balsam, and the different appearances in each case should be carefully observed.

The cartilaginous basis is to be examined also in thin sections, which may be cut either before macerating in acid, or subsequently. A whole tooth placed in moderately strong acid will become soft in four or five days, when thin sections of different parts may readily be cut with a sharp knife.

The dentinal tubes may be isolated from each other by longer maceration in acid, and afterwards by soaking for a few hours in dilute caustic soda or potash. It is better in this investigation to cut the thin section before maceration in acid, or to macerate the tooth until moderately soft, and then remove a thin section, which is to be further exposed to the action of the strong acid. A mixture of sulphuric and hydrochloric acids has also been recommended.

The examination of fluids does not require so much art as that of solid matters. Where it is wished to examine the whole of the contents of a fluid, all that is necessary is to place a drop upon a glass slide and to cover it with a piece of thin glass. It frequently happens however that it is the matter suspended in a fluid that it is desirable to examine. Under these circumstances the fluid should be placed in an ordinary test-tube, and after allowing the deposit to settle, the supernatant liquor should be poured off, and a drop of the deposit conveyed to the glass-slide. In other cases a pipette may be made use of to draw up the deposit from the bottom of the test-tube or other vessel in which it may be held. In examining water for living animalcules a small muslin-bag or net may be employed, through which the water may be poured, and the contents of the bag placed on the slide. In this way the *Desmidieæ* and some of the larger forms of *Infusoria* are best procured for examination.

When the quantity of deposit is very small, the following plan will be found of practical utility. After allowing the lower part of the fluid which has been standing to flow into the pipette as above described, and removing it in the usual manner, the finger is applied to the orifice, in order to prevent the escape of fluid when the upper orifice is opened by the removal of the finger. The upper opening is then carefully closed with a piece of cork. Upon now removing the finger from the lower orifice, the fluid will not run out. A glass slide is placed under the pipette, which is allowed to rest upon it for a short time. It may be suspended with a piece of string, or supported by a small retort-stand. Any traces of deposit will subside to the lower part of the fluid, and must of necessity be collected in a small drop upon the glass slide, which may be removed and examined in the usual way.

Another plan is to place the fluid with the deposit removed by the pipette in a narrow tube, closed at one end, the bore of which is rather less than a quarter of an inch in diameter. This may be inverted on a glass slide, and kept in this position with a broad elastic India-rubber band. The deposit, with a drop or two of fluid, will fall upon the slide, but the escape of a further quantity is prevented by the nature of the arrangement.

Amongst the fluids of the human body which may with advantage be submitted to examination with the microscope, there is none of more importance than the urine. This fluid being the great means which nature employs to rid the system of the used-up and effete matter of the body, becomes an index by which the completeness, redundancy, or inefficiency of this function may be examined. The following hints for the examination of this fluid will be found useful.

The urine which is to be examined should be collected in sufficient quantity, in order to obtain sufficient of the deposit for examination.

In all cases the urine should, if possible, be examined within a few hours after its secretion, and, in many instances, it is important to institute a second examination after it has been allowed to stand for 24 hours. Some specimens of urine pass into decomposition within a very short time after they have escaped from the bladder; or the urine may even be drawn from the bladder actually decomposed.

In other instances, the urine does not appear to undergo decomposition for a considerable period, and may be found clear, and without any deposit a day or two, or even longer, after it has been passed.

In those cases in which lithic acid or oxalate of lime are present, we shall find that the deposit increases in quantity after the urine has stood some time. The latter salt is frequently not discoverable in urine immediately after it is passed, but makes its appearance in the course of a few hours; depending upon a kind of acid fermentation, which has been the subject of some beautiful investigations by Scherer.

In order to obtain sufficient of the deposit from a specimen of urine for microscopical examination, we must place a certain quantity of the fluid in a conical glass, in which it must be permitted to remain for a sufficient time to allow the deposit to subside into the lower part.

Urinary deposits often require to be examined with different magnifying powers, those which are most frequently used being the inch and the quarter of an inch. Large crystals of lithic acid are often readily distinguished by the former, but crystals of this substance are sometimes so minute that it is absolutely necessary to use high powers. Octohedra of oxalate of lime are frequently found so small that they cannot be seen with any power lower than a quarter; and, in order to bring out the form of the crystals, higher magnifying powers than this are sometimes necessary. *Spermatozoa* may be seen with a quarter, but they then appear very minute. In these cases, an eighth of an inch object-glass will be of advantage. The casts of the tubes, epithelium, and the great majority of urinary deposits can, however, be very satisfactorily demonstrated with a quarter of an inch object-glass.

In the investigation of those deposits which are prone to assume very various and widely-different forms, such as lithic acid, it will sometimes be found necessary to apply some simple chemical tests, before the nature of the substance under examination can be positively ascertained.

The urine is very liable to the introduction of foreign substances. A paper on this subject by Dr. Beale will be found in the first volume of the 'Quarterly Journal of Microscopical Science.' The following is a list of these substances occasionally found by Dr. Beale :—

- Fragments of human hair.
- Cat's hair.
- Hair from blankets.
- Portions of feathers.
- Fibres of worsted of various colours.
- Fibres of cotton of various colours.
- Fibres of flax.
- Potato starch.
- Rice starch.
- Wheat starch, bread-crumbs.
- Fragments of tea-leaves, or separated spiral vessels and cellular tissue.
- Fibres of coniferous or other wood swept off the floor.
- Particles of sand.
- Oily matter—in distinct globules arising from the use of an oiled catheter, or from the accidental presence of milk or butter.

Besides the above, there are many other substances, met with less frequently, as, for instance, fragments of silk, mustard, flour, cheese, small fragments of the skin of potato, or of different kinds of fruit, and many others which will occur to the mind of every one. With the microscopical characters of these bodies the student should be perfectly familiar as soon as possible; and, as they may be obtained without the slightest difficulty, this is easily effected.

For the nature of the deposits found in the urine, see the article URINE.

The examination of the other fluids of the animal body present little difficulty. Next to the urine the blood is of most importance. In order to examine the blood, a small drop is placed upon a glass slide, and covered with thin glass, which is to be pressed down until a very thin, transparent, and almost colourless stratum only remains. If in this manner the individual globules cannot be seen distinctly, a little syrup or serum must be added; but it is better to avoid the addition of any fluid, if possible. Upon carefully focussing, the red globules will appear to present a dark centre and light circumference, or the reverse, according as the focus is altered, and here and there a white corpuscle may be observed. [BLOOD.]

If a little strong syrup be added to a drop of blood, the corpuscles will be found to have become flatter from exosmosis of a part of their contents; while, on the other hand, if placed in water, they become spherical from endosmosis, and ultimately burst. It is not difficult to make a solution of similar density to that in the interior of the corpuscle; and in this manner, as Dr. Rees expresses it, we may take the specific gravity of a blood-corpuscle, if we ascertain the specific gravity of the solution which has been added to the blood.

Acetic acid causes the membrane of the corpuscle to become more transparent and clear, and to swell up from endosmosis. After the application of this reagent the blood-corpuscle may be scarcely visible, but the membrane is not dissolved by it. Strong hydrochloric and nitric acids do not dissolve the globules; with the latter reagent the outline is often rendered darker and thicker, while the entire globule becomes smaller. The corpuscles are entirely soluble in ammonia and alkalies. They are rendered darker, and the walls corrugated, by the acid of the gastric juice, and after remaining in acid urine for some time a similar change occurs; hence the black colour of blood which has been effused into the stomach, and the dark smokey hue of acid urine containing blood.

We have before spoken of the crystals to be obtained from the blood. These crystals are very readily obtained by diluting blood with water. A drop of blood may be placed upon a glass slide, and after the addition of a drop of water, alcohol, or ether, the whole should be lightly covered with thin glass. A hair, or a small piece of thin paper or wood, may be placed between the glasses, in order that a stratum of fluid of sufficient thickness may be retained. Whenever it is possible, it is preferable to use defibrinated blood. Often the corpuscles and a little serum may be removed from the clot by firm pressure, and from this very perfect crystals may frequently be obtained. The blood-corpuscles become ruptured by endosmosis, their contents escape, and crystallise as the solution gradually becomes concentrated. The time which elapses before crystallisation takes place varies from an hour to several hours or days in different specimens of blood. Crystals may also be obtained in a similar manner from the coagulum of blood.

The form of the crystal often varies slightly in the same specimen, but the blood of different animals yields crystals of very different forms. The prismatic form is that most commonly obtained from the blood of man, the *Carnivora*, and fishes. Tetrahedral crystals appear most common in some of the *Rodentia*, as the guinea-pig, while six-sided tables are formed in the blood of the squirrel, mouse, and some others. Teichmann has succeeded in obtaining crystals from frog's blood by the addition of a very large quantity of water at a very low temperature.

The crystals form more readily in daylight than in the dark, but most rapidly when the slide is exposed in the light of the sun.

Guinea-pig's blood crystallises in the course of half an hour, or even sooner, if it be diluted with a little water or alcohol. Dog's blood also crystallises in the course of a short time upon the addition of a little alcohol. Human blood crystallises after the addition of water, slowly if only just removed from the body, but more quickly if the blood has been drawn a few hours.

It is obvious from what has been said above that the microscope is one of the most important instruments of research that has been placed in the hands of man. Its practical value has not however been yet fully recognised. It is employed by the medical man in the diagnosis of diseases, but in medico-legal investigations in the detection of adulterations in food, in ascertaining the value of fibrous materials in the arts, and in many departments of industry, it has yet to find its way. Dr. Beale gives the following instances of its utility as a means of diagnosis:—

"Diseases of the Kidney.—There is no class of diseases in which its powers have been more advantageously brought to bear by the practical physician than in those of the kidney. By a microscopical examination of the urine we are frequently enabled to ascertain the nature of certain morbid changes which are going on in the kidney, and even to distinguish during life the existence of certain well-defined pathological conditions of that organ. The laborious researches of Dr. Johnson have shown us how, by the peculiar character of the casts of the uriniferous tubes, which are found in the urine, we can ascertain whether the epithelium be desquamating, or, on the other hand, whether it presents no such tendency, but remains firmly attached to the basement membrane of the tube. If the epithelium be undergoing that peculiar change termed fatty degeneration, we shall often be able to ascertain the fact by examining a specimen of the deposit from the urine by the microscope. So again, by the presence of certain other deposits, and a knowledge of the symptoms usually associated with them, the physician is enabled to direct his attention, as the case may be, to the existence of local changes affecting some part of the genito-urinary mucous membrane, or to more general disturbance in the changes which take place in primary and secondary assimilation.

"Fatty Degeneration.—Of late years the remarkable changes which take place, and which have been described under the name of Fatty Degeneration, in some of the highly complex textures of the body, in consequence of which their properties become changed, and their functions impaired, or altogether destroyed, have been undergoing careful investigation by a vast number of highly-talented investigators.

"The recent discovery of a state of fatty degeneration affecting the arteries of the brain, in the majority of cases of apoplexy, by which the strength of their coats becomes deteriorated, and their elasticity entirely destroyed, would tend to lead us to infer that this disease is dependent rather upon complicated changes affecting nutrition, than upon the presence of a condition of plethora or hyperæmia, as was formerly supposed and acted upon.

"The connection between fatty degeneration of the margin of the cornea (arcus senilis), and similar changes taking place in the muscular tissue of the heart (a subject which has been carefully investigated by Mr. Canton), or in the cerebral vessels, must be regarded with great interest by every practitioner.

"The microscopical examination of the matters vomited in certain cases has proved to us that the presence of minute fungi, originally discovered by Professor Goodsir, and named by him *Sarcina Ventriculi*, occurs in connexion with certain morbid conditions of the stomach. These remarkable cases are much more frequently met with than was formerly supposed, and form an exceedingly interesting class of diseases. [ENTOPHYTA.]

"Tumours and Morbid Growths.—The microscope has many times afforded important aid in the diagnosis of tumours, although it has certainly failed in many instances; which circumstance has been brought forward by some, as an argument against its employment altogether. After careful microscopical examination, the best observers have failed in deciding as to the nature of a particular tumour submitted to examination; and they have been unable to pronounce as to its malignant or non-malignant character.

"On the other hand, not unfrequently this question has been positively and correctly answered in the affirmative or negative, and therefore it would surely not be right altogether to discard the use of an instrument which, although eminently useful in many instances, is not infallible; for it would appear to be the opinion of some, that the use of the microscope ought to be altogether abandoned in the diagnosis of tumours."

"For the discovery of Imposition the microscope is invaluable, as it almost necessarily follows that, in consequence of the frequency with which urine is subjected to minute investigation, patients often resort to various expedients to deceive the practitioner. Perhaps flour, starch, sand, and milk are more frequently employed for this purpose than any other substances. The microscope will obviously enable any one to detect the first three. If milk be added to urine, the mixture may very readily be mistaken for a specimen of the so-called chylous urine. Although a considerable quantity of fatty matter is present, in either case this fatty matter exists in a very different state. In milk we find the oil-globules, so characteristic of this fluid, while in true chylous urine not a single oil-globule can be found, although the specimen may contain a large quantity of fatty matter in a molecular state.

"Larvæ of the Blow-Fly in Urine.—A specimen of urine containing several bodies of about half an inch in length, and of a rounded form, was once sent to Dr. Todd for examination. The bodies in question looked not unlike the larvæ of some large fly, but, as it was confidently affirmed that they were passed by the urethra of a gentleman, the accuracy of this view of their nature was doubtful.

"Upon placing a portion of one of them under the microscope, tracheæ—(the air-vessels characteristic of the class of insects) were observed in considerable numbers; and this circumstance alone enabled me to say positively that they were not *Entozoa*, and that they could not have been passed in the manner stated. They were afterwards proved to be the larvæ of a fly.

The claws of *Echinococci* and portions of hydatid cysts have on several occasions been discovered in the urine, sputa, &c., upon submitting portions of these fluids to microscopical examination, proving beyond a doubt the existence of hydatids. [ENTOZOA.]

"Substances passed by the Bowels.—If the practitioner have a good knowledge of the use of the microscope, he can often ascertain the nature of substances passed from the alimentary canal; and by the aid of this instrument he can often at once decide as to the nature and origin of substances, which, to the unaided eye, only present most doubtful characters. Considerable perplexity has arisen from the presence of bodies in the stools of patients, which afterwards proved to be portions of almonds, gooseberry-skins, portions of potato, the testa of the tamarind, husks of wheat, &c.; not many years ago the uredo of wheat was mistaken for, and described as, a peculiar fungus, to which it was supposed the phenomena observed in cases of cholera were due.

"Portions of vessels which, unlike the other constituents of the food, have resisted the process of digestion, have been met with in the fæces, and mistaken for small intestinal worms, which they much resemble when examined by the unaided eye. Upon being subjected to microscopical examination their true nature was readily discovered.

"In Medico-Legal Inquiries the microscope has often afforded valuable aid. The distinction between blood-spots and red stains produced by fluids resembling blood in colour—between human hair and that of animals—and the detection of spermatozoa in cases of rape, need only be adduced as examples of the importance of the microscope in such investigations.

"For Detecting Impurities in Food and Drugs the microscope has afforded important aid, and there are several other purposes to which it may be applied."

In preparing this article we have been greatly indebted to Dr. Beale's most useful work on the 'Microscope, and its Application to Clinical Medicine,' also to the translation of Dr. Schacht's work on the 'Microscope in its special Application to Vegetable Anatomy and Physiology,' translated by Mr. Currey, and to Professor Quekett's admirable 'Treatise on the Microscope.' For those who would wish to refer to the subject further we give a list of the principal works devoted to this instrument:—Robert Hooke, 'Micrographia, 1667. Leeuwenhoek, 'Papers in Philosophical Transactions,' from 1673. Baker, 'Employment for the Microscope,' 1744. Adams, 'Micrographia Illustrated; or, the Knowledge of the Microscope Explained,' 1746. Adams, jun. 'Microscopical Essays, 1787. Pritchard, 'Microscopic Cabinet.' Chevalier, 'Des Microscopes et de leur Usage.' Sir David Brewster, 'Treatise on the Microscope.' Joseph Jackson Lister, 'Philosophical Transactions,' 1829. Ross, article 'Microscope,' in 'Penny Cyclopædia,' 1839, Carpenter, article 'Microscope,' in 'Cyclopædia of Anatomy and Physiology.' Mandl, 'Traite Pratique du Microscope,' 1839. Schleiden, 'Principles of Scientific Botany,' translated by Dr. Lankester, appendix 'On the Use of the Microscope,' 1849. Robin, 'Dn Microscope et des Injections.' Hannover, 'On the Microscope,' translated by Professor Goodsir, 1853. Benuett, 'An Introduction to Clinical Medicine,' 1853. Hogg, 'The Microscope, its History, Construction, and Application,' 1854. 'The Microscopical Journal.' 'Quarterly Journal of Microscopical Sciences.' Griffith and Henfrey, 'The Micrographical Dictionary,' 1854-55.

MICROSPORON. [ENTOPHYTA.]

MICRO'TUS, Schrank's name for a genus of Murine Rodents, embracing our English Water-Rat, *Mus amphibius*, Linnæus, &c. [MURIDÆ.]

MICROZOA'RIA (literally 'little animals'). This is the title employed by M. De Blainville for the *Animalcula infusoria* of earlier writers, who commonly classed these singular objects of microscopic research among the *Zoophyta*. Baker, Needham, Buffon, and Spallanzani, occnpied with the singular facts and hypotheses regarding the origin and vitality of these animated points, gave little attention to their zoological relations; the works of Linnæus contain almost no notice of more than the larger *Vorticellæ*, *Brachioni*, and *Volvoces*, which are ranked among the *Vermes Zoophyta*. The great founder of all the classifications of the minute *Infusoria*, the first careful observer of their permanent characters of form, surface, movements, and internal structure, is the accurate O. F. Müller, author of the 'Zoologia Danica.' Considering that in 1786 (the date of his work) the microscope had been scarcely at all improved since the days of Hooke, the numerous figures which Müller presented were highly creditable to his eye and hand. They have been frequently copied (as in the 'Encyclopédie Méthodique'), and yet retain a high value.

Müller's classification, founded upon the figure and surface of the animal, is convenient to the observer who desires to name the active molecules which pass under his microscope, but unsatisfactory to the zoological student.

The genera are arranged in some degree according to their apparent simplicity.

A. Without external organs.

* Substance thick.

Monas. A mere point.
Proteus. Of variable figure.
Volvox. Spherical.
Enchelis. Cylindrical.
Vibrio. Round, elongated. (Several of the animals included in this group should have beeu ranked among the Vermes.)

* Membranaceous.

Cyclidium. Oval, complanate. (Generate by division.)
Paramecium. Of an oblong figure. (Generate by division.)
Kolpoda. Sinuate, complanate. (Generate by division.)
Gonium. An angular mass.
Bursaria. Hollow like a purse.

B. With external organs.

* Naked.

Cercaria. With an extension like a tail. Some are said to have eyes.
Trichoda. Named for its hairiness. (Generate by division.)
Kerona. With little horny protuberances.
Himantopus. With slender extensions or cirri.
Leucophra. Ciliated over all the surface. (Generate by division.)
Vorticella. Ciliated about the mouth, contractile. The ciliæ have a whirling motion.

** Covered with a shell.

Brachionus. Ciliated nearly as *Vorticella*.

On this classification Lamarck ('Animaux sans Vertèbres') has made few alterations; he preserves the same genera nearly in the same order in all the naked *Infusoria*, but rejects from those with external organs (Infusoires appendiculés) *Vorticella* and *Brachionus* (which he places among his *Polypi*), and re-arranges the others thus:—

Infusoires appendiculés.

No tail { *Trichoda* (including *Leucophra* of Müller).
Kerona (including *Himantopus* of Müller).
A tail { *Cercaria.*
Furcocercaria.

The remaining groups are thus classed among the *Polypi*:—

Polypi ciliati.

Section 1. Vibratiles with oral ciliæ, having vibratory movement.
Rattulus. (*Trichoda Rattus* and *T. clavus* of Müller.)
Trichocerca. (*Cercaria forcipata*, &c., Müller.)
Vaginicola. (*Trichoda inquilina*, &c., Müller.)

Section 2. *Rotiferæ*, with oval ciliæ having rotatory movement.
Folliculina. (*Vorticella ampulla*, *V. vaginata*, &c., Müller.)
Brachionus. (Divided into sections, with or without a tail.)
Furcularia. (Includes the *Vorticella rotatoria*, or wheel-animal and others allied to it.)
Urceolaria. (*Vorticella viridis*, *Bursaria*, &c., Müller.)
Vorticella. (The pedunculated species of Müller, both simple and compound.)
Tubicolaria.

Cuvier constitutes for the *Infusoria* his fifth and last class of *Zoophyta*, observing however, what always struck the least informed zoologist, who contemplated the various forms and habits of these animals, that among them were several grades of organisation, and some forms which could not be reconciled to zoophytic structure. Bory de St. Vincent had adopted ('Encyclopédie Méthodique,' 1826) 82 genera, but Cuvier even reduces the number of Lamarckian genera.

De Blainville ('Actinologie') gives the following arrangement of the *Microzoaria*:—

Division I. *Microzoaria heteropoda.*

Section 1. *Rotiferæ.*—Body distinguished in parts anterior, medial, posterior (sometimes really showing head, thorax, and abdomen), with anterior bundles of ciliæ, which in their rapid movement resemble wheels. Posterior appendices simple, terminal.

The genera are as in Lamarck, with indications of the sub-genera adopted by Bory de St. Vincent.

Section 2. *Ciliiferæ*, with lateral ciliform appendices. The geuera are taken from Müller, namely, *Kerona*, *Himantopus*, *Paramæcium*, *Trichoda*, *Leucophra*, *Volvox*, *Cyclidium*, *Monas*, with indications of the sub-divisions adopted by Bory de St. Vincent, &c.

Division II. *Microzoaria apoda.*

With no external appendices, including *Bursaria*, *Kolpoda*, *Trachelina* (*Vibrio*, Müller), *Proteus*, *Cercaria*, *Enchelis*, and *Gonium*. Many of them are thought by De Blainville to be young *Planariæ* or *Hirudines*.

Nearly all the real information which accompanied these slight transformations of Müller's system of classification was derived from the numerous and acute observations of that eminent naturalist, whoso figures and descriptions we have often compared with tho indications of the microscope before this instrument received the marvellous improvements of Amici, Chevalier, Pritchard, Plösl, and Schiek. By their inventions, and the able use made of them since 1828, a new mine of knowledge has been opened on the history, structure, and zoological relations of the *Infusoria*. [INFUSORIA; DIATOMACEÆ; DESMIDIEÆ; ROTIFERA.]

MIDAS, M. Geoffroy's name for a sub-genus of the small South American Monkeys called *Ouistitis*. [JACCHUS.] The common name for the species of this sub-genus is Tamariu.

It has the following characters:—Muzzle short, facial angle 60°; forehead with an appearance of prominence, arising from the great angle of the upper edge of the orbits; upper incisors contiguous, under iucisors same size as the upper. Nails like claws, excepting those on the thumbs behind. Tail as in *Jacchus*. General dental formula as in *Jacchus*.

There are seven species, of which we select as the example *M. Rosalia*, the Marakiua, or Silky Tamarin. This pretty littlo monkey is entirely of a golden-yellow, varying to a redder tint, aud palest on the back and thighs. The hair, which is fine and silky, is so long about the head and neck as to form a ruff or mane, whence it has been called the Lion-Monkey. Its beauty and gentleness render it a very interesting pet; but great care is required to keep it from damp, which is destructive to it. It is supposed to live almost entirely on trees, and to be squirrel-like in its habits.

It is a native of Guayana, and the south of Brazil from Rio Janeiro to Cape Frio.

Desmarest notices a red and black variety (Guyana), and oue of a bright shining red from Brazil.

The species must not be confounded with *M. Leonina*, *Simia Leonina* (Humb.), the Leoncito, or Leonine Tamarin, which is probably the smallest monkey known. The last is brownish, and has a very well developed mane of that colour, which it bristles up when angry, so as to look like a little lion. The face is black, tho mouth white, and the tall black above and white below. It inhabits the plains bordering the eastern slope of the Cordillera, and is rare.

Silky Tamarin (*Midas Rosalia*).

MIDAS'S EAR. [AURICULA.]

MIDDLETONITE, a Carbonaceous Mineral, occurring in rounded masses, seldom larger than a pea, or in layers a sixteenth of an inch or less in thickness, between layers of coal. Colour reddish-brown by reflected light, and deep red by transmitted light. Powder light brown. Transparent in small fragments. Hard and brittle. Lustre resinous. No taste or smell. Blackens on exposure. Specific gravity 1·6. Found about the middle of the main coal or Haigh Moor seam at the Middleton collieries, near Leeds; also at Newcastle. The following is an analysis by Johnston:—

Carbon	86·437	
Hydrogen	8·007	
Oxygen	5·566	
		100

MIKA'NIA, a genus of Plants belonging to the natural order *Compositæ*, to the sub-order *Tubuliflora*, to the tribe *Eupatoriaceæ*, and the subtribe *Adenostyleæ*. It has a 4-flowered head, a naked narrow receptacle, four involucral leaves, with a bractlet added at the base or below it; the tube of the corolla short, with the throat dilate and somewhat campanulate; the anthers somewhat protruded; the achenium angular; the pappus in one row, rough and hairy.

M. officinalis has an erect, smooth, nearly simple stem, with leaves decussating somewhat triangular-ovate, cordate with a great sinus, toothed at the sides, entire towards the point, drooping; the panicles corymbose and terminal. This plant is a native of Brazil, where it is called Coraçoa de Jesu. It is a handsome plant. The leaves contain a bitter principle and an aromatic oil, and are used in the same way and for the same diseases as the Cascarilla and Cinchona barks. They are said to be an especially valuable remedy in remitting fevers and in atonic dyspepsia. They are administered in the form of extract or decoction.

M. Guaco, Guaco Plant, has an herbaceous twining stem; the branches round, sulcate, hairy; the leaves stalked, ovate, somewhat acuminate, shortly narrowed at the base, remotely toothed, netted, roughish above, hairy beneath; the corymbs axillary, stalked, opposite; the heads somewhat ternate, sessile; the bractlets linear, shorter than the involucre; the involucral scales linear-oblong, obtuse, downy; the achenia smooth. This is one of the plants called Guaco in South America, and is used both internally and externally as a remedy against the bites of poisonous serpents. This plant is cultivated by the Indians for the purpose of being used. It is easily known from other plants by the large indigo-blue spots that mark the under surface of its rough leaves. It is probable that the spotted character of the leaves of this and plants similarly employed, as the *Calladium helleborifolium* and a species of *Aristolochia*, have led to their use in the bites of poisonous snakes. "The mode of using this remedy," says Pöppig, "is very simple: the wound is somewhat distended, and the fresh-pressed juice is dropped into it; the surrounding parts being repeatedly covered with the pressed leaves; and the juice is also taken by the mouth. The tincture, made with common brandy, is also much celebrated, and recommended to travellers as a secure and portable means of cure. In Guayaquil little cakes are formed out of the fresh-bruised plants, which, when dried in the sun, retain their activity a long time. The effect of the Guaco is not in all cases alike quick and decided; but observations, both in Maranon and Ega, prove that after 24 hours' use the swelling had ceased, the pain vanished, and, with the exception of little ulcers, the cure had been effected. In Yurimaguas, and especially about Muniches, every year several persons are bitten by snakes; but the Guaco had acted so efficiently that in the memory of man only two children were known to have died of such wounds." Although Pöppig has given so favourable an account of this remedy, he says in another place that "the excision and cauterisation of the wound immediately after it is received is undoubtedly the safest plan." Besides the Guaco there are several other plants used in South America, some of which are called Guaco, as the *Herpestes colubrina*, *Dorstenia tubicina*, *Aristolochia cynanchifolia*, &c. The Guaco has been tried in this country as a remedy in hydrophobia, but without success. The Urali, or snake-poison of the Indians of British Guiana, is a compound, and contains in it strychnia. [STRYCHNOS.]

M. opifera is a smooth climbing plant, with an angular stem; it has stalked, cordate, acuminate, repand-toothed or nearly entire leaves, when full grown rather blunt; the heads stalked in corymbose panicles; the involucral scales oblong, rather acute; the bractlets lanceolate; involucre rather shorter. This plant is a native of Brazil, where it is called 'Erva da Cobia.' It is also employed against the bites of snakes, and is said to effect a cure by its powerful diuretic action. An account is given of this plant by Gomez in the Memoirs of the Royal Academy of Lisbon for 1812, where it is described as the *Eupatorium crenatum*.

The genus *Mikania* is closely allied to *Eupatorium*, and they belong to a group of plants in the order *Compositæ*, the most remarkable for their activity. Dr. Lindley states, in his 'Vegetable Kingdom,' that the famous styptic 'Matico' is the produce of *Eupatorium glutinosum*, and not of *Artanthe elongata*, as has been usually supposed. Of this plant Mr. Hartweg says, in a communication to Dr. Lindley, "Matico is the vernacular name applied by the inhabitants of Quito to *Eupatorium glutinosum*, or the *Chussalonga* in the Quichua language. It forms a shrub from 3 to 5 feet high, and is common in the higher parts of the Quitinian Andes, where its properties were discovered some years back by a soldier called Mateo, better known under his nick-name Matico (little Matthew), who when wounded in action applied accidentally the leaves of some shrub to his wound, which had the immediate effect of stopping the bleeding. This shrub happened to be the *Chussalonga*, which has since been called, in honour of its discoverer, Matico. That it is the true Matico of the inhabitants of Quito and Riobomba I have not the slightest doubt; both leaves and specimens have been gathered by myself, and upon comparing the latter with Kunth's description I found them to agree exactly with his *Eupatorium glutinosum*." The Matico has been used in Europe, and is said to be an exceedingly efficient styptic, and of great value in stopping the bleeding from small wounds.

(Pöppig, *Reise in Chile, Peru*, &c.; Lindley, *Vegetable Kingdom;* Lindley, *Flora Medica*.)

MILDEW is a disease which attacks both living and dead vegetable matter, and is believed by the vulgar to be owing to fogs, dew, meteors, and noxious exhalations, but in reality is caused by the ravages of parasitical *Fungi*. This malady is often of little importance to the subjects of its attack, as it appears towards the close of the year, when the most essential of the vital functions of plants are fulfilled, or in such a small degree as to produce no appreciable effect upon the general health of the plants infested. But it very often becomes a most serious evil, destroying the straw of corn, and so preventing the maturation of the grain, ravaging the fields of peas and beans, destroying the hopes of the gardener by seizing upon his peaches and nectarines, especially when forced, and not unfrequently extending its evil influence to the orchards and every description of kichen-garden crop.

The species of *Fungi* which produce these effects are always very minute, and often of microscopic smallness. Some are intestinal, attacking plants internally, and only becoming visible when they break through the surface of the plant for the purpose of shedding their spores; others are superficial, rooting and fructifying upon the outside of the epidermis. These two classes of Mildew-*Fungi* require to be carefully distinguished.

Of the Intestinal *Fungi* the following are the more common, namely:—

1. *Urido fœtida*, called the Pepper-Brand. This plant attacks wheat, filling the young seed with its jelly-like spawn, and producing myriads of fœtid deep-brown spores, which end by occupying the whole interior of the ripe grain.

2. *Erineum griseum*, and other species of the same genus, which overrun the leaves of the mountain ash, the sycamore, &c., forming broad-gray, orange, or brown blotches.

3. Various kinds of *Puccinia*. The mildew of wheat-straw is caused by *P. gramineum*, which is generated in cavities below the epidermis of the stem, and protrudes when ripe in the form of dull grayish-brown broken striæ. *P. Heraclei* occasionally attacks crops of celery and endive, spreading over the field, and producing the appearance of scorching.

4. *Æcidium cancellatum* occasionally does much harm to pear-trees

in the orchards of Herefordshire. It appears at first like bright yellow spots upon the upper surface of the leaves; by degrees a liquid matter is exuded from them; at the same time small conical processes appear in clusters from the under side of the leaf; these processes enlarge, become fibrous, open at the sides by numerous slits, and thence discharge their spores. This fungus often produces the most destructive consequences, appearing upon the leaves, stems, and fruits, and generally destroying the tree. Another species, *Æ. laceratum*, sometimes spreads over hawthorn hedges; and the common orange-red mildew of the Berberry is *Æ. Berberidis*.

5. *Sclerotium*, a hard kernel-like fungus, is a less common but sometimes very troublesome visitor. *S. compactum* occasionally establishes itself in the rind of fruits, rendering them uneatable; *S. Cyparissiæ* and others attack the leaves of various plants, particularly of the pear-tree.

In all these cases it is usually found that the most vigorous individuals are the first affected by the mildew, especially in the case of *Uredo* and *Puccinia*; and it is probable that the spores from which these plants are propagated are drawn into the circulation from the soil, along with the fluid matter on which plants feed; that they are carried along into the stem, and begin to grow as soon as they find themselves in a suitable situation, disturbing and disorganising the tissue by the production of their spawn, and taking to themselves that nutriment which would otherwise have been applied to the general maintenance of the plant attacked. Mr. Bauer found that he could always cause wheat to produce the *Uredo fœtida* by rubbing its grains with the spores of that fungus previous to their being sown; and Mr. Knight ascertained that by sowing pear-seeds in soil infested with the *Æcidium*, the very youngest leaves of the seedling plants were attacked.

Of superficial *Fungi* the following are the most remarkable:—

1. *Cylindrosporium concentricum*, a pulverulent species, which appears in dots arranged in a circular manner upon the leaves of the cabbage.

2. *Acrosporium monilioides*.—A frequent cause of the whiteness of leaves and stems in roses, &c. It consists of vast multitudes of filaments jointed like a necklace.

3. *Botrytis diffusa* and species of the genus *Aspergillus*, whose filaments bear tufts or branches, covered with spores. These form the white mealy appearance of the leaves of onions and similar soft-leaved plants.

4. *Erysiphe communis*, which forms the mildew of peas. It consists of white cobweb-like spawn, radiating from a solid gray spherical centre, filled with the spores of the species. Peach mildew is often caused by another of this genus, the *E. pannosa*.

The attacks of superficial *Fungi* are generally brought on by the debility of the species attacked; and it is probable that unhealthy individuals only are suited to the growth of these parasites. This is like what occurs among animals, which, when healthy, are scarcely attacked by parasitical vermin, but as soon as they become sickly are overrun by them. Heavy rains occurring suddenly after long drought are mentioned as a cause of this kind of mildew; and it may be supposed that the plants are debilitated by the dry weather, at which time the *Fungi* seize upon them, and that as soon as rain falls they grow with rapidity and quickly overrun the plants. It is said that deep-coloured roses and peaches are more liable to mildew than others; this may be referred to constitutional debility, for their colour is connected with a want of power to decompose carbonic acid, which is one of the most indispensable of vital functions in the vegetable kingdom. Transplanted onions, which are less vigorous than untransplanted ones, are the most subject to mildew.

These causes of mildew being rightly understood, the methods of preventing the evil are sufficiently obvious. To cure intestinal mildew the soil should be neither too rich nor too freely watered, and every precaution should be taken to prevent the spores of the mildew-plants from being communicated to the soil. Mr. Knight stopped the attacks of *Æcidium cancellatum* by taking up his mildewed pear-trees, washing their roots clean, pruning them closely, and removing them to a new situation; those removed became healthy, those left in the soil eventually perished. It would also appear that in some cases plants may be rendered incapable of taking the mildew. Mr. Bauer says that if corn attacked by pepper-brand is soaked in lime-water for at least twelve hours, and then well dried in the air before sowing, not only are all the *Fungi* adhering to it destroyed, but the plants themselves are incapable of nourishing the fungus; at least he found that prepared grains could not be inoculated, although unprepared grains could be. With regard to destroying superficial mildew, a restoration of vigour or its preservation seems to offer the best chances of success. Mr. Knight prevented his peas from mildewing by watering them abundantly and constantly; in Scotland, where the climate is more equable than in England, and the night dews more abundant, pea-mildew is unknown. The writer of this has seen a crop of onions perishing under the attacks of *Botrytis diffusa* gradually restored to health by a constant supply of water. As to the schemes of stopping superficial mildew by the application of sulphur, quick-lime, fresh wood-ashes, and similar substances, all of which have been recommended, it does not appear that any advantage follows their employment. When trees are attacked by superficial parasites the best plan of removing the evil is by cutting off all the mildewed branches and destroying them, together with shreds, nails, or whatever else may have been made use of in training the plants. Mr. Hayward recommends in addition that peach-trees, which are very liable to mildew, should be subsequently washed with a fluid consisting of 4 gallons of rain-water, 2lbs. of soft soap, 1lb. of flower of sulphur, 1lb. of roll tobacco, 1 quart of fresh-slaked lime, and 1 pint of spirits of turpentine, the whole boiled together for half an hour.

For a further account of the *Fungi* which produce diseases of plants see FUNGI.

MILIOBATIS. [SQUALIDÆ.]

MI'LIOLA. [FORAMINIFERA.]

MI'LIUM, a genus of Grasses belonging to the tribe *Agrostideæ*. It has membranous glumes, nearly equal, unarmed; the paleæ 2, nearly equal, unarmed, about as long as the glumes, and hardening on the the fruit; the spikelets convex on the back, or slightly dorsally compressed. There is but one British species of this genus, *M. effusum*. It has a diffuse panicle, with acute paleæ, a smooth stem, and linear-lanceolate leaves. It has a stem 3 or 4 feet in height, and is found in damp shady woods. (Babington, *Manual of British Botany*.)

MILK is an opaque fluid, secreted by the mammary glands of the females of the animals belonging to the class *Mammalia*, and adapted to the nourishment of their young offspring. It is of a specific gravity somewhat greater than that of distilled water, and possesses a peculiar odour, which is due to several acids. It consists, in addition to the watery portion, serum, &c., of globular particles, which are not more than half the size of the globules of human blood, having a diameter of about 1-10,000th of an inch. They are composed of a fatty matter (butter) and a coagulable substance, which in many points resembles albumen, termed 'caseum,' or 'caseine.'

The globules are specifically lighter than the fluid in which they are suspended, and easily ascend to the top when the milk is allowed to stand. This constitutes the cream, and consists of the butter, with some caseine and a portion of serum. By agitation, such as is effected by the various modes of churning, the fatty globules unite into a mass (butter), leaving the buttermilk, which consists of caseine and serum.

Milk from which the supernatant fluid, or cream, has been removed is termed 'skim-milk,' and still retains a considerable quantity of coagulable or caseous matter, which may be separated from the serum, or whey, by means of a rennet or any acid. This coagulated portion constitutes the curd, and is the basis of cheese. If a rennet be used, and all the portion coagulated by its means be separated, the addition of vinegar causes some of what remains to coagulate; and this has been termed 'zieger' by Schubler, but it is not certain that it differs from caseine. What remains after both these coagulated principles have been removed is the whey, which contains sugar-of-milk, some azotised substance (perhaps osmazome), lactic acid, and various salts.

The different constituents of milk, and the differences in the relative proportions of them in some of the common domestic animals will be best seen in the following tables:—

Milk	Cream	Butter	Fatty matter, solid at ordinary temperatures			*Stearine.*
			Liquid Fatty Matter	By saponification, yielding Butyric, Caproic, Capric, Margaric, and Oleic Acids, and Glycerine		*Butyrine.*
				By saponification, yielding no Butyric, Caproic, nor Capric Acids		*Oleine.*
		Buttermilk	Caseine.			
			Serum.			
	Skim-Milk	Matters which are coagulable	by Rennet			*Caseine* or *Curd.*
			not by Rennet, but by Acetic Acid			*Zieger.*
		Serum or Whey	Azotized Matter			*Osmazome* (?)
			Lactic Acid.			
			Sugar			*Sugar of Milk.*
			Salts	Soluble in Alcohol	Lactates of Potash, Soda, Ammonia, Lime, and Magnesia.	
				Soluble in Water, not in Alcohol	Chlorides of Potassium and Sodium.	
					Sulphate of Potash.	
					Phosphate of Potash and Soda.	
				Insoluble in Water	Phosphates of Lime, Magnesia, and Iron.	

Analyses of various kinds of Milk in 1000 *parts.*

	Water.	Fat.	Caseine.	Sugar of Milk.	Ash.
Woman (average). (Simon.)	883·6	25·3	34·3	48·2	2·3
Woman (maximum of numerous analyses) . .	914·0	54·0	45·2	62·4	2·7
Woman (minimum of ditto)	861·4	8·0	19·6	39·2	1·6
Woman, 14th day after delivery. (Clemm.) .	879·848	42·968	35·333	41·135	2·095
Woman. (L'Heritier.) .	867·8	42·5	11·7	74·0	4·0
Cow. (Simon.) . .	857·0	40·0	72·0	28·0	6·2
Ass. (Chevallier and Henri.)	916·3	1·1	18·2	60·8	3·4
Ass. (Peligot.) . .	904·7	12·9	19·5	62·9	
Goat. (Clemm.) . . .	868·0	33·2	40·2	52·8	5·8
Ewe. (Chevallier and Henri.)	856·2	42·0	45·0	50·0	6·8

As milk is the food of the young being amongst the *Mammalia* for a period of several months, it must contain all the elements necessary to the nutrition of the animal body. Dr. Prout therefore proposed to classify all food according to the constituents of milk :—

1. Aqueous foods, represented by water.
2. Albuminous foods, represented by the caseine.
3. Oleaginous foods, represented by the butter.
4. Saccharine foods, represented by the sugar.

The ashes also represent the inorganic constituents of the food of all animals. [FOOD.] The ashes in the milk of a cow examined by Haidlen contained in 1000 parts :—

		Per cent.
Phosphate of Lime	2·31 . .	47·1
Phosphate of Magnesia . . .	0·42 . .	8·6
Phosphate of Peroxide of Iron .	0·07 . .	1·4
Chloride of Potassium . . .	1·44 . .	29·4
Chloride of Sodium	0·24 . .	4·9
Soda	0·42 . .	8·6
	4·90	100·0

The characters of the milk in the mammary gland, and the mode of its secretion will be found under the article MAMMARY GLANDS.

Under the microscope fresh milk appears as a clear fluid in which fat-globules, the so-called milk-globules, are suspended as in an emulsion. These globules differ very considerably in size; the majority have a diameter of from 0·0012‴ to 0·0018‴, and although they are rarely found to measure 0·0038‴ in fresh milk, Henle states that he has found them to be 0·014‴, and according to Raspail and Donné, they are sometimes even 0·044‴. Although the milk-globules, without the addition of a re-agent, exhibit no trace of an investing membrane, its existence may readily be proved in two different ways. The first is the addition of acetic acid, which causes these globules to assume a variety of irregular forms which they would not if they were simply globules of fat. The second way is to add a little ether to milk, when it will be found that the ether will not dissolve up the milk-globules which it would were these simple globules of oily matter.

The milk immediately after delivery differs from milk that is drawn subsequently. It has received the name of colosteum. On examining colosteum under the microscope a very large number of fat-globules are seen, some of which are larger than those that occur in ordinary milk, and these are observed frequently clinging to each other; besides these there are granulated, yellow, roundish corpuscles, larger than the milk-globules, which appear to be composed of very minute fat-vesicles. Their diameter varies according to Henle from 0·0063‴ to 0·0232‴, but may be considered to be about 0·0111‴. The fat-granules of these bodies are more easily dissolved by ether than those of the milk-globules. Acetic acid and potash dissolve the granular combining substance, and scatter the fat-globules. From these facts it would appear that the colosteum-corpuscles are very small fat-globules imbedded in an albuminous substance. There is no appearance of a nucleus or an investing membrane. These molecules as a rule disappear the third or fourth day after delivery, although they have been found as late as the twentieth day. They frequently re-appear in the milk when any disease in the system supervenes. Although there can be no doubt that the nature of the food affects the composition of the milk, it has not yet been shown in what manner this affects the particular constituents of the milk; from experiments made on dogs it would appear that when fed on vegetable diet their milk was richer in butter and sugar, whilst the solid constituents are generally augmented on a mixed animal and vegetable diet. Fat food increases the quantity of butter. Playfair found the butter of cow's milk increased during stall-feeding, and diminished when the animals were kept out in the fields. Cows fed on hay that has been cut and collected in a dry summer yield a richer milk, than when fed on hay which has been cut in a wet season.

Ferrier found, from a series of experiments on a suckling woman, that the milk undergoes gradual changes during lactation. While the quantity of butter remained the same through the whole period, it was found that the caseine increased as the child became developed. The sugar of milk diminished and the salts increased during the same period.

Various instruments have been invented for testing the purity of milk, especially that of the cow. These instruments are called Galactoscopes, or Galactometers. [GALACTOMETER, in ARTS AND SC. DIV.]

MILK-THISTLE. [SILBYUM.]

MILK-WORT. [POLYGALA.]

MILLEFOIL. [ACHILLEA.]

MILLEPO'RIDÆ. In the Linnæan 'Systema Naturæ' the genus *Millepora* included fourteen species of solid corals perforated with conical non-lamelliferous pores. Several of these have been taken as types of new genera or sub-genera, and, according to the general practice of modern zoology, the Linnæan genus is transformed into a great family. Lamarck ('Animaux sans Vertèbres') places many of the Millepores in his fourth section of *Polyparia*, the foraminated corals, with *Catenipora* and *Tubipora*, which belong to other groups. The *Milleporidæ* form a distinct order in the Foraminated *Polypiaria* of Lamouroux ('Expos. Méthod.'), and include no less than eighteen genera, namely :—

Ovulites, Retepora, Lunulites, Orbulites, Ocellaria, Melobesia, Eudea, Alveolites, Theonea, Chrysaora, Millepora, Terebellaria, Spiropora, Idmonea. (*Distichopora, Hornera, Krusensterna,* and *Tilesia* are included among *Milleporidæ* in the table, but not in the body of the work.)

Lamouroux defines the *Milleporidæ* thus :—Polyparia, stony, polymorphous, solid, internally compact; cells very small or poriform, scattered or in series, never lamelliferous, though the parietes are sometimes lightly striated.

De Blainville collects the *Milleporidæ* into groups according to the form of the cells in the coral, and defines the family by characters drawn both from the animal and the stony support.

Animals in general very slender, and provided with a single circle of slender tentacula; cells sometimes of considerable size, but always without lamellæ or striæ within or without the tubes; polyparium fixed, varying in shape. Retrenching from the group the palmated kinds (to form the genus *Palmipora* among the *Madrephylliæa*), there remain, according to De Blainville, twenty-three genera, which are thus arranged :—

1. Cells polygonal, often rather large—*Favosites* (*Eunomia*), *Alveolites, Apsendesia, Theonea, Pelagia, Terebellaria, Polytrema, Frondipora, Lichenopora.*

2. Cells round, very fine, poriform, immersed—*Orbiculites, Marginopora, Stromatopora, Tilesia, Spinopora, Chrysaora, Ceriopora, Distichopora, Heteropora.*

3. Cells round, more or less tubular—*Pustulopora, Hornera, Idmonea, Cricopora.*

The following are the principal characters of these genera :—

§ 1. Cells Polygonal.

Favosites.—Animals unknown; cells prismatic, contiguous, vertical, or diverging, the parietes pierced with pores, the cavity divided by transverse septa; polyparium branched or massive, sometimes basaltiform.

It is a genus of Lamarck. Goldfuss added to the knowledge of its structure, but changed its name to *Calamopora*. De Blainville thinks *Eunomia* of Lamouroux may be included in it, but the descriptions are unlike. Ehrenberg places it near *Astræa*, in the family of *Madrephylliæa*, and we think with reason.

The *Favosites* are only known in a fossil state, and, we believe, only in strata of the Transition and Carboniferous eras, in the former of which they are specially abundant, in the Eifel, Siluria, at Dudley, &c.

F. Gothlandica (Goldfuss, tab. 26, f. 3) is a favourable example. (See figures on the next column.)

Eunomia.—Animals unknown; cells tubular, long, parallel, internally sulcated longitudinally, and transversely annulated; the parietes thick and solid. (Lamouroux, 'Expos. Méthod.')

The only species, *E. radiata*, is fossil in Oolitic series of Caen.

Alveolites.—Animals unknown; cells short, tubular, prismatic, alveoliform, the parietes thin; polyparium formed into reticulated layers, enveloping each other.

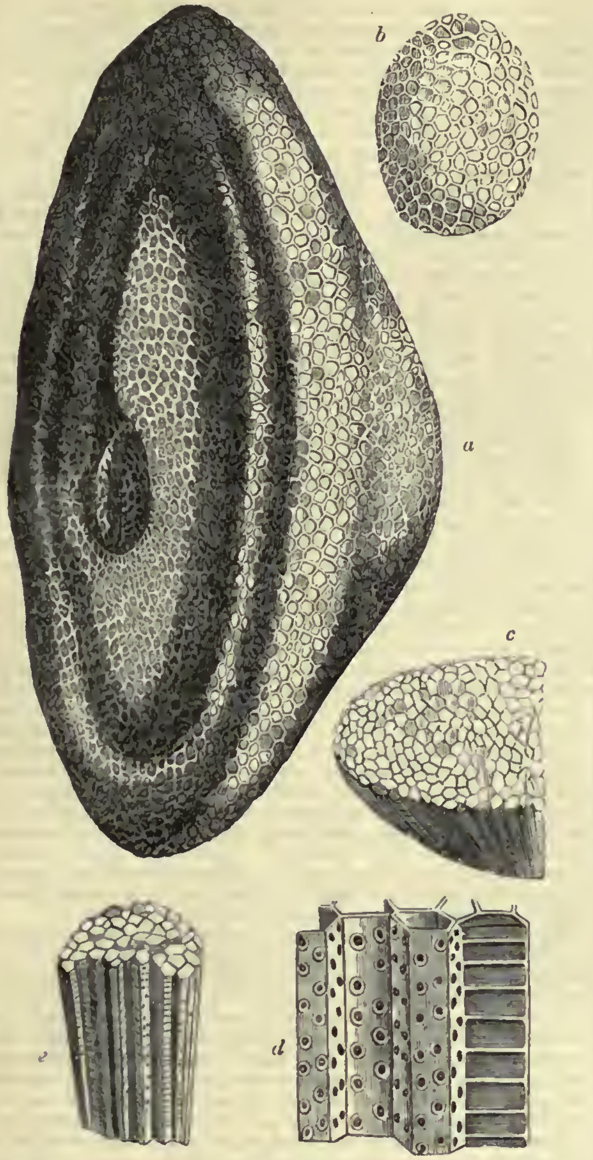
It is a genus of Lamarck, subsequently, but without sufficient reason, reunited by Goldfuss to *Favosites*, under the name of *Calamopora*.

Two living species and a few fossils, chiefly from the Tertiary series of Dax. De Blainville includes in the genus (not correctly) many of the *Calamopora* of Goldfuss which are to be ranked as *Favosites*.

Frondipora.—Animals unknown; cells unequal, subpolygonal, accumulated irregularly, prominent only on the external surface of a finely branched polyparium, which is fixed, arborescent, variously reticulated, and longitudinally striated on the non-celluliferous face.

One of the species is ranked as a *Retepora* by Lamarck. Lamouroux (following Tilesius) calls it *Krusensterna*. The species are recent in the seas of Kamtchatka and the Mediterranean. Ex. *F. reticulata.* (Blainv., pl. 69, f. 1.

Lichenopora.—Animals unknown; cells rather large, poriform or sub-tubular, sub-polygonal, accumulated and scattered on the interior surface of a fixed orbicular cupuliform polyparium, which is quite smooth externally.



Favosites Gothlandica.

a, *b*, two specimens; *c*, nuclei of the tubes; *d*, tubes magnified; *e*, portion of a vertical section.

It is a genus of Defrance, including one recent and three fossil species from the Cretaceous and Tertiary Strata. Ex. *L. turbinata.* (De Blainv., pl. 68, f. 4.)

Theonea.—Animals unknown; cells rather large and deep, sub-polygonal, accumulated irregularly, prominent on the tumid or angulated face of the polyparium, which is fixed, irregularly lobed, and more or less lacunose between the accumulations of pores. Ex. *T. clathrata.* (Lamouroux, pl. 80, f. 17.) From the Oolite of Caen.

Apsendesia.—Animals unknown; cells sub-polygonal, small, poriform, irregularly disposed, occupying the upper and external edge of sinuous ridges, smooth on one side, plaited on the other; polyparium globular or hemispherical, diverging from the base to the circumference. It is a genus of Lamouroux, from the Oolite of Caen. Ex. *A. dianthus.* (De Blainv., pl. 59, f. 2.)

Terebellaria.—Animals unknown; cells small, oval, sub-trigonal, quincuncially arranged on the surface of the polyparium, which is composed of short conical apparently twisted branches.

This beautiful coral, thus characterised, is found in the Oolite of Caen, and, it is believed, also abundantly near Bath. Perhaps only one species is known, which Lamouroux divides into two. Ex. *T. ramosissima.* (Lamour., pl. 82, f. 1, *a.*)

Pelagia.—Animals unknown; cells sub-polygonal, close, irregular, occupying the convex edge of numerous vertical ridges, disposed in a radiating form, and either simple or dichotomous on the upper surface of the coral; polyparium free, fungiform, excavated and lamelliferous above, convex, pedunculated, and circularly wrinkled below. Ex. *P. clypeata.* (Lamour., pl. 79, f. 5, 6, 7.) From the Oolite of Caen.

Polytrema.—Animals unknown; cells poriform, polygonal, irregular,

Terebellaria ramosissima.

unequal, numerous, occupying the knotty branches of a small fixed polyparium. It is a genus of Risso. Ex. *P. miniaceum.* (De Blainv., pl. 69. f. 4.)

§ 2. Cells rounded, poriform.

Orbitolites.—Animals unknown; polyparium a regular, orbicular, discoid, cellular, cretaceous mass; cells in two layers, sometimes apparent externally, and especially at the margin, which is thickened.

It is a genus of Lamarck, apparently founded upon an internal coral. One recent European species, and several fossils from the Chalk and Tertiaries of Europe, are mentioned. Ex. *O. complanata.* (De Blainv., pl. 72, fig. 2.)

Marginopora.—Animals unknown; cells poriform, excessively small, round, close, situated in the narrow tortuous folds of the circumference of the polyparium, which is free, irregular, discoid, thickened at the margin, and concentrically striated on both surfaces. (Probably an internal coralline plate.) Ex. *M. vertebralis.* (Blainv., pl. 69, f. 6.)

Stromatopora.—Animals unknown; polyparium hemispherical or sub-globose, formed of alternately solid and porous adherent superposed layers.

The character is from Goldfuss, the author of the genus. The cells are very small, the external surface concentrically wrinkled. The species are fossil in the Transition Limestone, &c., of the Eifel, Siluria, Dudley, &c. Mr. Lonsdale has described a new species similar to a Nummulite in figure. Ex. *S. concentrica.* (Goldfuss, 'Petrifacta Europæ,' tab. 8.)

Stromatopora concentrica.

a, surface reduced; *b*, vertical section reduced; *c*, portion highly magnified.

Ceriopora.—Animals unknown; cells poriform, round, close, irregularly distributed in concentric layers; polyparium polymorphous, often globular or lamellar.

This genus was established by Goldfuss, but is curtailed by a stricter definition by De Blainville, to suit fossils which appear in the Chalk of Maestricht and the Transition Rocks of Bamberg. Ex. *C. micropora.* (Goldfuss, tab. 10, f. 4.)

Chrysaora.—Animals unknown; cells poriform, very fine, with a round opening, accumulated on the intervals of ridges, which anastomose on the surface of the fixed irregularly ramose polyparium.

It is a genus of Lamouroux, to which De Blainville refers many of the *Cerioporæ* of Goldfuss, which belong to the Oolitic Formations. Ex. *C. spinosa.* (Lam., pl. 81, f. 6.)

Tilesia.—Animals unknown; the polyparium formed of tortuous verrucose cylindrical branches; cells small, accumulated in irregular patches, which project above the general surface, and are separated by smooth intervals. Ex. *T. distorta.* (Lam., pl. 74, f. 5, 6.) From the Oolite of Caen.

Spinopora.—Animals unknown; polyparium adherent by a concave concentrically striated face below; above reticulated, tuberculated, and bearing between the tubercles poriform cells. Fossil from the Chalk. Three species. Ex. *S. mitra.* (De Blain., pl. 70, f. 3.)

Distichopora.—Animals unknown; cells of two kinds; some stelliform, scattered, superficial, shallow; the others poriform, deep, unequal, forming three lateral rows on each side of the branches of an arborescent polyparium—these branches are compressed, obtuse, subflexuous, and tubulose within.

This Lamarckian genus contains the *Millepora violacea* of Linnæus. (De. Blainv., pl. 55, f. 2.)

Heteropora.—Animals unknown; cells round, poriform, completely immersed, of two sorts; some, larger than the others, are regularly dispersed on the whole surface of the polyparium, which is fixed, lobed, or branched, and formed of superposed laminæ.

It is a genus of De Blainville, formed to include certain *Cerioporæ* of Goldfuss which have two sorts of pores. Ex. *H. cryptopora.* (Goldfuss, tab. 10, f. 3.)

Heteropora cryptopora.

a, *b*, two specimens; *c*, pores magnified.

Fossil from the Chalk of Maestricht.

Mr. Lonsdale mentions one from the Silurian Rocks. (Murchison's 'Silurian System.')

§ 3. Cells round, and more or less tubular and prominent.

Pustulopora.—Animals unknown; cells rather prominent, pustulose or mammillated, distant, with round openings; polyparium formed of superposed laminæ, cylindrical, digitiform, or a little branched, fixed.

The few fossils which have these characters are separated from the *Cerioporæ* of Goldfuss by De Blainville. They are from the Chalk and Oolite. Ex. *P. madreporacea.* (Goldfuss, tab. 10, f. 12.)

Hornera.—Animals unknown; cells with a circular opening, prominent, detached, dispersed almost quincuncially on the inner face of the branches of a fragile ramulose polyparium, which is fistulose and furrowed on the non-polypiferous face.

It is a genus of Lamouroux, formed from *Retepora* of Lamarck. It includes several living species, from the seas of Europe and Australasia, and more fossils, chiefly from the Tertiary Strata, but Mr. Lonsdale notices one from the Dudley Limestone. Ex. *H. frondiculata.* (Lam., pl. 74, f. 7, 8, 9.)

Hornera frondiculata.

a, natural size; *b*, *c*, fragments of the upper and lower sides, magnified.

Idmonea.—Animals unknown; cells prominent, sub-conical, distinct, with a circular opening, arranged in half rings or short cross-lines, on two-thirds of the circumference of the branches of the polyparium, which is not porous, but slightly channelled on the non-celluliferous face; the branches are divergent and triquetral.

One living species belongs to this genus of Lamouroux, and several fossils from the Oolite of Caen, and Chalk and Tertiaries of Maestricht and Paris. Goldfuss has included two of them among *Reteporæ*. Ex. *I. triquetra.* (Lam., pl. 79.) From the Oolite of Caen.

Cricopora.—Animals unknown; cells tubular, rather prominent, with a circular opening, arranged in rings transversely or obliquely on the surface of a fragile polyparium, which branches into cylindrical parts obtuse at the extremity.

This genus was named *Spiropora* by Lamouroux, but it is only rarely that the cells take anything approaching to a spiral arrangement. The coral is alveolar through its mass. Some of the most characteristic species are fossils from Caen. *F. Faujasii* is from the Chalk of Maestricht, and De Blainville joins to the group two recent species, *Seriatopora annulata* and *S. nuda* (Lamarck). Ehrenberg calls the group *Myriazoon*, and Wiegmann *Truncularia*.

MILLER'S DOG. [SQUALIDÆ.]

MILLER'S-THUMB. [COTTUS.]

MILLET. [SORGHUM.]

MILLSTONE-GRIT is the title of a remarkable group of strata which belong to the Carboniferous System, and separate the Coal Formation from the Mountain Limestone. It may be regarded as one of the many instances of transition on a large scale, which reveal to the geologist local changes of level and position of the ancient lands, whereby new currents were occasioned in the sea, and new depositions produced in its bed. Instead of the deposits of mountain limestone generated by processes almost purely marine, we have in the Millstone-Grit group evidence of streams from the interior of elevated lands and periodical currents which spread pebbles, sand, and clay, with land-plants, over surfaces where previously corals and shells were accumulated in the quiet sea. The character of this group varies according to a certain law of development in passing from the south to the north of England. It is of little importance in the south-west of England, South Wales, or any of the midland coal-fields; but in Derbyshire it acquires great thickness, and appears in some of the most striking scenes of that romantic county. Here it is a series of thick arenaceous rocks, alternating with shales and flagstones below the coal and above the limestone. Perhaps no more remarkable feature in English geology can be noticed than the bold crags of millstone-grit which are crossed as the traveller proceeds from the coal of Sheffield to the limestone of Castleton.

Farther to the north, between the deep limestone dales of Yorkshire, the millstone-grit rocks appear on the summit of Ingleborough, Peughent, and Wharnside, mixed with shales, limestones, ironstones, and beds of coal. At least three distinct bands of coarse pebbly millstone-grit here occur, though not in one hill, and a similar character belongs to the series in Durham and Northumberland. Through all the extreme north of England indeed the millstone-grit group passes by its coal, ironstone, &c., to the coal formation above, and by its limestones and peculiar shales to the mountain limestone below, by so easy a gradation that the whole appears one vast series of associated deposits.

The rock from which the group is named the Millstone-Grit, is a very coarse-grained quartzose sandstone, with layers of pebbles, often defining the upper or under surfaces of beds, and sometimes (as near Keighley) containing remarkable masses of laminated mica, which is not common in the substance of the stone. The most coarse and quartzose parts of the stone have a vague resemblance to unmicaceous granites (as that of Ravenglass), and this is strengthened by the occasional abundance of felspar, in large masses crystallised within, but fragmented or worn to a pebbly aspect externally. This discloses probably the true history of the rock. It is a re-aggregated mass of the disintegrated materials of granite; and as almost every sandstone of the coal districts is liable to assume locally the coarseness of grain of the millstone-grit, and all appear to contain felspar grains and fragments (often decomposed to porcelain clay), the importance of a study of the Millstone-Grit becomes evident. The organic remains are a mixture of those belonging to the Coal Formation (Plants), and those of the subjacent Limestone (*Conchifera*, *Mollusca*).

MILVUS. [FALCONIDÆ.]

MIMOSA, a genus of Plants belonging to the natural order *Leguminosæ*. It has polygamous flowers; petals 4 or 5, connected together into a 4- or 5-cleft funnel-shaped corolla; stamens inserted in the base of the corolla, or in the stipe of the ovary, equal in number to the lobes of the corolla, or double or triple that number; legume compressed, flat, 1- or many-jointed; joints 1-seeded; ribs permanent; stipules petiolar; leaves bipinnate, with one or more pairs of pinnæ, each pinna bearing 2 or many pairs of leaflets; flowers rose-coloured or white, disposed in heads. The leaves are frequently sensible to touch, as in the Sensitive Plant. The species are very numerous.

M. sensitiva, the Sensitive Plant, has prickly stems and petioles; leaflets ovate-acute, dotted, with adpressed pili beneath, but glabrous above. It is a native of Brazil. The flowers are rose-coloured and tetrandrous. The leaflets are sensitive to touch, but not so much so as the following species.

M. pudica has a prickly herbaceous stem, with the petioles and peduncles more or less beset with stiff hairs or bristles; leaves somewhat digitately pinnate, with 4 pinuæ, each pinna bearing many pairs of linear leaflets. It is a native of Brazil, and is commonly grown in our gardens under the name of Sensitive Plant, the leaves falling on the slightest touch. The roots of this plant and its allies emit a most offensive smell, resembling the odour of a sewer at the time of impending rain. The legumes of *M. saponaria*, according to Royle, form a considerable article of commerce in India on account of their saponaceous qualities. [SENSITIVE PLANTS.]

(Lindley, *Vegetable Kingdom*; Don, *Dichlamydeous Plants.*)

MIMO'SEÆ, a sub-order of Plants belonging to the natural order *Leguminosæ*, whose flowers are regular, the stamens long, usually indefinite in number, and hypogynous, and the flowers valvate in æstivation. They are in many cases polygamous, and their leaves are always more or less compound. The principal genus of the division is the *Acacia*. [ACACIA.] *Mimosa* itself consists of a considerable number of species, many of which are remarkable for the irritability of their leaves, a curious property which has always rendered them objects of interest. [SENSITIVE PLANTS.] The species commonly cultivated for the exhibition of this phenomenon is the *Mimosa pudica*, a South American annual. Among the useful plants belonging to *Mimoseæ*, and not included in the genus *Acacia*, are the *Ingas sapida*, *I. dulcis*, *I. biglobosa*, and some others, whose pods contain a sweet nutritious fæcula, which renders them fit for food; and several kinds of *Prosopis*, the astringency of whose pods and bark renders them valuable for tanning purposes. In general, in the northern hemisphere, *Mimoseæ* are confined to tropical countries, or to those which have a high summer heat; but in the southern hemisphere they extend beyond such limits, as in Van Diemen's Land, where Acacias, called Wattles, are the commonest wood. [LEGUMINOSÆ.]

MIMULUS, a genus of Plants belonging to the natural order *Scorphulariaceæ*. It has a tubular calyx, 5-angled and 5-toothed; corolla ringent, upper lip 2 lobed, lower one trifid, usually bigibbous at the base, segments all flat; stamens 4, didynamous, inclosed; cells of anthers diverging or divaricate, at length subconfluent; stigma bilamellate; capsule hardly furrowed, 2-valved, valves entire with flat margins, dissepiment at length free; placentas adnate. The species are erect or procumbent, glabrous, rarely villous herbs, with usually tetragonal stems; leaves opposite, usually toothed, rarely quite entire; flowers axillary, solitary, pedicellate, superior ones sometimes racemose.

M. luteus, Yellow-Flowered Monkey-Flower, has leaves closely toothed, lower ones on long petioles, ovate or somewhat lyrate, superior ones rounded cordately, stem clasping; calyx ovate, but campanulate in the fructiferous state, with ovate-acute teeth, the upper tooth larger. It is a native of Chili. Babington says it has become naturalised in Great Britain. The corolla is yellow, with a dark mark in the mouth.

M. moschatus, Musk-Scented Monkey-Flower, has diffuse stems clothed with woolly villi; leaves petiolate, ovate, or ovate-lanceolate, a little toothed, rounded at the base, rather pilose, and somewhat clammy; calyx tubular, but oblong in the fruit-bearing state, with lanceolate unequal teeth. It is a native about the Columbia River, on the north-west coast of America. The plant exhales a strong scent of musk. The flowers are small and yellow. The plant is diffuse, rooting at the base.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany.*)

MIMUS, a genus of Birds belonging to the family *Merulidæ*. [MERULIDÆ.] *M. polyglottus* (Boie), the Mocking Bird, the Mimic Thrush, is the *Turdus polyglottus* of Linnæus, and the *Orpheus polyglottus* of Swainson. The male of this bird has the upper parts of the head, neck, and back, dark brownish ash, and when new-moulted a fine light gray; wings and tail nearly black, the first and second rows of coverts tipped with white; primary coverts in some males wholly white, in others tinged with brown. Three first primaries white from their roots as far as their coverts; white on the next six, extending from an inch to one and three-fourths farther down, descending equally on both sides of the feather; the tail is cuneiform, the two exterior feathers wholly white, the rest, except the middle ones, tipped with white; chin white; sides of the neck, breast, belly, and vent, a brownish-white, much purer in wild birds than in those that have been domesticated; iris of the eye yellowish cream-coloured, inclining to golden; bill black, the base of the lower mandible whitish; legs and feet black and strong.

Female very much resembling the male, but the white is less pure, spreads over only seven or eight of the primaries, does not descend so far, and extends considerably farther down on the broad than on the narrow side of the feathers. The black is also more of a brownish cast.

Young birds with the breast spotted like that of a thrush: young male with the white on the wing broader and of greater purity than in the female. (Wilson.)

The extraordinary vocal powers of this wonderful song-bird, and his lively habits, as recorded by eye and ear witnesses, are so uncommon, that we should think we were reading of some magical bird in a fairy tale, did we not know the fidelity and accuracy of the excellent observers who describe it. Wilson thus portrays this polyglot:—

"The ease, elegance, and rapidity of his movements, the animation of his eye, and the intelligence he displays in listening and laying up lessons from almost every species of the feathered creation within his hearing, are really surprising, and mark the peculiarity of his genius. To these qualities we may add that of a voice full, strong, musical, and capable of almost every modulation, from the clear mellow tones of the wood-thrush to the savage scream of the bald eagle. In measure and accent he faithfully follows his originals. In force and sweetness of expression he greatly improves upon them. In his native groves, mounted on the top of a tall bush or half-grown tree, in the dawn of dewy morning, while the woods are already vocal with a multitude of warblers, his admirable song rises pre-eminent over every competitor. The ear can listen to his music alone, to which that of all the others seems a mere accompaniment. Neither is this strain altogether imitative. His own native notes, which are easily distinguishable by such as are well acquainted with those of our various song-birds, are bold and full, and varied seemingly beyond all limits. They consist of short expressions of two, three, or at the most five or six syllables, generally interspersed with imitations, and all of them uttered with great emphasis and rapidity, and continued with undiminished ardour for half an hour or an hour at a time. His expanded wings and tail, glistening with white, and the buoyant gaiety of his action, arrest the eye as his song most irresistibly does the ear. He sweeps round with enthusiastic ecstacy; he mounts and descends as his song swells and dies away; and, as my friend Mr. Bartram has beautifully expressed it, 'he bounds aloft with the celerity of an arrow, as if to recover or recal his very soul, expired in the last elevated strain.' While thus exerting himself, a bystander destitute of sight would suppose that the whole feathered tribes had assembled together on a trial of skill, each striving to produce his utmost effect, so perfect are his imitations. He many times deceives the sportsman, and sends him in search of birds that perhaps are not within miles of him, but whose notes he exactly imitates; even birds themselves are frequently imposed on by this admirable mimic, and are decoyed by the fancied calls of their mates, or dive with precipitation into the depths of thickets at the scream of what they suppose to be the sparrow-hawk.

"The Mocking-Bird loses little of the power and energy of his song by confinement. In his domesticated state, when he commences his career of song, it is impossible to stand by uninterested. He whistles for the dog; Cæsar starts up, wags his tail, and runs to meet his master. He squeaks out like a hurt chicken, and the hen hurries about with hanging wings and bristled feathers, clucking to protect its injured brood. The barking of the dog, the mewing of the cat, the creaking of a passing wheelbarrow, follow with great truth and rapidity. He repeats the tune taught him by his master, though of considerable length, fully and faithfully. He runs over the quiverings of the canary and the clear whistlings of the Virginian nightingale, or red-bird, with such superior execution and effect, that the mortified songsters feel their own inferiority, and become altogether silent, while he seems to triumph in their defeat by redoubling his exertions. This excessive fondness for variety however, in the opinion of some, injures his song. His elevated imitations of the brown thrush are frequently interrupted by the crowing of cocks; and the warblings of the blue-bird, which he exquisitely manages, are mingled with the screaming of swallows or the cackling of hens: amidst the simple melody of the robin we are suddenly surprised by the shrill reiterations of the whip-poor-will, while the notes of the kill-deer, blue-jay, martin, baltimore, and twenty others, succeed with such imposing reality, that we look round for the originals, and discern with astonishment that the sole performer in this singular concert is the admirable bird now before us. During this exhibition of his powers he spreads his wings, expands his tail, and throws himself around the cage in all the ecstacy of enthusiasm, seeming not only to sing, but to dance, keeping time to the measure of his own music. Both in his native and domesticated state, during the solemn stillness of night, as soon as the moon rises in silent majesty, he begins his delightful solo; and serenades us the live-long night with a full display of his vocal powers, making the whole neighbourhood ring with his inimitable medley."

Audubon is of opinion that in song it is far beyond the nightingale. He pronounces the notes of that bird to be equal to those of a soubrette of taste, who, could she study under a Mozart, might perhaps in time become very interesting in her way. But he thinks it quite absurd to compare her essays to the finished talent of the Mocking Bird. In confinement its melody, though vary beautiful, falls far short, in his judgment, of its "wood-notes wild." He describes its imitative powers as amazing, and says that these birds mimic with ease all their brethren of the forests or of the waters, as well as many quadrupeds; but though he has heard that the bird possesses the power of imitating the human voice, he never met with an instance of that mimicry.

The last-mentioned author gives us a most interesting detail of the loves of these charming birds amid the rich scenery where the great *Magnolia*, with its thousand beautiful flowers, Bignonias, the white-flowered *Stuartia*, and the Golden Orange, are intertwined with innumerable vines. "For awhile," continues this graphic describer, "each long day and pleasant night are thus spent; but at a peculiar note of the female he ceases his song, and attends to her wishes. A nest is to be prepared, and the choice of a place in which to lay it is to become a matter of mutual consideration. The orange, the fig, the pear-tree of the gardens, are inspected; the thick briar patches are also visited. They appear to be well-suited for the purpose in view; and so well does the bird know that man is not his most dangerous enemy, that, instead of retiring from him, they at length fix their abode in his vicinity, perhaps in the nearest tree to his window. Dried twigs, leaves, grasses, cotton, flax, and other substances are picked up, carried to a forked branch, and there arranged. The female has laid an egg, and the male redoubles his caresses. Five eggs are deposited in due time, when the male, having little more to do than to sing his mate to repose, attunes his pipe anew. Every now and then he spies an insect on the ground, the taste of which he is sure will please his beloved one. He drops upon it, takes it in his bill, beats it against the earth, and flies to the nest to feed and receive the warm thanks of his devoted female."

The eggs are pale-green, blotched and spotted nearly all over with umber-brown. The female sits 14 days.

Mocking Bird (*Mimus polyglottus*).

The enemies of the Mocking Bird are cats, the *Falco Stanleii*, and snakes, especially the Black Snake, which Wilson describes as the mortal enemy of our songster's eggs and young, and as the object of his especial and deadly vengeance; for the bird rarely leaves his foe, when he has found him, alive. "Children," says Audubon, "seldom destroy the nests of these birds, and the planters generally protect them. So much does this feeling prevail throughout Louisiana, that they will not willingly permit a Mocking Bird to be shot at any time."

The food of this species consists, according to Wilson, of the berries of the red cedar, myrtle, holly, and many species of *Smilax*, together with gum-berries, gall-berries, and a profusion of others with which the swampy thickets abound, as well as winged insects, of which it is exceedingly fond.

"The Mocking Bird," says Wilson, "inhabits a very considerable extent of both North and South America, having been traced from the states of New England to Brazil, and also among many of the adjacent islands; much more numerous in those states south than in those north of the river Delaware, being generally migratory in the latter, and resident (at least many of them) in the former. A warm climate and low country, not far from the sea, seem most congenial to their nature; accordingly we find the species less numerous to the west than east of the great range of the Alleghany, in the same parallels of latitude. In the severe winter of 1808-9 I found these birds occasionally from Fredericksburg in Virginia to the southern parts of Georgia."

Nuttall states that it inhabits the whole continent and the adjacent islands, from Rhode Island to the larger islands of the West Indies, continuing through the equatorial regions and as far south as Brazil. Nor is it confined to the eastern or Atlantic states; for it is found in the State of Arkansas, and more than a thousand miles from the mouth of Red River. Say notices it as breeding at the western sources of the Platte, near the base of the Rocky Mountains. Bullock saw it on the table-land of Mexico. Mr. Litchfield informed Nuttall that it is commonly heard in Venezuela.

Mr. Darwin ('Journal and Remarks') notices, in his account of Maldonado, a Mocking-Bird, *Orpheus modulator*, called by the inhabitants Calandria, as remarkable for possessing a song far superior to that of any other bird in the country: indeed it was nearly the only bird in South America which he observed to take its stand for the purpose of singing. He compares the song to that of the Sedge-Warbler, but says that it is more powerful, and that some harsh notes and some very high ones are mingled with a pleasant warbling. It is heard only during spring: at other times its cry is harsh, and far from harmonious. He states that near Maldonado these birds were tame and bold, constantly attending the country-houses in numbers, to pick the meat which was hung up on the posts or walls; but if any other small bird approached, the Calandria drove it away. Mr. Darwin adds, that, on the wide uninhabited plains of Patagonia, another closely allied species, *Orpheus Patagonicus* of D'Orbigny, which frequents the valleys clothed with spiny bushes, is a wilder bird, and has a slightly different tone of voice. ('Voyages of H.M.S. Adventure and Beagle,' vol. iii.)

Mr. Swainson ('Fauna Boreali-Americana,' vol. ii., and 'Classification of Birds,' vol. ii.) notices the striking analogy between the Mocking Bird and *Lanius Carolinensis* (the Loggerheaded Shrike). Both the birds, he remarks, are typical examples of two distinct groups: they are of the same size, clothed in nearly the same coloured plumage, seek the same kind of food, agree in the structure of their wings and tail (almost in that of their feet), build the same kind of nest and in similar situations, imitate the notes of other birds, eject their unserviceable food in the same manner, and yet, in his opinion, are totally distinct in real affinity.

The term 'Mock-Bird' is sometimes used to designate the Sedge-Bird (*Curruca salicaria* of Fleming, *Sylvia Phragmitis* of Bechstein, *Calamodyta Phragmitis* of Bonaparte); and that of Mock-Nightingale is sometimes applied to the Black-Cap [Black-Cap], and also to the Fauvette, *Curruca hortensis*, Br. and Flem., *Motacilla hortensis*, Gm., *Sylvia hortensis*, Bechst.

MIMUSOPS, a genus of Plants belonging to the natural order *Sapotaceæ*. It has a calyx 6- to 8-parted; segments disposed in a twin order; corolla with a double row of segments, the outer row containing from 6 to 16 in number, which are either entire or divided, the inner row containing 6 or 8 entire segments; antheriferous stamens 6 or 8, opposite the inner segments of the corolla, alternating with as many sterile ones; ovarium 6-8-celled; berry 1- or few-seeded from abortion. The species are trees with alternate quite-entire glabrous coriaceous leaves, and axillary fascicles of 1-flowered pedicels. The flowers are small and white; the fruit edible.

M. Elengi has oval-lanceolate or oblong leaves, acuminated, glabrous; pedicels many together, shorter than the petioles, which are glabrous. It is a native of the East Indies, where it is much planted on account of its fragrant flowers, which come out chiefly in the hot season. A fragrant water is distilled from the flowers. The seeds yield an abundance of oil in request for painters. The leaves are said to produce an extraordinary noise when burnt.

M. Kaki has obovate leaves, very blunt, silvery or hoary beneath, hardly three times as long as the petioles, crowded at the ends of the branches; flowers fascicled, hexandrous. It is a native of the East Indies and Australia within the tropic. The tree yields a gum, and the fruit has a sweetish taste, and is much eaten by the natives of India.

(Don, *Dichlamydeous Plants;* Lindley, *Vegetable Kingdom.*)

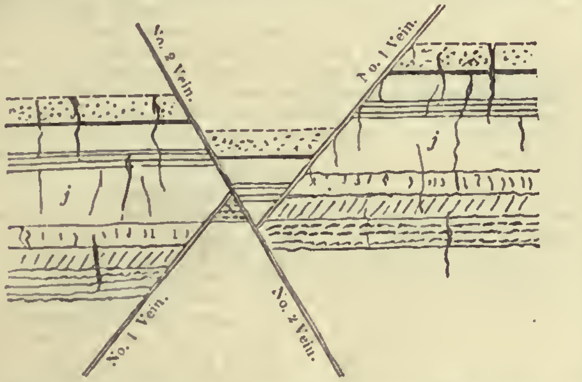
MINERAL VEINS. The principal inorganic constituents of the crust of the earth are in general capable of arrangement as the products of water or of heat; and to each of these classes belong peculiar characteristic features of composition, aggregation, and arrangement. The products of water are mostly laid in the form of strata; the products of heat are often seen to cross, penetrate, and overlie or underlie these layers of rock, in dykes or in huge amorphous masses. But there is a third less distinctly limited class of aggregations in the crust of the earth, whose form is different from either of the preceding types, and whose origin, though perhaps not independent either of heat or water, is yet not to be understood without the consideration of other and peculiar conditions. Such are metallic and mineral veins, spar veins, and other crystallised and concretionary accumulations, common in both stratified and amorphous rocks, under a great variety of circumstances, the essential conditions of which appear however to be few in number. To ascertain these conditions is the first object of a philosophical inquiry into the origin of mineral veins; for the laws of the phenomena may thus become correctly known, and the true theory, the ultimate end of the inquiry, be satisfactorily indicated.

The most frequent form in which metallic and mineral veins occur is that of a vertical or slightly inclined mass, occupying what was once a fissure, or narrow open space, traversing the stratified or amorphous rocks for a variable but often considerable length horizontally, and a limited or unknown depth in a perpendicular direction. This is called a Rake Vein. Occasionally the mineral masses are found arranged in a narrow vertical or oblique tubular form, like an irregularly expanded chimney, traversing the strata: such are sometimes called Pipe Veins. From these two sorts of veins parts occasionally pass laterally, and are called Flat Veins, and there are frequently ramifications from all of them, called Strings, and wholly or almost detached lumps, or bunches, or nests, of ore and spar, in the contiguous rocks.

Now the general condition of all these occurrences is the existence, anteriorly to the accumulation of the metallic and sparry substances in the rake, pipe, flat, &c., of a cavity in the substance of the rocks, or a separation between the beds or blocks of stone. The same forms of occurrence belong to various spars and other substances, and the same general condition is predicable of them. That cavities really did exist in these situations, previous to the formation of the veins, is often evident from the fact that the sparry or metallic matters lie in the interior of closed originally hollow shells, or fill lines of fracture and fissure across corals, shells, and fishes. It is further evident from the fact that along the line of a rake-vein the strata are commonly found to have been violently displaced, and moved upwards or downwards many inches, feet, yards, or fathoms, even to fifty or more fathoms, and reunited in this broken state by the subsequently introduced mineral crystallisations. This consideration supplies us with a definition of veins, identical, except by the omission of the words in brackets, with that given by Werner :—"Veins are rents produced in rocks, which were afterwards filled [from above] with certain substances." ('On Veins,' p. 57.)

In such cavities, spars of several kinds, as carbonate of lime, quartz, sulphate of barytes, sulphate of strontian, are frequently found, entirely unconnected with metalliferous districts, and as a usual and ordinary occurrence. In metalliferous districts the same and other minerals occur, associated with carbonates, phosphates, arseniates, sulphurets, &c. of lead, iron, copper, silver, &c., in almost every proportion. Between the most valued mineral vein, such perhaps as ores of precious metal, and the unprofitable massses of 'dead spar,' which occur in almost every limestone-quarry, there is an almost uninterrupted gradation; they must all be taken into the induction of phenomena, as a basis of theory; yet there are peculiarities in the geographical and geological relations of the metalliferous or true mineral veins which require separate classification, and justify some special inferences touching the local conditions and geological times of their formation.

1. In a mining district, however rich, not all the cavities in the rocks yield metallic minerals, even though they contain spars such as often accompany these. Generally the ores of lead, copper, silver, &c., are limited in their occurrence to such great fissures of the rocks as are accompanied by displacements of the masses of rock which bound the fissure. Thus great fissures, Nos. 1 and 2, in the figure, which



are marked by dislocations, may be richly filled with valuable ores, and yet the detached cracks and fissures (*j*) may contain only unprofitable spars or thin partings of clay.

2. When, as frequently happens in mining districts, veins accompanied by dislocation cross each other, the veins commonly become either richer or poorer in metal, and exhibit other peculiarities, about the junctions.

3. Such veins which cross may be of quite different natures: No. 1, for example, may yield copper-ore, and No. 2, lead-ore. This difference of contents in adjacent or meeting veins is even very frequently the case when the direction of the veins on the surface differs by a quadrant of a circle. Thus in Cornwall, veins which pass east and west may yield tin or copper, and those which run north and south produce lead. In Aldstone Moor, veins running east-north-east and west-south-west are rich in lead, those ranging north-north-west and south-south-east are often unproductive.

4. The same veins vary in respect of the nature of their contents; some yielding lead or copper, and others copper or tin, according to depth from the surface, the nature of the inclosing rock, and other less known conditions. Below the surface, 100 or more yards, veins may yield principally sulphuret of lead, with a variable admixture of the double sulphuret of copper and iron, and near the surface these may be exchanged for carbonate, phosphate, and arseniates of lead, carbonates of copper, and red oxide of iron. We may believe these metallic salts to be derived from the sulphurets by processes of change originating from the surface. Again, veins which cross different sorts of rocks, as limestone, sandstone, and argillaceous shale, may be very rich in limestone, very poor in shale, and of variable value in sandstone. Now, as the effect of dislocations in such countries is frequently to cause, on the two sides of a vein, very different beds to be on the same level, so that limestone is opposite to shale, or to sandstone, or to the same or a different bed of limestone, the complexity of the phenomena met with in practical mining, even in one vein, need not surprise a prudent reasoner. Generally speaking the miner looks for a change in the quality of the vein with every marked change of the including ground (or 'country,' as it is termed in Cornwall).

"In the older rocks we see the same vein intersecting clay-slate and granite; it is itself continuous, and there is no doubt of its identity; and yet the contents of the part inclosed by one rock shall differ very much from what is found in the other. In Cornwall, a vein that has been productive of copper-ore in the clay-slate, passing into the granite becomes richer, or, what is more remarkable, furnishes ores of the same metal differently mineralised. If we pursue it farther into the granite, the produce of metal frequently is found to diminish." (Taylor, in 'Report to the British Association,' 1833.)

5. This dependence of the productiveness of veins on some quality of the rocks which they traverse, is a phenomenon of the same order as the relation of veins in general to particular classes of strata or particular masses of igneous rocks. Dislocations of the strata occur in almost every district, yet it is chiefly in certain assemblages of the strata that metallic veins are abundant. In Great Britain and Ireland, generally speaking, the only districts of mineral veins are situated among the ancient strata; perhaps no metallic veins occur in these islands above the Palæozoic Strata [PALÆOZOIC SERIES]; and though in other parts of the world strata of much more recent origin do yield some valuable ores, it is under peculiar and limited conditions.

6. Among these conditions appears to be the proximity of rocks of igneous origin. Thus, in the Pyrenees, rocks of the age of the chalk yield iron-ores near igneous rocks, and not elsewhere. On a general survey of mining districts, without regard to their age, some relation of this kind appears. It is near the granites of Cornwall and Brittany, near the porphyries of Caldbeck Fells in Cumberland, near the greenstone of Aldstone Moor, that metallic veins are abundant; but on the other hand there is no metallic vein known in connection with the sienites of Malvern or Charnwood, while the rich lead-mines of Flintshire and Grassington Moor in Yorkshire are not accompanied by traps visible at the surface, or known in the mines; and the toadstone of Derbyshire has been thought to actually cut off the lead-veins. Perhaps on this important point prudence will be best satisfied by admitting the real influence of certain igneous rocks on the productiveness of mineral veins, not merely as being of igneous origin, but as being of particular chemical qualities, and having certain definite properties in relation to the passage of thermic and electric currents.

7. A certain relation of veins to the physical geography of the country is traceable. It is chiefly in or near to mountainous regions that mineral veins abound; and this appears to be mainly owing to the fact that, in such countries, the strata are more broken than elsewhere, and more divided by masses and dykes of igneous rocks, circumstances already known to influence the occurrence of mineral veins; but several authors mistake the nature of this relation, and in particular Werner, whose treatise 'On Veins' is very valuable, attaches too much importance to it. He says, "The occurrence of veins depends much upon the external form of the mountains, on the position of the whole chain of mountains in respect to its extent and declivity, on the particular position of the country where they [the mountains] occur, whether the country be composed of hills with gentle declivities and roundish or flattish summits, or whether it be a place in a principal valley." (Werner, 'On Veins,' p. 54.)

Before a satisfactory theory of veins can be possible, we must possess correct general inferences on two points—the origin of fissures and cavities in rocks, and the nature of the forces by which those fissures have been filled. Each of these points has been thought difficult of approach: the former has certainly been reached; the way to the latter is perhaps only indistinctly perceived.

Fissures and other cavities in rocks exist as effects of several natural causes, and present diverse appearances characteristic of these.

Caverns in limestone rocks are sometimes independent of real fissures, and other evidence of movements of the rocks, and may even be thought in some cases to be original, or left such when the rock was formed in the sea. Such cavities actually occur in modern coral reefs, left by the peculiar growth of the lithophytes: in certain cases (for instance magnesian limestone) the small cavities may have been formed by gas extricated in the course of the formation of the stone. Now in such closed cavities, large or small, the crystallisations which we find (carbonate of lime, sulphate of barytes, sulphate of strontian, quartz, oxide of iron, sulphuret of iron, &c.) are of the same kinds, and may be due to the same causes, as the crystallisations in originally hollow shells, or in the cavities left by the dissolution of these from the rocks. To the above catalogue may therefore be added sulphuret of zinc, arseniuret of iron, sulphuret of lead; for these minerals occur in the situations just named, especially near faults or veins.

Cracks in many limestone rocks are as perfectly internal cavities as those above-named, and are, in the neighbourhood of veins or metalliferous fissures, lined with similar crystallisations, adding to the list carbonate of copper. (In Magnesian Limestone of Yorkshire.)

Joints are open cracks traversing beds of stone, and come under the same description as other often very large open fissures unaccompanied by dislocation. These fissures are often arranged with so much symmetry as to leave no doubt of the influence of polarities among the molecules of the rocks when they were formed. Joints and fissures, especially near veins, often partake of the minerals which they contain.

Faults, or fissures accompanied by dislocations, offer, in addition to all the facts already mentioned, the very important information that the crust of the earth has been broken at different times, as well as in different directions. In the drawing of two intersecting veins, which illustrates this article, it will be seen that the vein No. 2 cuts through and displaces the strata, which had been already broken and displaced by the vein No. 1. The relative antiquity of these two veins has been generally allowed to be in the order of the numbers. Now as the metalliferous contents of the fissures No. 1 are divided by No. 2, as well as the strata which bound it, there appears reason to conclude that the vein No. 1 was filled with its mineral contents before the disturbance of the ground by the fissure No. 2.

We are thus conducted to the remaining part of the general inquiry proposed, namely, the causes concerned in filling the cavities of all kinds, already classed. The evidence of the dislocation of strata on the sides of most mineral veins leads, when generalised, to the recognition of several systems of veins, even in one district, of unequal antiquity. It is also found that these systems pass in different directions respectively, one set east-north-east, another north-north-west, others to intermediate points; and further, there are observed in these systems of veins—unlike in direction, and unequal in antiquity—some general and characteristic differences in the contents of the veins.

Werner gives eight successive systems of veins in the Freyberg Mines, but the definitions are far from clear. M. Carne gives eight successive groups of veins and slides in Cornwall, more clearly characterised; the oldest are tin veins (lodes), underlying (dipping) to the north, ranging nearly east and west by compass. The second are tin veins, underlying to the south, ranging east and west nearly (by compass). The third includes east and west copper veins. The fourth are diagonal (or contra) veins, ranging north-west and south-east, and yield copper. The fifth class includes cross-courses, ranging north-north-west and south-south-east, and rarely yielding metal, except lead. A sixth group yields copper. A seventh includes 'cross flukans' (clay veins), ranging nearly north and south, and an eighth, the 'slides,' which are formed of soft clay, and cut through all the others.

This classification, though too hard and precise for exact adaptation to nature, is valuable as an index to many complicated phenomena; but the relative antiquity of so many sets of fractures is a difficult problem, requiring much mechanical science, and a knowledge of the relative hardness and resisting power of the masses broken. Sir H. De la Beche has shown ('Ordnance Report on the Geology of Cornwall,' &c., p. 299) a simple case of this nature, in which the intersecting elvan dyke is probably not the newest of the two fractures. In the elaborate volume just quoted the reader will find a vast body of digested information regarding the phenomena of the Cornish and Devon mineral veins. As a combined result, we find in the veins of Cornwall a manifest tendency to two sets, one (the oldest) east-north-east, yielding most of the ores, the other north-north-west, crossing the preceding almost from sea to sea. In Devonshire also two sets appear, one (the oldest) nearly east and west, yielding most of the ores, the other north and south, crossing the other. Continuing the investigation, we find this system of cross courses (ranging north and south) extended into Dorsetshire, and there dividing the chalk, so that a comparatively recent geological date for some of the great cross courses of Devon and Cornwall may be probably inferred. Adopting the views of this author, we find evidence of four systems of east and west fractures in the district of Cornwall and Devon:—1. That of the upheaval of granite, and the arrangement of the strikes of the beds of slate. 2. The elvan (porphyry) courses, which traverse alike the granite and the strata disturbed with it. 3. The east and west systems of veins. 4. The system (indistinctly traced) of east and west clay slides; and adding to them the north and south traps, elvans, cross courses, and flukans, we see clearly how many and various have been the fractures and fissures, and how complicated the conditions under which these fissures were stored with their contents. What was the agency by which this was accomplished?

Werner (1791) believed that fissures were filled from above, by precipitations of earthy and metallic salts held in solution by water. As some of the substances common in mineral veins are not known to be soluble in water, separately or in combination, we can only adopt this view upon the supposition that the crystallisations in veins are the result of double decompositions in the liquid; nor even with this aid is the process at all clear by which the metallic masses were formed.

Lehman had previously (1753) introduced the notion of sublimed vapours and exhalations; and if we believe that sulphuretted hydrogen gas was abundant in these, the formation of sulphurets from salts of lead, copper, &c. might become a possible case. Necker revived this idea. ('Geol. Society Abstracts,' 1832.) Drs. Hutton and Playfair maintained that the vein-spars and metallic ores were injected into fissures not in a state of solution in water, but in a state of fusion through heat. They were a sort of metalliferous dykes.

In consequence of the experiments of Mr. Fox, which show in certain cases the passage of electrical currents between different parts of the metalliferous veins of Cornwall, and an augmentation of temperature in them as we descend into the earth, a fourth general view has gradually and obscurely grown up to importance. In this view electrical forces are appealed to for determining the deposition of matter brought into the fissures by water operating on metallic aggregations, at great depths and under considerable heat. Such heated waters would circulate upwards and downwards in the open spaces of the rocks; in the upper parts of the fissures they would be cooled, and might deposit part of their dissolvent contents; these would be arranged by electrical affinities under the influence of the various nature, direction, and fissuring of the rocks.

Such affinities might be dependent on local electrical currents, generated by the local differences of the rocks and minerals, or on the general terrestrial currents which govern common magnetism, or on a combination or opposition of these. Under any circumstances, evidence of these general currents must be looked for in the general phenomena, and the local currents must be sought in the local phenomena. Adopting this theory as at least partially true, we may venture to refer to general currents the remarkable fact of the frequent arrangement of metals in east and west veins, or in veins pointing a little north or a little south of east and west; for within such limits in European and Mexican latitudes these general electrical currents may be conceived to pass, varying most in Europe, according as the polarities varied from time to time. We may refer to local currents the limitation (which is seldom really, though often in appearance, arbitrary) of the metallic contents of a vein to particular adjacent rocks, to particular oblique parallel shoots or pipes, to particular sides or ends of a vein, to particular depths, or particular nidiform masses. To a succession of such operations we may refer the successive vertical lamination of several sorts of crystals (fluor, carbonate of barytes, lead-ore, blonde, &c.) in the same vein; and after a principal vein was partially filled, we may conceive without difficulty the deposition of nearly similar contents in neighbouring fissures or joints, or even closed cavities, if these should then become the lines of easiest electrical conduction.

The reader will find a comprehensive view of this hypothesis compared with characteristic phenomena in the 'Ordnance Report on Devon and Cornwall.' Indeed anything approaching to the strict and severe process of deductive reasoning from known physical truths, applied to conditions like those ascertained in the districts of Cornwall and Aldstone Moor, has been hardly attempted elsewhere. Yet the occasion is favourable. Sir H. De la Beche has embodied a vast mass of available results in the Report already quoted. Mr. Fox has experimentally almost made mineral veins by imitating the natural arrangements of the rocks of Cornwall: the electrotype process is daily revealing new and unexpected phenomena of electrical transfer under manageable conditions; and there are these great inducements for an earnest general investigation of the whole subject, that in the first place crystallography and the doctrines of molecular forces would assuredly be advanced by it; and, what is still more important, laws of judgment and practice in mining operations would be satisfactorily established and confidently applied to cases entirely beyond the range of ordinary experience. We must however caution the reader who prefers this new view of the origin of veins against any contemptuous disregard of the opinions of Werner, Lehman, and Hutton, on the ground of special difficulties in regard to solutions in water, sublimations of vapours, or igneous fusions of minerals. There is abundance of facts known to redeem their speculations from a hasty charge of absurdity; there are many insulated facts which seem to agree with them; and at all events the descriptions furnished by Pryce, Werner, Carne, Fournet, Fox, Henwood, Taylor, and De la Beche, must be carefully and respectfully considered, and combined with the general laws of the earth's structure and established principles of physics, before we can boast of a theory of Mineral Veins.

(Pryce, *Mineralogia Cornubiensis*; Werner, *On Veins*, 1791—English edition, 1809; Hawkins, Carne, Davy, and others, in *Transactions of the Geological Society of Cornwall*; Williams, *Mineral Kingdom*; Fournet, in D'Aubuisson's *Geology*, vol. iii.; Fox, in *Proceedings of Polytechnic Society*; Henwood and Necker, in *Abstracts of Geological Society of London*, 1832; Taylor, in *Report to British Association*, 1833; Becquerel *Traité d'Electricité*, 1835; Murchison, *Silurian System*; Phillips, in Lardner's *Cyclopædia*, 1839; De la Beche, *Ordnance Report on Cornwall, Devon, and West Somerset*, 1839; Lyell, *Principles of Geology*.)

MINERALOGY, according to the definition given by Kirwan, is the art of distinguishing mineral substances from each other. It may be regarded both as a science and an art: as a science, in reference to the knowledge requisite for supplying accurate descriptions of minerals, and forming what may be termed a natural classification; and an art, in reference to the arrangement of the descriptive characters for the purpose of afterwards distinguishing minerals from each other.

Mineralogy then must be considered as including the chemical composition of bodies, and an account of their external or physical properties. Both are requisite, for substances occur which agree in their chemical composition, and exhibit differences in their external characters; while there are other bodies which differ in their chemical constitution, but agree in their external properties.

Various methods of arrangement of minerals have been proposed by different authors. According to Werner, minerals were divided into the four classes of earthy minerals, saline minerals, inflammables, and metals; Karsten classed them under the heads of earths, salts, combustibles, and metals: Haüy divided minerals into acidiferous earthy substances, earthy substances, non-metallic combustible bodies, matallic bodies, substances not sufficiently known to admit of classification, rocks, and volcanic products. In Phillips's 'Elements of Mineralogy,' the classes are earthy minerals, alkaline-earthy minerals, acids, acidiferous earthy minerals, acidiferous alkaline minerals, native metals, metalliferous minerals, and combustible minerals. Berzelius attempted a strictly chemical classification of minerals: he has however candidly admitted that considerable difficulties attend this method, owing, in part at least, to the uncertainty which exists as to what are the essential and what the accidental constituents of a mineral.

The following is the arrangement of Dufrenoy as given in Professor Ansted's 'Elementary Course of Geology,' &c.:—

Class I.—Simple Bodies, or Binary Compounds never bases, generally essential ingredients in combinations, and serving as proximate elements.

Group 1. Hydrogen.
2. Carbon.
3. Silicon.
4. Sulphur.
5. Selenium.

Class II.—Alkaline Salts.

Group 1. Salts of Ammonia.
2. Salts of Potash.
3. Salts of Soda.

Class III.—Alkaline Earths, and Earths.

Group 1. Salts of Barytes.
2. Salts of Strontia.
3. Salts of Lime.
4. Salts of Magnesia.
5. Salts of Yttria.
6. Salts of Alumina.

Classs IV.—Silicates.

Group 1. Anhydrous Aluminous Sililcates.
2. Hydrous Aluminous Silicates.
3. Silicates of Alumina and Lime, or their isomorphs.
4. Aluminous and Alkaline Silicates, and their isomorphs.
5. Hydrous Aluminous Silicates with Alkaline and Lime bases, and their isomorphs.
6. Non-aluminous Silicates.
  a. With Lime as a base.
  b. With Zircon as a base.
  c. With several bases.
7. Silico-Aluminates.
8. Silico-Fluates.
9. Silico-Borates.
10. Silico-Titanates.
11. Silico-Sulphurets.
12. Aluminates.

Class V.—Metals.

Group 1. Cerium.
2. Manganese.
3. Iron.
4. Chromium.
5. Cobalt.
6. Nickel.
7. Zinc.
8. Tellurium.
9. Cadmium.
10. Antimony.
11. Arsenic.
12. Mercury.
13. Titanium.
14. Tantalium.
15. Niobium.
16. Pelopium.
17. Ilmenium.
18. Lead.
19. Tin.
20. Bismuth.
21. Iranium.
22. Tungsten.
23. Molybdeum.
24. Vanadium.
25. Copper.
26. Silica.
27. Gold.
28. Platinum.
29. Iridium.
30. Osmium.
31. Rhodium.
32. Palladium.

Dana, in his useful 'Manual of Mineralogy,' adopts the following classification:—

Class I.—Gases; consisting of or containing Nitrogen or Hydrogen.

Class II.—Water.

Class III.—Carbon, and Compounds of Carbon.

Class IV.—Sulphur.

Class V.—Haloid Minerals: Compounds of the Alkalies and Earths with the Soluble Acids, or of their Metals with Chlorine or Fluorine.

1. Salts of Ammonia.
2. Salts of Potash.
3. Salts of Soda.
4. Salts of Barytes.
5. Salts of Strontia.
6. Salts of Lime.
7. Salts of Magnesia.
8. Salts of Alumina.

Class VI.—Earthy Minerals: Silica and Siliceous or Aluminous Compounds of the Alkalies and Earths.

1. Silica.
2. Lime.
3. Magnesia.
4. Alumina.
5. Glucina.
6. Zirconia.
7. Thoria.

Class VII.—Metals and Metallic Ores.

1. Metals easily oxidisable: Iron, Lead, Copper, Mercury, &c.
2. Noble Metals: Gold, Silver, Platinum.

We have already observed that Mineralogy includes a knowledgo of the chemical composition and of the external and physical properties of minerals, and they are all divisible into two great classes of crystallised and uncrystallised. With respect to regularly crystallised minerals, we refer for an account of their forms to what is stated under CRYSTALLOGRAPHY. There are some substances which do not assume regular forms, but have an imperfect crystalline structure; while those bodies which are not either crystallised or crystalline, unless they are pulverulent, aro described as massive, and these are subdivided into such as possess particular forms, as botryoidal, mammellated, nodular, stalactitic, reuiform, globular, and amorphous, or without any particular form.

The structure of minerals is an important feature. It may be Columnar, Lamellar, or Granular. The following are explanations of the terms used in describing the different kinds of columnar structure:—

Fibrous: when the columns aro minute and lie in the same direction, as gypsum and asbestus. Fibrous minerals very commonly havo a silky lustre; a fibrous variety of gypsum, and one of calc-spar have this lustre very strongly, and each is often called satin-spar.

Reticulated: when the fibres, or columns, cross in various directions, and produce an appearance having some resemblance to a net.

Stellated: when they radiate from a centre in all directions, and produce a star-like appearance. Stilbite and gypsum are examples.

Radiated, divergent: when the crystals radiate from a centre without producing stellar forms. Examples, quartz, gray antimony.

Iu the Lamellar Structure the laminæ or leaves may be thick, or very thin; they sometimes separate easily, and sometimes with great difficulty. When the laminæ are thin and separate easily, the structure is said to be Foliaceous. Mica is a striking example, and the term Micaceous is ofteu used to describe this structure. When the laminæ are thick, the term Tabular is often applied; quartz and heavy spar afford examples. The laminæ may be elastic, as in mica, flexible, as in talc, or graphite, or brittle, as in diallage. Small laminæ are sometimes arranged in stellar shapes; this occurs iu mica.

When the grains iu the texture of a mineral are coarse, it is said to be Coarsely Granular, as iu granular marble; when fine, Finely Granular, as in granular quartz; and if no grains can be detected with the eye, the structure is described as Impalpable, as in chalcedony. Granular minerals, when easily crumbled by the fingers, are said to be Friable.

Massive minerals also take certain imitative shapes, not peculiar to either of theso varieties of structure. The following terms are used in describing imitative forms:—

Globular: when the shape is spherical or nearly so: the structure may be Columnar and Radiating, or it may be Coucentric, consisting of coats liko an onion. When they are attached, they are called Implanted Globules.

Reuiform: kidnoy-shaped. In structure, they aro like globular shapes.

Botryoidal: when a surfaco consists of a group of rounded prominences. The promineuces or globules usually consist of fibers radiating from the centre.

Mammillary: resembling the botryoidal, but consisting of larger prominences.

Filiform: like a thread.

Acicular: slender like a needle.

Stalactitic: having the form of a cylinder or cone hanging from the roofs of cavities or caves. The term stalactite is usually restricted to the cylinders of carbonate of lime hanging from the roofs of caverns; but other minerals are said to have a stalactitic form when resembling these in their general shape and origin. Chalcedony and brown iron-ore are often stalactitic.

Reticulated: net-like.

Drusy: a surface is said to be drusy when covered with minute crystals.

Amorphous—shapeless: having no regular structure or form, either crystalline or imitative.

Crystals are also called Pseudomorphous. A pseudomorphous crystal is one that has a form which is foreign to the species to which the substance belongs.

Crystals sometimes undergo a change of composition from aqueous or some other agency, without losing their form; for example, octahedrons of spinel change to steatite, still retaining the octahedral form. Cubes of pyrites are changed to red or brown iron-ore.

Again, crystals are sometimes removed entirely, and at the same time and with equal progress, another mineral is substituted; for example, when cubes of fluor-spar are transformed to quartz. The petrifaction of wood is of the same kind.

Again, cavities left empty by a decomposed crystal are refilled by another species by infiltration, and the new mineral takes on the external form of the original mineral, as a fused metal the form of the mould into which it is cast.

Again, crystals are sometimes incrusted over by other minerals, as cubes of fluor by quartz; and when the fluor is afterwards dissolved away, as sometimes happens, hollow cubes of quartz are left.

The first kind of Pseudomorphs are Pseudomorphs by Alteration; the second, Pseudomorphs by Replacement; the third, Pseudomorphs by Infiltration; the fourth, Pseudomorphs by Incrustation.

Pseudomorphous crystals are distinguished by having a different structure and cleavage from that of the mineral imitated in form, and a different hardness, and usually little lustre.

A large number of minerals have been met with as pseudomorphs. The causes of such changes have operated very widely and produced important geological results.

The characters of minerals depending on light are also arranged. They are of five kinds, and arise from the power of minerals to reflect, transmit, or emit light. They are as follows:—1, Lustre; 2, Colour; 3, Diaphaneity; 4, Refraction; 5, Phosphorescence.

The lustre of minerals depends on the nature of their surfaces, which causes more or less light to be reflected. There are different degrees of intensity of lustre, and also different kinds of lustre.

The kinds of lustre are six, and are named from some familiar object or class of objects:—

Metallic: the usual lustre of metals. Imperfect metallic lustre is expressed by the term Sub-Metallic.

Vitreous: the lustre of broken glass. An imperfect vitreous lustre is termed Sub-Vitreous. Both the vitreous and sub-vitreous lustres are common. Quartz possesses the former in an eminent degree; calcareous spar often the latter. This lustre may be exhibited by minerals of any colour.

Resinous: lustre of the yellow resins. Opal and zinc-blende are examples.

Pearly: like pearl. Talc, native magnesia, stilbite, &c., are examples. When united with sub-metallic lustre, the term Metallic-Pearly is applied.

Silky: like silk; it is the result of a fibrous structure. Fibrous carbonate of lime, fibrous gypsum, and many fibrous minerals, more especially those which in other forms have a pearly lustre, are examples.

Adamantine: the lustre of the diamond. When sub-metallic, it is termed Metallic-Adamantine. Varieties of white lead-ore are examples.

The degrees of intensity are denominated as follows:—

Splendent: when the surface reflects lights with great brilliancy, and gives well defined images. Elba iron-ore, tin-ore, some specimens of quartz and pyrites are examples.

Shining: when an image is produced, but not a well-defined image. Calcareous spar and celestine are examples.

Glistening: when there is a general reflection from the surface, but no image. Talc and copper-pyrites are examples.

Glimmering: when the reflection is very imperfect, and apparently from points scattered over the surface. Flint and chalcedony are examples.

A mineral is said to be Dull when there is a total absence of lustre, as chalk.

In distinguishing minerals, both the external colour and the colour of a surface that has been rubbed or scratched, are observed. The latter is called the Streak, and the powder abraded, the Streak-Powder.

The colours are either metallic or non-metallic.

The Metallic are named after some familiar metal, as copper-red, bronze-yellow, brass-yellow, gold-yellow, steel-gray, lead-gray, iron-gray.

The Non-Metallic colours used in characterising minerals, are various shades of white, gray, black, blue, green, yellow, red, and brown. There are thus snow-white, reddish-white, greenish-white, milk-white, yellowish-white; bluish-gray, smoke-gray, greenish-gray, pearl-gray, ash-gray; velvet-black, greenish-black, bluish-black; azure-blue, violet-blue, sky-blue, indigo-blue; emerald-green, olive-green, oil-green, grass-green, apple-green, blackish-green, pistachio-green (yellowish); sulphur-yellow, straw-yellow, wax-yellow, ochre-yellow, honey-yellow, orange-yellow; scarlet-red, blood-red, flesh-red, brick-red, hyacinth-red, rose-red, cherry-red; hair-brown, reddish-brown, chestnut-brown, yellowish-brown, pinchbeck-brown, wood-brown.

The expression a Play of Colours is used when several prismatic colours appear in rapid succession on turning the mineral. The diamond is a striking example; also precious opal.

Change of Colours: when the colours change slowly on turning in different positions, as in labradorite.

Opalescence: when there is a milky or pearly reflection from the interior of a specimen, as in some opals, and in cat's eye.

Iridescence: when prismatic colours are seen within a crystal; it is the effect of fracture, and is common in quartz.

Tarnish: when the surface-colours differ from the interior; it is the result of exposure. The tarnish is described as Irised, when it has the hues of the rainbow.

Polychroism: the property, belonging to some prismatic crystals, of presenting a different colour in different directions. The term Dichroism has been generally used, and implies different colours in two directions, as in the mineral iolite, which has been named dichroite because of the different colours presented by the bases and sides of the prism. Mica is another example of the same. The more general term has been introduced, because a different shade of colour has been observed in more than two directions.

These different colours are observed only in crystals with unequal axes. The colours are the same in the direction of equal axes, and often unlike in the direction of unequal axes. This is the general principle at the basis of polychroism.

Diaphaneity: the property which many objects possess of transmitting light; or in other words, of permitting more or less light to pass through them. This property is often called transparency, but it is properly one of the degrees of diaphaneity. The following terms are used to express the different degrees of this property:—

Transparent: a mineral is said to be transparent when the outlines of objects, viewed through it, are distinct. Glass and crystals of quartz are examples.

Sub-Transparent, or Semi-Transparent: when objects are seen, but their outlines are indistinct.

Translucent: when light is transmitted, but objects are not seen. Loaf-sugar is a good example; also Carrara marble.

Sub-Translucent: when merely the edges transmit light faintly When no light is transmitted, the mineral is described as opaque.

Those minerals whose faces emit light exhibit two sets of phenomena, Refraction and Polarisation. [REFRACTION, and POLARISATION, in ARTS AND SC. DIV.]

The index of refraction has been obtained for many minerals, of which the following are a few:—

Air	1·000	Calc-Spar	1·654
Tabasheer	1·211	Spinel	1·764
Ice	1·308	Sapphire	1·794
Cryolite	1·349	Garnet	1·815
Water	1·335	Zircon	1·961
Fluor-Spar	1·434	Blende	2·260
Rock-Salt	1·557	Diamond	2·439
Quartz	1·548	Chromate of Lead	2·974

Many crystals possess the property of refracting light in two directions instead of one, and objects seen through them consequently appear double. This is called Double Refraction. It is most conveniently exhibited with a crystal of calc-spar, and was first noticed in a pellucid variety of this mineral from Iceland, called from the locality Iceland-Spar. On drawing a line on paper and placing the crystal over it, two lines are seen instead of one—one by ordinary refraction, the other by an extraordinary refraction. If the crystal, as it lies over the line, be turned around, when it is in one position the two lines will come together. Instead of a line make a dot on the paper, and place the crystal over the dot: the two dots seen will not come together on revolving the crystal, but will seem to revolve one around the other. The dot will in fact appear double through the crystal in every direction except that of the vertical axis, and this direction is called the Axis of Double Refraction. To view it in this direction the ends must be ground and polished. The divergence increases on passing from a view in the direction of the axis to one at right angles with it, where it is greatest. In some substances the refraction of the extraordinary ray is greater in the latter direction than that of the ordinary ray, and in others it is less. In calc-spar it is less, it diminishing from 1·654 to 1·483. In quartz it is greater, it increasing from 1·5484 to 1·5582. The former is said to have a Negative Axis, the latter a Positive.

This property of double refraction belongs to such of the fundamental forms as have unequal axes; that is, to all except those of the monometric system. Those forms in which the lateral axes are equal (the dimetric and hexagonal systems) have one axis of double refraction; and those in which they are unequal (the trimetric, monoclinate and triclinate systems), have two axes of double refraction.

Both rays in the latter are rays of extraordinary refraction. In nitre the two axes are inclined about 5° to each other; in arragonite 18° 18′; in topaz 65°. The positions of the axes thus vary widely in different minerals.

The extraordinary ray exhibits a peculiar property of light, termed Polarisation. Viewed by means of another doubly-refracting crystal, or crystalline plate (called from this use of it an analysing plate), the ray of light becomes alternately visible and invisible as the latter plate is revolved. If the polarised light be made to pass through a crystal possessed of double refraction, and then be viewed in the manner stated, rings of prismatic colours are developed, and on revolving the analysing plate the coloured rings and intervening dark ring successively change places.

Several minerals give out light either by friction or when gently heated. This property of emitting light is called Phosphorescence.

Two pieces of white sugar struck against one another give a feeble light, which may be seen in a dark place. The same effect is obtained on striking together fragments of quartz, and even the passing of a feather rapidly over some specimens of zinc-blende is sufficient to elicit light.

Flour-spar is the most convenient mineral for showing Phosphorescence by Heat. On powdering it, and throwing it on a shovel heated nearly to redness, the whole takes on a bright glow. In some varieties the light is emerald-green; in others purple, rose, or orange. A massive fluor from Huntington, Connecticut, shows beautifully the emerald-green phosphorescence.

Some kinds of white marble, treated in the same way, give out a bright yellow light.

After being heated for a while the mineral loses its phosphorescence; but a few electric shocks will in many cases to some degree restore it again.

Many minerals become electrified on being rubbed, so that they will attract cotton and other light substances; and when electrified some exhibit positive and others negative electricity when brought near a delicately suspended magnetic needle. The diamond, whether polished or not, always exhibits positive electricity, while other gems become negatively electric in the rough state, and positive only in the polished state. Friction with a feather is sufficient to excite electricity in some varieties of blende. Some minerals thus electrified retain the power of electric attraction for many hours, as topaz, while others lose it in a few minutes.

Many minerals become electric when heated, and such species are said to be Pyro-Electric.

If a prism of tourmaline, after being heated, be placed on a delicate frame, which turns on a pivot like a magnetic needle, on bringing a magnet near it, one extremity will be attracted, the other repelled, thus indicating the polarity alluded to. Several other minerals exhibit electrical phenomena, especially boracite and topaz, which, like tourmaline, are hemihedral in their modifications.

Magnetism is exhibited more especially in the ores of iron. The loadstone, as the magnetic oxide of iron is called, is common where the ores of iron are found. When mounted like a horse-shoe magnet, a good loadstone will lift a weight of many pounds. This is the only mineral that has decided magnetic attraction; but several ores containing iron are attracted by the magnet, or, when brought near a magnetic needle, will cause it to vibrate; and moreover, the metals nickel, cobalt, manganese, palladium, platinum, and osmium, have been found to be slightly magnetic.

Minerals vary in their specific gravity. This must be ascertained as for any other substance. [SPECIFIC GRAVITY, in ARTS AND SC. DIV.]

The Hardness of minerals differs much, and is the point first attended to by the mineralogist. In order to ascertain the hardness of a mineral it is only necessary to draw a file across the specimen, or to make trials of scratching one with another. As standards of comparison, the following minerals have been selected, increasing gradually in hardness from talc, which is very soft and easily cut with a knife, to the diamond, which nothing will cut; this table is called the Scale of Hardness:—

1. Talc, common foliated variety.
2. Rock-Salt.
3. Calc-Spar, transparent variety.
4. Fluor-Spar, crystallised variety.
5. Apatite, transparent crystal.
6. Felspar, cleavable variety.
7. Quartz, transparent variety.
8. Topaz, transparent crystal.
9. Sapphire, cleavable variety.
10. Diamond.

If on drawing a file across a mineral it is impressed as easily, as fluor-spar, the hardness is said to be 4; if as easily as felspar, the hardness is said to be 6; if more easily than felspar, but with more difficulty than apatite, its hardness is described as 5½ or 5·5.

The file should be run across the mineral three or four times, and care should be taken to make the trial on angles equally blunt, and on parts of the specimen not altered by exposure. Trials should also be made by scratching the specimen under examination with the minerals in the above scale, as sometimes, owing to a loose aggregation of particles, the file wears down the specimen rapidly, although the particles are very hard.

Minerals differ in their state of aggregation. Solid minerals may be—

Brittle: when parts of the mineral separate in powder on attempting to cut it.

Sectile: when thin pieces may be cut off with a knife, but the minera pulverises under a hammer.

Malleable: when slices may be cut off, and these slices will flatten out under the hammer, as native gold and silver.

Flexible: when the mineral will bend, and remain bent after the bending force is removed, as talc.

Elastic: when after being bent it will spring back to its original position, as mica.

A Liquid is said to be Viscous when on pouring it the drops lengthen and appear ropy, as petroleum.

When a mineral is broken its cut surface presents different aspects. The following are the several kinds of fracture in minerals:—

Conchoidal: when the mineral breaks with a curved or concave and convex surface of fracture. Flint is a good example.

Even: when the surface of fracture is nearly or quite flat.

Uneven: when the surface of fracture is rough with numerous small elevations and depressions.

Hackly: when the elevations are sharp or jagged, as in broken iron.

Soluble minerals may have taste: the kinds are—

Astringent: the taste of vitriol.

Sweetish-astringent: the taste of alum.

Saline: taste of common salt.

Alkaline: taste of soda.

Cooling: taste of saltpetre.

Bitter: taste of Epsom salts.

Sour: taste of sulphuric acid.

Excepting a few gases and soluble minerals, minerals in the dry unchanged state do not give off odour. By friction, moistening with the breath, the action of acids, and the blow-pipe, odours are sometimes obtained, which are thus designated:—

Alliaceous: the odour of garlic. It is the odour of burning arsenic, and is obtained by friction and more distinctly by means of the blow-pipe from several arsenical ores.

Horse-Radish odour: the odour of decaying horse-radish. It is the odour of burning selenium, and is strongly perceived when ores of this metal are heated before the blow-pipe.

Sulphureous: odour of burning sulphur. Friction will elicit this odour from pyrites, and heat from many sulphurets.

Fetid: the odour of rotten eggs or sulphuretted hydrogen. It is elicited by friction from some varieties of quartz and limestone.

Argillaceous, the odour of moistened clay. It is given off by serpentine and some allied minerals when breathed upon. Others, as pyrargillite, afford it when heated.

Without submitting the mineral to a regular analysis, advantage is often taken of the effects of heat by means of the blow-pipe, with or without the aid of certain fluxes, as soda, phosphoric salt, &c.; and the mineral is stated to be either fusible alone, or with the assistance of the different fluxes, and the nature of the resulting compound is described; sometimes it is a colourless glass, at other times coloured, transparent, or opaque, &c. [BLOW-PIPE, in ARTS AND SC. DIV.]

(Dana, *Manual of Mineralogy*; Dana, *A System of Mineralogy*; Austed, *Elementary Course of Geology, Mineralogy, &c.*; Phillips, *Introduction to Mineralogy*; Phillips, *Elements of Mineralogy*; Jackson, *Minerals and their Uses*; Sowerby, *Popular Mineralogy*.)

MINIM. [LEUCISCUS.]

MINIUM. [LEAD.]

MINK, a name for the Vison-Weasel, *Mustela* (*Putorius*) *Vison*. [MUSTELIDÆ.]

MINNOW. [LEUCISCUS.]

MINT. [MENTHA.]

MINX, a name for the Vison-Weasel. [MUSTELIDÆ.]

MINX-OTTER, Pennant's name for the Vison-Weasel. [MUSTELIDÆ.]

MINYAS. [ACTINIADÆ.]

MINYAS, a genus of *Echinodermata*.

MIRE-CROW, a name for the Laughing Gull. [LARIDÆ.]

MIRE-DRUM, a name for the Bittern (*Botaurus stellaris*). [BITTERN.]

MIROUNGA, Dr. Gray's name for a genus of Seals. [PHOCIDÆ.]

MISCOPHUS. [LARIDÆ.]

MIPSILUS. [FORAMINIFERA.]

MISPICKEL. [IRON.]

MISSEL-THRUSH. [MERULIDÆ; THRUSHES.]

MISSELTOE, or MISTLETOE. [VISCUM.]

MISTONUSK, one of the Cree Indian names for the American Badger (*Meles Labradoria*, Sab.). [BADGER.]

MITE. [ACARIDÆ.]

MITHRAX. [MAIIDÆ.]

MITRA. [VOLUTIDÆ.]

MITU, a name for some of the Curassow Birds. [CRACIDÆ.]

MNEMIA. [ACALEPHÆ.]

MOA. [DINORNIS.]

MOCHA-STONE. [AGATE.]

MOCO. [Hystricidæ.]

MOCKING BIRD. [Mimus.]

MODIOLA. [Mytilidæ.]

MOEHRINGIA, a genus of Plants named after Paul Henry Gerard Moehring, a German physician, author of 'Hortus Proprius,' and other works. This genus belongs to the natural order *Caryophyllaceæ*, and has 5 sepals, 4 or 5 petals, either entire or slightly emarginate; 8 to 10 stamens, 2 or 3 styles, the capsule opening with 4 or 6 valves; the seeds numerous, with an appendage at the hilum. The species are alpine plants with the habit of *Arenaria*.

M. trinervia has ovate-acute stalked 3-5-nerved leaves, the upper ones sessile, the petals shorter than the calyx, the sepals lanceolate-acute, 3-ribbed; the intermediate rib strongest and rough. This plant was formerly referred to *Arenaria*, but it may be distinguished from that genus by the appendage to the hilum of the seed. This plant is found in damp shady places, and is a native of Great Britain. Four other species of this genus are described by Koch in his 'Flora Germanica;'—*M. muscosa*, *M. prona*, *M. polygonoides*, and *M. villosa*.

The species are alpine plants, and adapted for cultivation on rock-work or in small pots. They may be propagated by dividing them at the root. They are best grown in pots, in a mixture of sand, loam, and peat.

(Babington, *Manual of British Botany;* Don, *Dichlamydeous Plants.*)

MOENCHIA, a genus of Plants named after Conrad Moench, professor of botany at Marburg, who wrote several works on botany; amongst others, 'Enumeratio Plantarum Indigenarum Hessiæ, præsertim Inferioris,' Cassel, 1777, 8vo; also a work on the cultivation of North American forest-trees in Germany.

The genus *Moenchia* belongs to the natural order *Caryophyllaceæ*, and has 4 erect sepals, 4 entire petals, 4 stamens, a many-seeded capsule opening at the end with 8 teeth.

M. erecta is the only British species. It is a small glaucous plant growing in dry gravelly and sandy places.

(Babington, *Manual of British Botany.*)

MOHOLI. [Lemuridæ.]

MOHR. [Antilopeæ.]

MOHSITE, a Mineral, consisting of Titaniate of Iron. It occurs crystallised. The primary from is a rhomboid. The crystals occur attached and macled. The cleavage is not observable. The fracture is conchoidal. The hardness is sufficient to scratch glass. The colour and streak are black. The lustre metallic. It is opaque; not attracted by the magnet. It is found in Dauphiny.

MOLASSES. [Sugar.]

MOLE. [Talpidæ.]

MOLE-BAT. [Orthagoriscus.]

MOLE-CRICKET. [Gryllidæ.]

MOLE-RAT. [Talpidæ.]

MOLENESIA, a genus of Fishes belouing to the family *Cyprinidæ*. The species are American.

MOLGE. [Amphibia.]

MOLGULA. [Tunicata.]

MOLI'NIA, a genus of Grasses belonging to the tribe *Festucineæ*. It has unequal glumes without lateral ribs, shorter than the lanceolate spikelet, of 2 or 3 semicylindrical flowers and a subulate rudiment of another; the paleæ hardening on the loose fruit, and the styles terminal. There is one species which is British—

M. cœrulea, which has an erect elongate narrow panicle; spikelets from 1- to 3-flowered; the outer paleæ 3- rarely 5-nerved, downless; the upper part of the stem naked. The leaves are long, linear, and alternated. It grows on wet heaths in alpine situations. This species is the *M. depauperata* of Lindley.

(Babington, *Manual of British Botany.*)

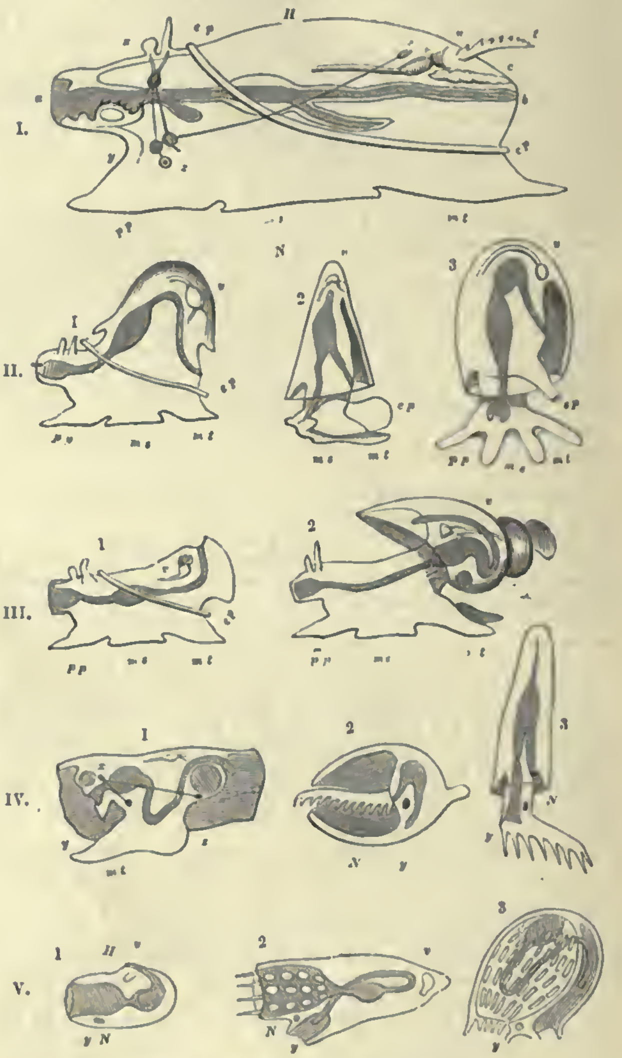
MOLLUSCA. Referring to the articles Conchifera, Gasteropoda, Cephalopoda, and Malacology, for information as to the zoological arrangement and subdivision of the various families of the *Mollusca*, we shall in the present article consider the animals which constitute this great group in a purely anatomical and morphological point of view; that is, we shall endeavour to show—firstly, what Common Plan or Archetype is discoverable among the varieties of Molluscan forms; secondly, in what way the Common Plan is more specially modified in the leading sub-typical groups of this great division of the animal kingdom; thirdly, the various modes in which the organs are arranged being thus comprehended—what peculiar characters are presented by these organs themselves; and fourthly, the development of the *Mollusca*, so far as it bears upon the idea of a Common Plan, will be discussed.

1. *The Common Plan or Archetype of the Mollusca.*—By the Common Plan or Archetype of a group of animals we understand nothing more than a diagram, embodying all the organs and parts which are found in the group, in such a relative position as they would have, if none had attained an excessive development. It is, in fact, simply a contrivance for rendering more distinctly comprehensible the most general propositions which can be enunciated with regard to the group, and has the same relation to such propositions as the diagrams of a work on mechanics have to actual machinery, or those of a geometrical work to actual lines and figures. We are particularly desirous to indicate the sense in which such phrases as Archetype and Common Plan are here used; as a very injurious realism—a sort of notion that an Archetype is itself an entity—appears to have made its way into more than one valuable anatomical work. It is for this reason that if the term Archetype had not so high authority for its use, we should prefer the phrase 'Common Plan' as less likely to mislead.

There are two modes in which the Archetype or Common Plan of any group of animals may be set forth. In the first, the community of plan among the members of each group would be demonstrated; and then, the minor plans thus obtained being compared together, the general Common Plan would be deducible. But this analytical method (which has been carried out to a certain extent for the *Mollusca* by the writer in a Memoir in the 'Philosophical Transactions' for 1852), would require more space and more illustration than can here be devoted to it; we must, therefore, take the opposite course, and, assuming a Common Plan, trace out its modifications in the subordinate plans, and explain the laws by whose operation they are effected.

This assumed Common Plan or Archetype of the *Mollusca* may be represented by *fig.* I, I.:—

Fig. I.



I. The Ideal Archetype or Common Plan of the *Mollusca*.

II. Its modifications in consequence of the development of an abdomen and consequent neural flexure of the intestine. 1, Hypothetical; 2, Pteropod; 3, Cephalopod.

III. Modifications resulting from the development of a post abdomen and consequent hæmal flexure. 1, Hypothetical; 2, Pectinibranchiate Gasteropod.

IV. Primarily neural flexure modified by subsequent changes. 1, Lamellibranchiate Mollusc; Neural *Molluscoida*. 2, Brachiopod; 3, Polyzoon.

V. Hæmal *Molluscoida* (Ascidians). 1, simple hæmal flexure, as in *Appendicularia;* 2, after hæmal flexure the intestine is bent back, and an atrium is formed; the branchial sac remains comparatively small; 3, the branchial sac comparatively large.

a, oral aperture; *b*, anal aperture, or extremity of the intestine; *c*, renal organ; *pp*, propodium; *ms*, mesopodium; *mt*, metapodium; *ep*, epipodium; *l*, branchiæ; *u*, auricle; *v*, ventricle; *x*, cerebral ganglia; *y*, pedal ganglia; *H*, hæmal region; *N*, neural region.

[The letters have the same signification in these and all the other figures, with the exception of figure 10.]

This figure is supposed to be bilaterally symmetrical, and the following parts and regions are to be distinguished in it:—(H). The Hæmal Region, or that upon which the heart is situated, and which corresponds with what is commonly termed the dorsal region. The word dorsal, however, is vague, being used in different senses in various divisions of the animal kingdom, and should therefore be, abandoned in philosophical anatomy. For the same reason, the opposite region (N) is termed, not ventral, but Neural, inasmuch as it is the region in which the great centres of the nervous system are placed. The termination (a) is the anterior or oral; the end (b), the posterior, or anal. Between these extremities the intestine takes a straight course. The neural surface is that upon which the majority of Molluscs move and by which they are supported; and it is commonly modified to subserve these purposes into a muscular expansion or disc called the Foot. Three regions again, often very distinctly divided from one another, may be distinguished in this foot:—an anterior, the Propodium (pp); a middle, the Mesopodium (ms); and a posterior, the Metapodium (mt). In addition to these, the upper part of the foot or middle portion of the body may be prolonged into a muscular enlargement on each side, just below the junction of the hæmal with the neural region—the Epipodium (ep). The mass of the body between the foot proper and the abdomen, or post-abdomen, which bears the Epipodium, and whose limits cannot very well be defined, though it would be very convenient to have a name for it, may be termed the Mesosoma (mid-body); and for what is loosely called the head the name Prosoma might advantageously be adopted. On the upper part of the sides of the head or Prosoma are two pairs of organs of sense: the Eyes (which may be supported on pedicles—Ommatophores), and the Tentacles. In the hæmal region the integument may be peculiarly modified and raised up at its edges into a free fold, either in front of or behind the anus, and when so modified it is called a Mantle (Pallium). In front of the anus again the Branchiæ (t) project as processes of the hæmal region. Among the internal organs we need only point out the position of the Heart (u, v), which lies in front of the branchiæ in the hæmal region; and the Nervous Ganglia (x, y, z), of which there are three principal pairs arranged around the alimentary canal, which they encircle by means of their commissures.

Such is the Common Plan of which all Molluscs whatsoever may be regarded as modifications; the next question is, to consider the laws according to which the plans of the great sub-classes of the *Mollusca* may be derived from it.

2. *Modifications of the Common Plan.*—The structural peculiarities of all known Molluscs may be very simply accounted for by the excessive or defective relative development of certain regions in the Archetype, more particularly of one or other parts of the Hæmal Region. Of this region the portion which lies in front of the anus may be conveniently termed the Abdomen, while to that which lies behind it the term Post-Abdomen may be applied. Now, if it be supposed that the Abdomen grows out of proportion to the rest of the body, constituting a kind of prominence, and that the intestine passes into the outgrowth so as to form a sort of loop (II.), it is clear that the open angle of this loop will be turned towards the Neural surface; and the intestine may be appropriately said to have a Neural flexure. On the other hand, if it be supposed that the Post-Abdomen grow out in the same way, and draws into itself a loop of the intestine, then the open angle of the loop will be in the opposite direction, that is, it will be directed towards the Hæmal surface; the intestine therefore may in this case be said to have a Hæmal flexure (III.). It will be readily understood that either Abdomen or Post-Abdomen may develop a mantle or not, and that the existence or absence of this mantle has nothing to do with the essence of the change in question, however much it may affect the external appearance of the resulting form.

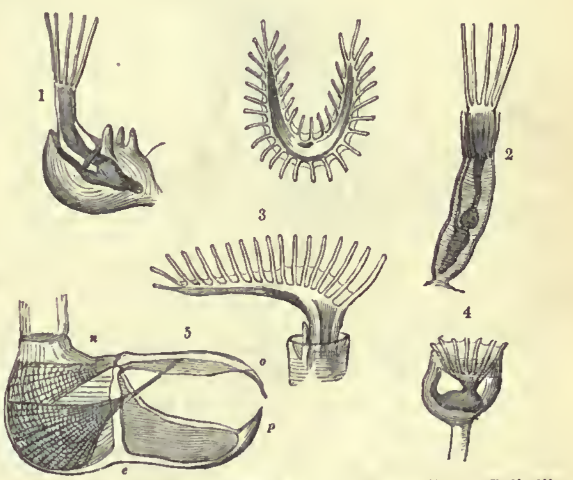
Again, the extent to which the Abdomen or Post-Abdomen is developed, may have a great influence on the relative position of certain organs of the Mollusc. Thus, in the first place, the position of the anus may become greatly altered. When there is a neural flexure it will acquire a direction towards the neural surface and backwards, the final approximation to the oral end depending on the amount of the development of the abdomen on the one hand, and that of the neural region on the other. Again, if the outgrowth of the abdomen take place, not symmetrically, but more or less on one side of the median line, the final position of the anus will be towards the opposite side and to the right or left, as the case may be.

It is even conceivable (this amount of modification indeed actually obtains in nature) that by an exceedingly one-sided development of the abdomen, the anus may be thrust quite round on to the hæmal side. Its final position therefore must not be regarded as certainly indicative of the direction of the flexure by which it obtained this position. Where there is a hæmal flexure again, the direction of the anus will be normally towards the hæmal (that is, dorsal) side, and forwards; its approximation to the head, its asymmetrical position, and the amount to which it may be thrust backwards and towards the neural side, depending upon conditions of the same order.

It is not merely the anus which is affected by these changes however; the branchiæ (and the heart which follows them) undergo similar transpositions, whose nature and origin it is very necessary to understand in order to appreciate their value as organic characters. M. Milne-Edwards long since pointed out the singular fact that, in certain Molluscs, the branchiæ are in front of the heart, while in others they are behind it. The latter he termed *Opisthobranchiata*, the former, *Prosobranchiata*. It will be seen that our Archetype is Opisthobranchiate. Now, it is easy to understand that if an Abdomen were developed in front of the heart, without involving the cardiac region, the Mollusc would remain opisthobranchiate; if however it were more extensively developed so as to involve the heart and branchiæ, the heart, from having been in front, would eventually take a position posterior to the branchiæ, and the Mollusc would thus become prosobranchiate. So with regard to the development of a Post-Abdomen; its effect on the position of the heart and branchiæ would depend wholly on the extent of hæmal surface which it involved. It follows, therefore, that Opisthobranchism may co-exist with either a hæmal or a neural flexure, or with none; while Prosobranchism indicates one or the other, but not which; and that these organic characters, however valuable, are secondary to and therefore of less importance than the neural and hæmal flexures (that is, development of an abdomen or post-abdomen), on which they depend. Dealing with the facts furnished by adult structure alone then, there are two primary modifications of the Molluscan Archetype, which may be shortly termed the Neural and Hæmal Plans. The *Cephalopoda, Pulmonata, Pteropoda, Lamellibranchiata, Brachiopoda,* and *Polyzoa*, are the molluscs which present modifications of the Neural Plan. The *Heteropoda, Gasteropoda, Tectibranchiata, Inferobranchiata, Cyclobranchiata, Tubulibranchiata, Nudibranchiata,* and *Ascidioida*, are those which present modifications of the Hæmal Plan.

3. *The Neural Plan and its Principal Modifications.*—Milne-Edwards has proposed a division of the *Mollusca* into the *Mollusca* proper, and the *Molluscoida* (*Molluscoïdes*), including under the latter class those Polype-like forms, the *Polyzoa* and the *Ascidioida*. Believing that the *Molluscoida* are as truly and wholly Molluscan as any other *Mollusca*, we nevertheless consider the distinction drawn by the eminent French naturalist to be very important, and that it should be retained as a primary subdivision of the great Hæmal and Neural Divisions. In the hæmal division the limits of the *Molluscoida* are the same for us, as for M. Milne-Edwards; but in the neural we include somewhat more. In fact, if the most fitting definition for this subdivision be those Molluscs which have the neural region comparatively little developed and the nervous system reduced to a single or at the most a pair of ganglia, while the mouth is usually surrounded by a more or less modified circlet of tentacles, then we shall find that, in the neural division, we must include the *Brachiopoda* with the *Polyzoa*. Commencing our study of the morphology of the special groups of the *Mollusca* with the Neural Division; and with the *Molluscoid* sub-division of the neural forms then, we have to consider first, the *Polyzoa* and the *Brachiopoda*:—

Fig. 2.



Polyzoa.—1, *Membranipora.* 2, *Bowerbankia.* 3, *Plumatella.* 4, *Pedicellina.* 5, *Avicularium.*

The *Polyzoa.*—Conceive the abdomen of the Archetype to be greatly prolonged, the neural region with its appendages, the organs of sense, and the heart, remaining undeveloped; so that the anus comes into close apposition with the oral extremity, while the edges of the latter are produced into long ciliated tentacles, and the result will be a Polyzoon, which needs only the power of gemmation to give rise to those composite aggregations which are so characteristic of the group.

The Polyzoic type itself presents five subordinate modifications in the five principal orders of the group:—the *Cyclostomata, Ctenostomata, Cheilostomata, Hippocrepia,* and *Pedicillinida.*

In the first three, the body of the Polyzoon when fully expanded is completely straightened, there being no permanent fold or inversion of the integument. In the last two there is such a permanent inversion.

In the *Cyclostomata* the horny or calcareous deposit in the integument of the abdomen joins the soft parts by an even level edge, and there is nothing which serves as a cover or operculum, for the retracted Polyzoon.

In the *Ctenostomata* (*fig.* 2, 2) the margins of that portion of the abdomen which is inverted in the retracted state are produced into a toothed horny sheath, which can be retracted by special muscles, and which serves as an operculum.

In the *Cheilostomata* (*fig.* 2, 1) the horny or calcareous deposit takes place in such a manner that the hardened integuments of the front portion of the hæmal region constitutes a sort of lid, regularly articulated upon the hinder portion, and provided with proper occlusor (and perhaps levator?) muscles. It should be noted that the anal aperture is directed away from this lid or operculum.

In each of the previous divisions the tentacles are arranged on a circular disc, or lophophore, of whose edges they are prolongations; but in the great majority of the *Hippocrepia* (*fig.* 2, 3), which are all fresh-water forms, the lophophore is so produced into two arms on the anal side as to assume a horse-shoe shape. It is important to consider this in connection with the peculiar features presented by the *Brachiopoda*.

Thirdly, we venture to regard the peculiar genus *Pedicellina* (*fig.* 2, 4) as constituting an order by itself. Essentially a Polyzoon, it is nevertheless distinguished from all other *Polyzoa* by the circumstance that its tentacles are united together by a membrane into a cup, which cup is never protruded far beyond the general boundary of the body.

The *Cheilostomata* are remarkable for possessing two kinds of moveable appendages—*Flabellaria*, whip-like processes, articulated to a bulb containing muscles by which they are moved; and *Avicularia* or bird's-head processes (*fig.* 2, 5). The structure of the latter is of great interest in a morphological point of view, and demands particular attention. They consist of a larger piece, or valve (*p*), shaped like a bird's head and produced into a longer or shorter process of attachment, to which a smaller valve (*o*), representing the bird's lower jaw, is articulated. Stalked or sessile, these avicularia present during life an incessant snapping action, produced by the alternate contraction of two sets of muscles, which arise from the concavity of the 'skull' of the bird's head by wide fan-shaped origins, and seem to be inserted by narrow tendons into the smaller articulated valve. The one tendon (*c*) is inserted into the smaller valve in front of the line of articulation, and the other (*n*) behind it, and therefore by their alternate action they raise and depress the lesser valve upon the larger.

Fig. 3.

Rhynchonella psittacea.

a, oral aperture; *b*, anal aperture, or extremity of the intestine; *l*, adductor muscles of *Brachiopoda*; *n*, cardinal muscles of *Brachiopoda*; *p*, pedicle; *p' p''*, pedicle muscles; *y*, pedal ganglion.

The *Brachiopoda*.—Now, if we compare the relative positions and mode of articulation of the operculum and cell of a Cheilostomatous Polyzoon, or of the two valves of an avicularium, with those which obtain in the shells of the typical *Brachiopoda*, such as the *Terebratulidæ* and *Rhynchonellidæ*, the resemblance will be found to be very striking; and still more so, if in addition the arrangement of the muscles be taken into consideration. In such a Brachiopod, in fact (*fig.* 3), the shell is composed of two valves—one large, excavated, and produced into a canal or tube, through which a pedicle of attachment passes; while the other is smaller and more or less flattened. The two valves are articulated together by means of a socket in the smaller valve and a tooth in the larger, on each side, the intermediate space being free, just as the operculum of the Polyzoon is united with its cell, or as the lesser valve of an avicularium is articulated with the larger. So likewise the anal extremity of the Brachiopod is turned from the smaller valve. Then the arms of the Brachiopod are essentially comparable to those of the lophophore of a Hippocrepian Polyzoon, except that their direction is different; the calcified supports to which they are fixed in many *Brachiopoda*, are so variable in form and so extensively absent in others, that their existence can in nowise affect the homology of the parts. Again, if we leave out of consideration the pedicle-muscles (which are however, in all probability, as Mr. Hancock as shown, the homologues of the retractors of the *Polyzoa*), the arrangement of the other muscles is precisely what we have seen to obtain in the avicularium: the adductors which pass from the larger valve to be inserted into the smaller, in front of its point of support, corresponding precisely with the occlusor muscles of the avicularium; while the cardinal muscles, which arise from the larger valve, and pass to be inserted into the cardinal process of the smaller, behind the point of support, are identical with the divaricator muscles of the avicularium.

The existence of distinct muscles for the purpose of separating the valves of the shell is characteristic of the *Polyzoa* and *Brachiopoda*, the only approximation to such an arrangement at present known among the *Lamellibranchiata* being presented by the *Pholades*.

Finally, if the great proportional size of the *Brachiopoda*, their pedunculated attachment, their thick and solid shells, and their simple forms, be brought forward as arguments against the view we take of their essentially polyzoic nature, we would remind the objector of the like opposition in such features between *Boltenia* and *Botryllus*, or *Aplidium*, among the Ascidians.

Two principal modifications of the common Brachiopod plan are to be observed. In the *Terebratulidæ* and *Rhynchonellidæ*, and in all probability in their extinct allies the *Spiriferidæ*, *Orthidæ*, and *Productidæ*, the muscles are always arranged in three sets—Adductor, Cardinal, and Peduncular. At the same time the mantle (whose homology with the produced edges of the non-retractile part of the abdomen of a Polyzoon is at once appreciable), though divided into two distinct lobes in front, is continuous and entire behind, that is, towards the peduncle. A still more remarkable feature in their organisation is that, at least in *Waldheimia* and *Rhynchonella*, there is no anal aperture, the intestine terminating in a cæcum directed towards the middle of the large valve.

In the *Craniadæ*, *Discinidæ*, and *Lingulidæ* the muscles have a very different arrangement, which could only be rendered intelligible by detailed descriptions and illustrations, as the homologies of these muscles with those of the other division are not yet determined. The lobes of the mantle again are completely separated (*Discina*, *Lingula*, *Crania*?), and the intestine opens upon one side of the body between these lobes. There are no teeth, and the articulation of one valve with the other and the modes of attachment vary remarkably; *Lingula* having a long peduncle; *Crania* being attached by the surface of its lower valve; and *Discina* having an aperture in the corresponding valve through which a portion of the adductor passes, and spreading out at its extremity into a sort of plug, acts as a pedicle.

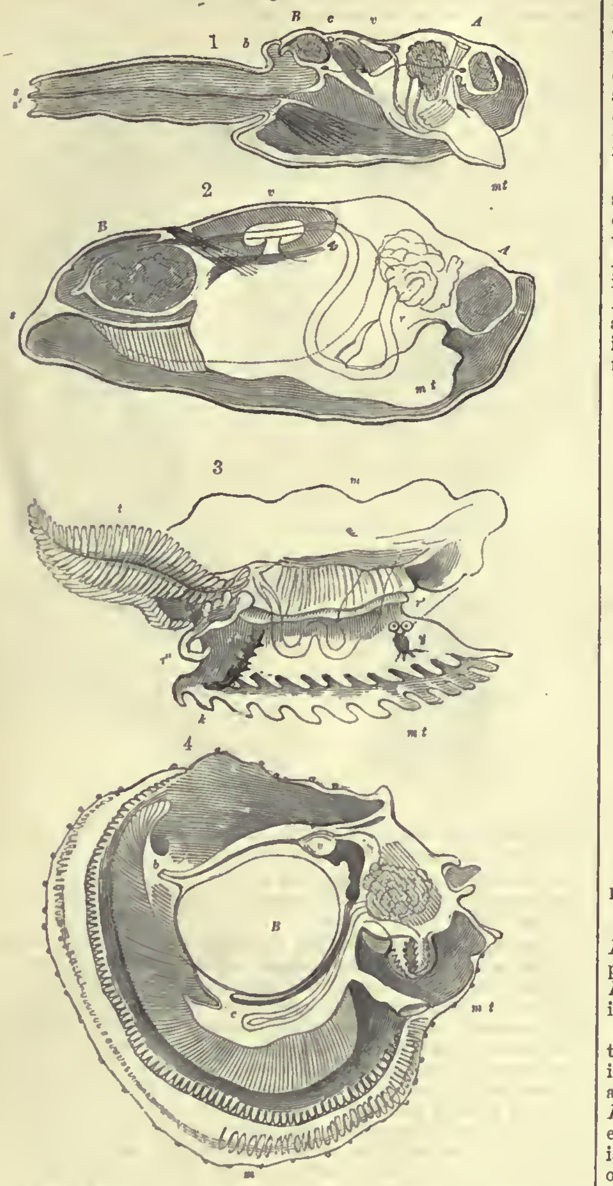
Neural Mollusca.—The *Lamellibranchiata*. In all *Mollusca* proper the neural region is developed to a much greater extent than in the *Molluscoida*, and there are always three pairs of ganglia, two Cerebral, two Pedal, and two Parieto-Splanchnic (or branchial). The especial characters of the *Lamellibranchiata*, as modifications of the Archetype, are the following:—The hæmal region is well developed in its abdominal portion, but forms no prominent sac-like abdomen, into which the viscera enter in the adult condition. Its edges are produced into extensive pallial lobes, which are arranged on each side of a longitudinal plane, and not above and below a horizontal one (or more properly before and behind a transverse one), as in the *Brachiopoda*. The mouth is surrounded by a fringe, representing the tentacles in the *Molluscoida* (as may be well seen in *Pecten*, *fig.* 4, 4) which is produced laterally into elongated 'palps,' but is totally unprovided with any manducatory apparatus. The intestine passing from the stomach either forms a simple loop with a second open angle directed hæmally, or this loop may be much coiled and convoluted: the intestine finally passing over the great posterior adductor and terminating between the lobes of the mantle behind it.

The foot may be more or less largely developed, but never presents any clear distinction into pro- meso- and meta-podium, unless indeed, as we are inclined to suspect, the whole free portion of the foot of the *Lamellibranchiata* ought to be regarded as a modified metapodium. Besides the pedal muscles, the Lamellibranchs possess one or two characteristic muscles—the adductors, which approximate the valves of the shell, and whose greater or less development seriously affects the ultimate form of the animal.

The gills deviate but little from their archetypal form and position in some Lamellibranchs, such as *Trigonia* and *Pecten*, being merely thrown downwards by the development of the mantle. In *Nucula* (*fig.* 4, 3), their inner edges are united posteriorly, but they remain comparatively small. In the majority of Lamellibranchs however, the gills are exceedingly large in proportion to the rest of the body, and consist of two double plates, which are united with the mantle and with one another, in such a manner as to divide the pallial cavity into two chambers, a supra- and infra-branchial, which communicate only by the passage between the anterior edge of the branchiæ and the foot, and by the multitudinous perforations in the branchial plates themselves.

It is in the absence of external organs of sense or of any buccal masticatory apparatus, and in the peculiar arrangement of the gills, that the main difference between the *Lamellibranchiata* and the *Gasteropoda* lies; and hence the great resemblance which the ideal section of

Fig. 4.



Lamellibranchiata.—1, *Lutraria.* 2, *Unio.* 3, *Nucula.* 4, *Pecten.*

a, oral aperture; *b*, anal aperture, or extremity of the intestine; *c*, renal organ; *m*, mantle; *r*, labial palpi; *s s'*, anal and branchial siphons; *t*, branchiæ; *v*, ventricle; *y*, pedal ganglion; *A*, anterior adductor; *B*, posterior adductor.

a typical Lamellibranch bears to a typical Gasteropod. Compare (*fig.* 4) 4 with with 1, 3, and 2.

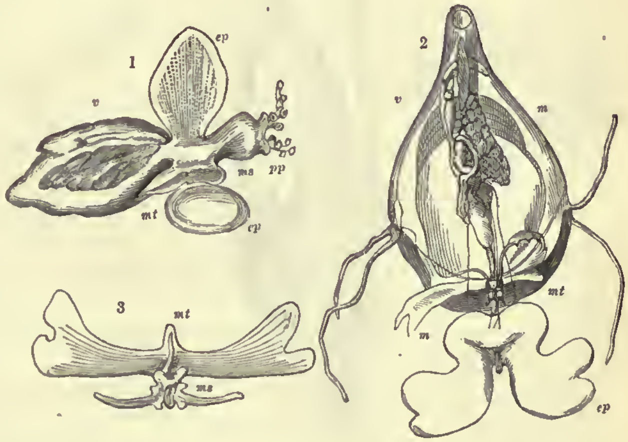
It may seem at first sight inconsistent with our own principles to consider as neural molluscs these Lamellibranchs, which confessedly have the principal loop in the intestine open to the hæmal side. But the position of the largely-developed mantle, completely in front of the anal aperture, and the direction of the aortic end of the heart, unchanged from what is observable in the Archetype, are sufficient, apart from developmental considerations, which will be adduced by and bye, to prove that the second flexure of the intestine in this case is to be considered accidental, the result of the great development of the mesosoma, to serve as a chamber for the viscera, and of the enlargement of the great posterior adductor, thrusting up the rectum which passes over it.

As for the leading varieties of form of the Lamellibranchs, there are none which, in reality, depart very widely from the Common Plan. Perhaps *Teredo* or *Pholas*, on the one hand, and *Ostræa*, on the other, may be regarded as the extreme forms, the former being as much as possible elongated longitudinally, the latter attaining the extreme of concentration about a centre. At the same time there is a reduction of parts to a minimum, as shown in the absence of a second adductor, and of any foot in the adult state. The differences between these forms are however decidedly less than those which may be observed between the extreme forms among the *Cephalopoda* or *Gasteropoda*.

The *Pteropoda* and *Pulmonata.*—The Lamellibranchs are, as we have said, curiously exceptional in presenting the general features of the *Mollusca* proper, without that singular buccal apparatus which we meet with in all other members of the subdivision, whether neural or hæmal, and whose peculiar nature is described below. Again, they are exceptional in the vast development and symmetrical longitudinal division of their mantle, and in the corresponding division of their pallial shell into two pieces or valves—characters we shall not meet with again in any modification of the Common Plan.

In the *Pteropoda* and *Pulmonata* the mantle is never developed into such lateral lobes, and the shell to which it gives rise never consists of two pieces, but is constituted by a single mass, which either has the form of a flat plate or presents some modification of a cone. Again, the foot (or some part of it) is always well developed, presenting no obvious distinction into regions in the *Pulmonata;* but in the *Pteropoda* often exhibiting a well-marked meso- and meta-podium, and always presenting a characteristically large epipodium—an organ which in these Molluscs constitutes the so-called 'wings,' from which their name is derived.

Fig. 5.



Pteropoda.—1, *Pneumodermon.* 2, *Cleodora.* 3, *Psyche* (foot and head only). Letters as in figure 1.

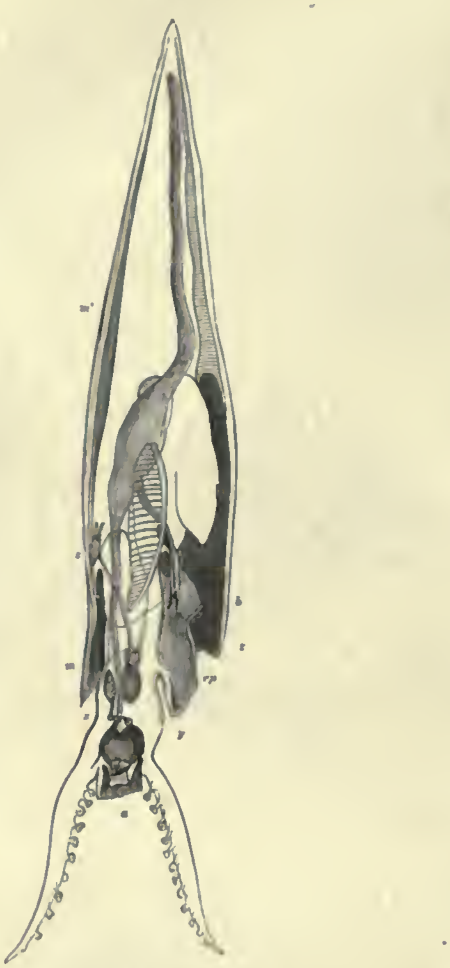
There is usually a well-developed mantle in the *Pteropoda* and *Pulmonata*, and its walls act as a branchial surface without being produced into true gills—(*Hyalæa?*)—the sea-water in the marine *Pteropoda* and the air in the terrestrial and aquatic *Pulmonata* being inspired and expired into its cavity.

In the *Pteropoda* in general, the aperture of the pallial cavity and that of the anus, are situated upon the posterior surface of the body, in accordance with the neural flexure of the intestine. The anal aperture however is usually thrust to one side of this surface, and, in *Limacina* and *Spirialis*, this lateral thrust has taken place to such an extent, that not only the anal aperture, but that of the mantle cavity, is thrown up completely on to the dorsal surface. This latero-dorsal, or dorsal position of the anal and respiratory apertures, is as regular in the *Pulmonata* as it is exceptional in the *Pteropoda*.

In the *Pteropoda* and *Pulmonata* some most important modifications of form are produced by the greater or less development of the mesosoma on the one hand and of the mantle on the other. The predominance of the latter is to be observed in such forms as *Criseis, Cleodora, Hyalæa,* and *Helix;* while the former may be seen in *Pneumodermon* and in *Limax*. In the latter the mantle is very small, and in the former it is almost if not entirely absent; what is ordinarily considered as the mantle in this mollusc being in fact nothing more than the mesosoma. The like confounding together of parts so essentially different has taken place, we shall find, in the *Nudibranchiata* and in the *Heteropoda*.

The *Cephalopoda.*—In the Pteropod forms, *Pneumodermon* and *Clio*, a hood, giving off long processes covered with suckers from its inner surface, surrounds the oral aperture, and there is every reason to believe corresponds with the propodium, whose lateral halves have united over the mouth. If the like process were to take place in a *Criseis*, but to a greater extent, so that the mouth were thrust back between the halves of the mesopodium, and the propodium and mesopodium formed one continuous tentaculigerous sheath around the oral aperture; and if at the same time the two halves of the epipodium united posteriorly into a funnel-shaped tube, the *Criseis*, so far as its external organisation goes, would no longer be a Pteropod, but would have become a Cephalopod. In fact, the Cephalopod may be derived from the Archetype by supposing these modifications. The mantle is always well developed, and its cavity incloses one or two pair of gills. The two halves of the epipodium are united behind into what is called the funnel, a peculiar apparatus, of great importance in the economy of many Cephalopods; and in the majority of the group the sides of the foot, having united in front of, and forming a complete sheath for, the head, are produced into eight or ten processes, the so-called arms, on which are set the acetabula, or suckers.

Fig. 6.



Vertical Section of *Loligo media*.

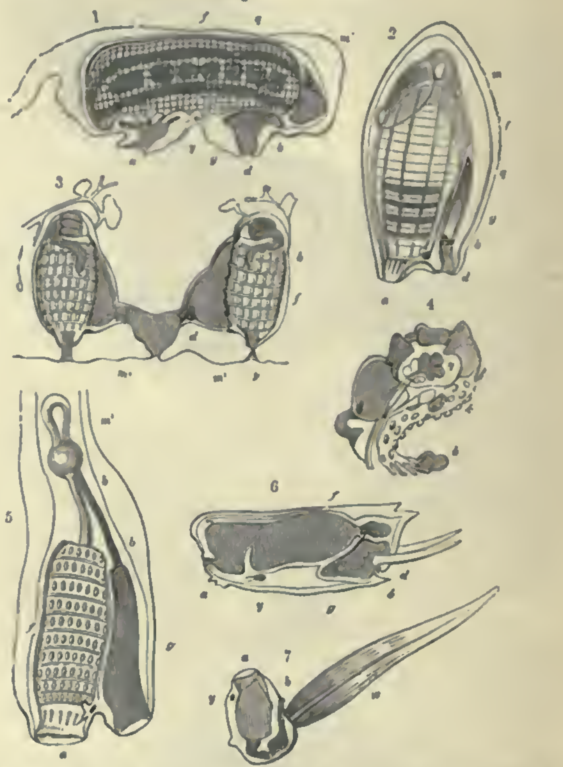
a, oral aperture; *b*, anal aperture, or extremity of the intestine; *m*, mantle; *m'*, shell; *t*, branchiæ; *x*, cerebral ganglia; *y*, pedal ganglia; *z*, parieto-splanchnic ganglia; *ep*, funnel.

Beyond this peculiar arrangement and development of the external organs, we are not aware that any characters exist by which the *Cephalopoda*, as a class, can be distinguished from the other *Mollusca*. Among themselves they present a remarkable harmony, differing chiefly in the number of their branchiæ, in the internal or external position of their shell, and in the nature of the appendages into which the edges of the foot are modified—characters which do not attain to ordinal importance in other divisions of the *Mollusca*.

Having thus glanced at all the leading modifications of the Neural Plan, we may next turn to the Hæmal Plan, commencing with its Molluscoid modification constituted by the *Ascidioida* alone.

The *Ascidioida*.—As a Molluscoid group, the Ascidians are characterised, in the first place, by the rudimentary condition of their whole neural region, and by the reduction of their nervous system to a single infra-œsophageal ganglion. Besides these however, their organisation presents certain characters which appear at first sight very remote from such a Common Plan as has been described, and hardly deducible from it. An Ascidian, in fact, is usually fixed by one extremity of its body, and presents at the other two apertures. One of these leads into a wide cavity, whose entrance is fringed with a circlet of tentacles, and whose walls (except along the middle line anteriorly and posteriorly) are perforated by innumerable ciliated apertures, and often thrown into folds, by which their surface is greatly increased. At the bottom of this cavity—the branchial sac—a second wide aperture leads into the alimentary canal, which invariably presents a hæmal flexure, and then almost always bends backwards neurally to terminate in a second wide cavity. This, the *atrium*, whose more external portion is usually termed the *cloaca*, opens externally by the second or cloacal aperture, and extends along each side of the branchial sac up to its median line of attachment—communicating freely with its cavity by means of the small ciliated apertures which have been mentioned. The single ganglion lies between the oral and cloacal apertures.

Fig. 7.



Ascidioida.—1, *Boltenia.* 2, *Cynthia.* 3, *Botryllus.* 4, Intestine of *Perophora.* 5, *Clavelina.* 6, *Salpa.* 7, *Appendicularia.*

a, oral aperture; *b*, anal aperture, or the extremity of the intestine; *d*, cloacal aperture and atrium; *f*, branchial sac; *g*, hypo-pharyngeal band; *m'*, test; *q*, genitalia; *y*, pedal ganglia.

Now, in what manner is this form derivable from the Archetype? It is to be remarked, in the first place, that the pharynx, large in the *Polyzoa*, becomes comparatively enormous in the Ascidians; while the tentacles, which were very large in the *Polyzoa*, are in the Ascidians comparatively small. Next, with the development of a post-abdomen, the intestine acquires a hæmal flexure; but instead of the anal aperture remaining on the hæmal side, it is bent round, by the same process as in *Spirialis* and *Limacina*, but in the inverse direction. Suppose with all this that a mantle has been developed, and that its free margin remaining small and narrow, has followed the anus to the neural side, while its cavity has extended up on each side of the pharynx to the middle line of the hæmal surface of the latter, carrying to a great extent a process of which the outline may be seen in *Cymbulia*, and giving rise to the atrium;—imagine also that the sac thus constituted externally by the inner surface of the mantle (third tunic), and internally by the pharynx, becomes perforated by minute apertures—and the result would be an Ascidian.

Such is the manner in which the Ascidian type is derivable from the Common Plan. Of this type the group presents three subordinate modifications. The first is that presented by the extraordinary and instructive genus *Appendicularia* (*fig.* 7, 7), which in a manner represents permanently the larval state of the more perfect members of the group—swimming by means of a long rapidly-vibrating tail, like that of a tadpole. In *Appendicularia* there is no cloacal aperture or atrium. The mouth opens into a wide pharynx representing the branchial sac of other Ascidians; from this a gullet leads into the stomach. The narrower intestine passes from the stomach, forwards and to the hæmal surface, where it terminates without bending downwards, and without being surrounded by any special cavity. *Appendicularia* therefore might be said to be a form in which the process of modification of the Molluscan Archetype into the Ascidian Type is arrested half way.

In all other Ascidians this process is complete, and there is a distinct cloacal aperture and atrium; but these forms again may be arranged under two great sub-typical modifications, according to the development of the branchial sac relatively to that of the post-abdomen. In such forms as *Cynthia*, *Boltenia*, *Perophora*, *Botryllus*, the branchial sac attains so great a proportional size as to occupy the whole, or nearly the whole, length of the body, the intestine lying on one side of it: these might therefore be well denominated *Ascidiæ Branchiales*, Branchial Ascidians. On the other hand, in *Clavelina*, *Aplidium*, *Polyclinum*, *Salpa*, the alimentary canal lies completely behind the branchial sac, which is proportionally small, and these might therefore be termed *Ascidiæ Intestinales*, Intestinal Ascidians. A very complete mutual representation will be found to obtain between the members of these two groups.

Hæmal Mollusca.—In passing from the Hæmal *Molluscoida* to the Hæmal *Mollusca*, we find the same new features presenting themselves as in the Neural Division, the transition being even more abrupt, from the absence of any representative of the *Lamellibranchiata*. In all these *Mollusca*, in fact, there is a more or less well-developed foot; a distinct head, with its organs of sense and buccal armature; and three pairs of ganglia—cerebral, pedal, and parieto-splanchnic.

The modification of the Common Plan is carried to a less extent in this than in the Neural Division, the chief varieties of its forms depending on the changes in the shape of the shell with which the majority are provided; on the greater or less development of the different regions of the foot; but most of all in the relative proportions of the mesosoma and mantle.

If we divide the Hæmal *Mollusca* into two great groups—the one consisting of the *Heteropoda, Scutibranchiata, Tubulibranchiata, Pectinibranchiata*, and *Cyclobranchiata*, families which are most intimately allied, and which are connected as a group by the diœcious arrangement of their reproductive organs; and the other of the *Nudibranchiata, Inferobranchiata*, and *Tectibranchiata*, families in like manner united, among other characters, by their common hermaphrodism, then we shall find in each such group two extremes of form—the one resulting from the great development of the pallial region, the other from that of the mesosoma. In the Diœcious Division, *Dentalium, Vermetus, Atlanta*, and the ordinary *Pectinibranchiata* may be regarded as examples of the former case; and in the Monœcious Division the *Inferobranchiata* and *Tectibranchiata;* while the mantle becomes rudimentary or absent altogether in the Diœcious *Firoloides*, in the Monœcious *Phyllirhoë*, and the *Nudibranchiata* in general, where the region from which the so-called branchial processes arise, and which is commonly called the mantle, is not the homologue of the mantle of *Atlanta* for example, but of its mesosoma, which here, as in *Firoloides*, constitutes the main portion of the body.

Fig. 8.

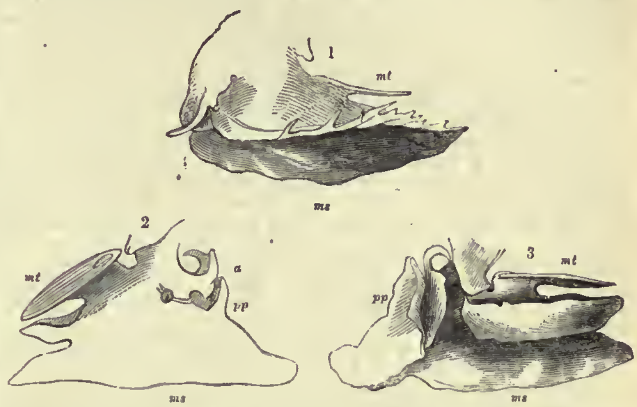
Heteropoda.—8, *Atlanta;* 9, *Firoloides.*

a, oral aperture; *b*, anal aperture, or the extremity of the intestine; *mt*, mantle; *ms*, mesopodium; *pp*, propodium; *v*, ventricle.

The foot in the Monœcious Hæmal *Mollusca* rarely presents any special development of its different regions, except that in certain forms—namely, *Aplysia* and *Gasteropteron*—the epipodium is as well marked as in the *Pteropoda*, and serves the same end in locomotion. This is well known in *Gasteropteron*, and we have seen a tropical *Aplysia* 'fly' through the water in precisely the same way as a Pteropod would do. These epipodial lobes have been frequently called mantle, although the true mantle is a most distinct and obvious structure.

In the Diœcious group the epipodium is never well developed, presenting itself at most under the form of little lobes and processes —at least it would seem probable that the neck-lappets and head-lappets of the *Trochidæ* are rudiments of the epipodium. On the other hand, it is in this group that the propodium, mesopodium, and metapodium attain their most complete and distinct form; as in *Atlanta*, where the propodium constitutes the anterior flattened fin, the mesopodium the rounded sucking disc, and the metapodium extends backwards, as the tail-like lobe which carries the operculum. In *Firoloides* we find that the mesopodium has vanished, and the metapodium has taken the form of a mere filament, while the propodium constitutes the great swimming fin.

Fig. 9.



Foot of *Pectinibranchiata.*—1, *Trochus;* 2, 3, *Natica.*

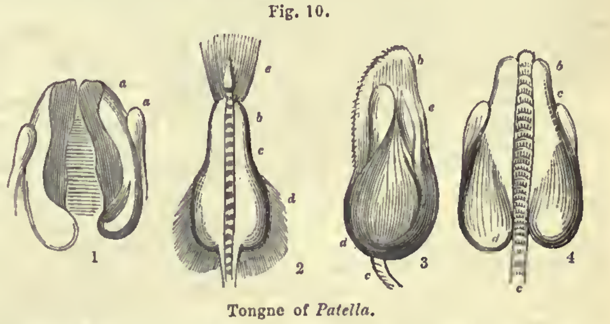
a, oral aperture; *mt*, metapodium; *ms*, mesopodium; *pp*, propodium.

In the ordinary *Pectinibranchiata*, on the other hand, the foot may not be differentiated into its subdivisions at all, the metapodium being marked only by the position of the operculum, when this exists, as in *Buccinum*. In other cases, as in *Oliva* and *Sigaretus*, a deep cleft marks off a very distinct propodium from the conjoined mesopodium and metapodium; in others, as in *Pteroceras*, the metapodium is as specialised as in *Atlanta;* while again, in such forms as *Natica*, the three constituent parts are distinguishable—the propodium constituting the hood in front of the head; the mesopodium the creeping disc; and the metapodium the operculigerous lobe. (*Fig.* 9, 2 and 3.)

Having thus passed in review those modes of arrangement of the various organs of the *Mollusca* which constitute the Common Plan of the group and the subordinate plans of its leading subdivisions, we have next to consider the peculiarities presented by these organs themselves, or, in other words, those more striking features in which the organs of the *Mollusca* differ from those of the *Vertebrata, Annulosa*, and *Radiata*. The most important organs, in this point of view, are those of—1, the Alimentary; 2, the Circulatory; 3, the Respiratory; 4, the Renal; and 5, the Nervous System.*

1. The Alimentary Organs, in certain *Mollusca*, present two kinds of apparatus which are met with in no other division of the Animal Kingdom. The first of these is that peculiar manducatory instrument usually called the 'tongue,' which is possessed by all the *Mollusca* proper, except the *Lamellibranchiata;* and for the first description of whose true structure and mode of action we are, we believe, indebted to Mr. Thompson (see article 'Tongue,' in the 'Cyclopædia of Anatomy and Physiology'), although the organ itself had been more or less an object of attention ever since the time of Cuvier.

Fig. 10.



Tongue of *Patella.*

1. *a a*, the cartilaginous plates which constitute the pulley over which the elastic plate 2, *b*, supporting the series of teeth *c*, plays; *d* and *e* are the anterior and posterior insertions of the intrinsic muscles of the tongue. 3 is a side view, and 4 a view from above, of the entire apparatus.

The tongue is essentially composed of a cartilaginous mass, with a pulley-shaped upper and anterior surface, which projects from the bottom of the oral cavity. An elastic plate plays over the pulley, and is attached at each end to muscles which arise from the upper and

* Our limits preclude the consideration of the tegumentary and genital systems, whose peculiarities however are less exclusively Molluscan.

lower surfaces of the cartilaginous mass. Along the middle line of this elastic plate successive transverse series of strong recurved teeth are set—new ones being continually formed behind as the old are worn away—in a sort of persistent dental sac.

When the tongue is brought into play it is protruded by appropriate muscles from the cavity of the mouth, and its extremity is firmly applied against the body to be rasped. The superior and inferior sets of muscles, which are inserted into the corresponding ends of the elastic plate, now contract alternately, and the resulting action is precisely that of a circular saw. It is by means of this apparatus that the Carnivorous *Mollusca* bore through the shells of the animals upon which they prey; and perforated shells which have been thus emptied abound on every coast.

The other appendage of the alimentary canal peculiar, so far as we at present know, to the *Mollusca*, is what is termed the Crystalline Style, a transparent, usually elongated body, which projects by one end into the stomach, and is lodged for the rest of its extent in a sac formed by a diverticulum of that organ. The Crystalline Style is found in a great number of Lamellibranchs (to which group it has erroneously been supposed to be confined), but has hitherto been observed in only a few Pectinibranch *Mollusca*, such as *Pteroceras*, *Strombus*, *Trochus*, and *Murex*. Its function is wholly unknown.

Among the alimentary appendages, the Liver in one group, the Ascidians, departs sufficiently from the ordinary plan to deserve particular notice. In these animals (*fig.* 7, No. 4, *k*) it always consists of a series of narrower or wider anastomosing tubules, commencing in cœca upon the outer surface of the intestine, which they envelope in a close network, and terminating by a narrow duct in the stomach. In the *Botryllidæ* the hepatic tubules are remarkably wide.

2. The nature of the Circulatory System in the *Mollusca* is at present in some respects a vexed question, more especially as regards the important point whether they possess a true closed system of vessels or not. Without entering into any discussion of the various arguments used on both sides of a dispute which is in some respects verbal, we may be permitted shortly to state our own conclusions on the subject.

In the *Polyzoa* there are no special circulating organs, if we except the cilia with which the perivisceral cavity is often lined, and which keep up a continual current in the perivisceral fluid; nor do we imagine that any one will insist that in them the perivisceral cavity is not a sinus, but has a truly venous lining membrane.

In the *Ascidians* there is a heart, but it is a simple muscular sac, open at each end, and possessing the extraordinary power of reversing the direction of its contractions, and thus circulating its blood first in one way and then in the opposite. The blood thus poured out is driven through channels in which assuredly no separate lining membrane is demonstrable. Indeed it is difficult to comprehend how any one with a living Ascidian under his microscope can question that here, at any rate, the circulation takes place through lacunæ, and not through vessels with distinct walls.

In the *Brachiopoda* a very remarkable vascular system has been said to exist, consisting of two hearts (in *Rhynchonella* of four), each composed of an auricle and a ventricle; the former being in free communication with the perivisceral venous sinuses (perivisceral cavity, *nobis*), while the latter ends in an aorta, whose branches undergo a regular distribution. Such is the circulatory system in the *Brachiopoda* according to Professor Owen; but our own inquiries have tended to strengthen very greatly the doubts first raised by Mr. Hancock as to the true nature of this so-called circulatory system. In fact these inquiries lead us to doubt whether the so-called 'hearts' of the *Brachiopoda* have anything at all to do with the circulating system; inasmuch as, in the first place, we are pretty confident that no 'arteries' are given off from the apices of the 'ventricles,' as has been said, and think it more than probable that they open externally. Secondly, there is no evidence at present, either indirectly from structure or directly from observation during life, that the so-called 'hearts' of any Brachiopod are contractile. Thirdly, the multiplication of these hearts to four in *Rhynchonella* seems not a little to militate against their cardiac nature.

We may fairly conclude then that, for the present, the nature of the circulatory system in the *Brachiopoda* must be regarded as an open question.

Mollusca Proper.—The doctrine first advocated by M. Milne-Edwards that in these Molluscs the circulating system is always more or less incomplete, has met with a wide acceptance, but also with no small opposition. So far as the minute transparent Molluscs, which can be submitted to direct microscopical observation during life, are concerned, we do not understand how the truth of M. Milne-Edwards's doctrine can be questioned. If the term 'venous lining' is to have any meaning but a non-natural one, assuredly it cannot be said with truth that anything of the kind exists in the sinuses of *Firoloides*, or of *Atlanta*, or in those of the *Pteropoda*.

In the larger *Mollusca*, on the other hand, much depends on the verbal question—what is the definition of a 'vein,' or 'venous membrane?' If a lamina of connective tissue separable from the surrounding parts be a venous wall, then doubtless the venous blood-channels of many Lamellibranchs and Gasteropods, and perhaps of all Cephalopods, are veins. If on the other hand a greater histological differentiation corresponding to that which exists in the *Vertebrata* be required to constitute a vein, evidence of the existence of anything of the kind in the greater proportion of the venous blood-channels of these creatures is at present wanting.

As regards the grosser structure of the circulatory apparatus in the *Mollusca* proper, it may be observed that, in the *Lamellibranchiata* there is either a single auricle and a single ventricle (*Ostræa*), a single ventricle and a double auricle (most Lamellibranchs), or two auricles and two ventricles (*Arca*). In all other *Mollusca*, except the *Cephalopoda*, there is a single auricle and a single ventricle. In the *Cephalopoda* the heart is essentially similar to that of the Lamellibranchs, inasmuch as it consists (in the *Dibranchiata*) of a single ventricle and of two contractile, so-called 'Branchio-Cardiac Veins,' which represent the two auricles of the Lamellibranchs. The circulation in these creatures is assisted (at least in *Loligo media*, in which we lately had opportunities of convincing ourselves of the fact), not only by the regular contraction of the so-called 'branchial hearts,' which are dilatations of the afferent branchial veins, but by that of the gills themselves.

The nature of the so-called Pericardium in the *Mollusca* has been much misunderstood. It is most important to recollect that in no case is there evidence of its being a closed serous sac comparable to the pericardium of the higher animals. On the contrary, wherever it has been examined with sufficient care (*Lamellibranchiata*, *Pteropoda*, *Heteropoda*, *Nudibranchiata*, and *Cephalopoda*), it has been found to be a blood-sinus, which in some cases (*Pteropoda*, *Cephalopoda* (?), *Lamellibranchiata* (?), and *Heteropoda*) communicates with the exterior by the mediation of the renal organ.

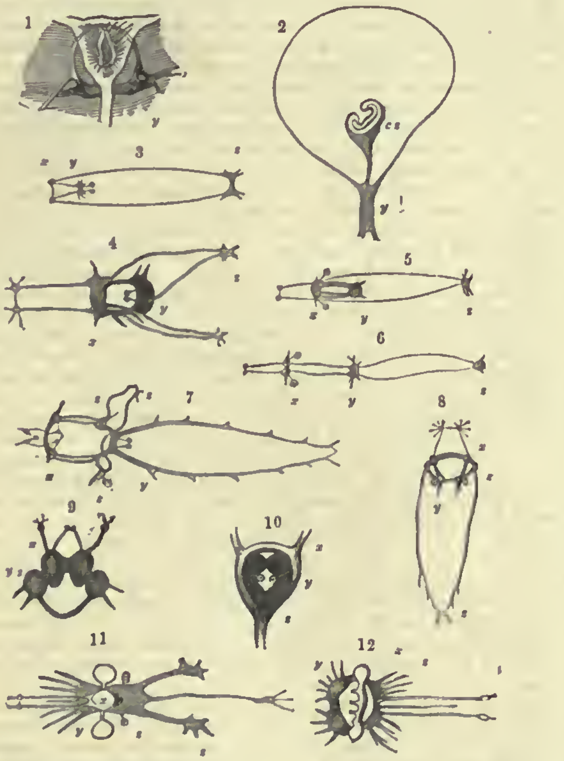
3. The Respiratory Function is performed by modifications of several distinct parts in the *Mollusca*.—1. By the general surface of the pallial cavity, which may be more or less adaptively modified: this kind of respiratory organ is to be found in the *Brachiopoda*, *Pteropoda*, and *Pulmonata*. 2. By specially modified parts of the walls of the pallial cavity into true gills: the whole tendency of the modification of form which these gills undergo is to increase their surface, and this end, generally speaking, is effected in one of three ways:—*a.* By the development of simple processes, as in *Patella* or *Atlanta*. *b.* The simple processes become ramified, so that the gill eventually consists of a stem with lateral branches, and these again may be subdivided into smaller and smaller branchlets—*Pectinibranchiata* and *Cephalopoda*. *c.* In the *Lamellibranchiata* each gill essentially consists of a stem with lateral undivided branches, and in such forms as *Trigonia* and *Nucula* (*fig.* 4, No. 3, *t.*); the branchiæ have precisely this structure. In *Nucula* the lateral branches are comparatively short, but in *Trigonia* they are much longer. In *Pecten* they turn up at their free ends upon themselves and form a close loop, so that the free end takes a position near the fixed extremity; at the same time lateral processes are given off from the branches which unite and connect them together by a very loose and open vascular network. Each gill has thus become a flattened pouch, completely open, both laterally and superiorly; the sides of the pouches are very open, and are constituted superficially by the parallel produced and reflected portions of the gill-branches, and more deeply by the very loose network formed by the anastomosing lateral processes. Now, if we suppose that the reflected portion of the outer gill-pouch adheres to the mantle, while the reflected portion of the inner gill-pouch remains free on each side of the foot, but adheres to its fellow behind the foot, thus forming a complete partition across the pallial cavity, the deep vascular network becoming very close, and giving off vertical septa, by which the pouch becomes divided into successive antero-posterior chambers; then the result will be such a gill as we meet with in the Oyster, the *Unio*, and the great majority of *Lamellibranchiata*. The minute structure of these branchiæ strikingly resembles that of the branchial sac of the Ascidians, as has been long since pointed out by Siebold and others, and has given rise to the prevalent idea that the two organs are homologous. Structural resemblance, however, is in itself no true basis for the establishment of homologies, and here there are abundant means of demonstrating the resemblance to be simply analogical. 3. The 'branchiæ' of the *Nudibranchiata* again doubtless subserve respiration, but they are developed from the mesosoma, and contain the gastro-hepatic processes of the alimentary canal—features by which they are essentially distinguished from true gills. 4. The branchial sac of the Ascidians is, as we have shown, a modification of their pharyngeal sac, resembling the gills of fishes (especially *Amphioxus*) more than any structure to be found in other *Invertebrata* (the nearest approximation perhaps is in the cloacal branchiæ of Neuropterous Larvæ and of some Annelids). Like the wall of the gill-pouch of *Lamellibranchiata*, that of the branchial sac of the Ascidians is fundamentally composed of two elements—a superficial strong framework of branchial bars corresponding with the 'gill-branches,' and a deeper vascular network connecting these. The more obvious peculiarities in the structure of the branchial sac of Ascidians are produced by the plaiting of its wall into the so-called branchial folds, which may vary in number from four (*Cynthia*) to a number so great that the wall of the sac appears crimped (*Phallusia*).

4. The Renal Organs.—The existence of a special organ for the urinary secretion has now been demonstrated in all the great divisions of the *Mollusca* except the *Polyzoa* and *Brachiopoda*. The essential feature

of the molluscan kidney is the deposition of a quantity of urinary excretion beneath a free surface, which in all aquatic *Mollusca* is, by some means or other, freely bathed with water. In *Phallusia*, for instance, minute rounded sacs, each clothed with a delicate epithelium, and containing one or many concretions, are scattered over the intestine immediately beneath the lining of the atrial cavity. It is probable that the constant current setting through this cavity carries away some portion of the secretion; but the greater part seems to remain, and eventually coats the whole parietal surface of the atrium. Here the secreting part of the apparatus appears to be out of proportion to the excretory. In the *Pteropoda* and *Heteropoda* the reverse relation would appear to obtain. In these animals in fact the concretions have not yet been detected; but the excretory apparatus is an elongated sac which opens at one end by the side of the anus, and at the other communicates with the pericardial blood-sinus. The sac contracts rhythmically and with great rapidity, so that the blood in contact with its delicate walls must be very effectually washed. How far the internal communication with the blood-sinuses is available for the same end, is not at present understood. In the *Lamellibranchiata* (at least in *Unio*) the pericardial sinus is connected anteriorly with the internal cavities of two spongy bodies—the glands of Bojanus—in which a great quantity of concretionary matter may be detected; on the other hand, the outer surfaces of these glands lie in a cavity which admits the water freely by an opening placed anteriorly close to the genital aperture. This cavity clearly corresponds with the contractile sac of the *Pteropoda* and *Heteropoda*, but no evidence of contractility has yet been observed in it or in the renal organ itself. Keber also denies that any direct communication exists between the interior of the kidneys and pericardial sinus and the outer sac, but it is somewhat difficult to make sure of this. However this may be, the arrangement of the kidney in *Unio* is very interesting from its close analogy with what obtains in the *Cephalopoda*, where the 'serous cavities,' which open at the base of the gills and contain the peculiar spongy venous appendages attached to one of their walls, correspond exactly with the excretory sacs of the *Lamellibranchiata*, while the spongy appendages themselves are but the glands of Bojanus in another form. Our limits will not permit of the description of the structure of the renal organ in *Nudibranchiata* and *Pectinibranchiata*, but it might readily be shown to resemble in all essential points that of the *Lamellibranchiata* and *Cephalopoda*.

5. The Nervous System of the *Mollusca*.—The *Molluscoida* and the *Mollusca* respectively present a remarkable agreement in the general

Fig. 11.



Diagrams of the Central Nervous System—1, *Waldheimia*; 2, *Phallusia*; 3, *Lamellibranchiata*; 4, *Pterocerus*; 5, *Atlanta*; 6, *Firola*; 7, *Patella*; 8, *Bullæa*; 9, Eolis (after Alder and Hancock); 10, *Criseis*; 11, *Ommastrephes* (Hancock); 12, *Nautilus* (Owen). The circles with central dots represent the auditory vesicles.

cs, ciliated sac; *x*, cerebral ganglia; *y*, pedal ganglia; *z*, parieto-splanchnic ganglia.

arrangement of their nervous apparatus, which consists in the *Polyzoa* and *Ascidioida* of a single ganglion placed in the midst of the neural region of the body; in the former case between the oral and anal apertures, in the latter between the oral and cloacal apertures. In the *Brachiopoda* the nature of the nervous system is only known with certainty in the *Terebratulidæ*, where it consists of a single elongated ganglion having the same position as in the *Polyzoa*, sending on each side a commissural branch to surround the mouth, and giving off numerous branches to the mantle. In the *Brachiopoda* no distinct organs of sense have yet been observed, but in the Hippocrepian *Polyzoa* a little tongue-shaped organ projecting from the lophophore close to the ganglion, probably represents the 'languet' of the Ascidians, an organ whose function is not known, but which probably performs, in conjunction with the ciliated sac, the part of an organ of sense. The 'ciliated sac' is, as its name implies, essentially a small ciliated pouch placed between the oral end of the hypopharyngeal band and the circlet of tentacles. In the *Cynthiæ*, *Phallusiæ*, &c., it becomes enlarged and twisted upon itself, so that its margin frequently presents a very elegantly convoluted pattern, *fig.* 11, 2, *c s*. In this form it was described by Savigny as the 'Tubercule Antérieure.' In *Appendicularia* and in the *Salpæ* an otolithic sac is also attached to the ganglion.

In all the *Mollusca* proper the nervous system presents a remarkable uniformity as to its central elements, and remarkable differences in their arrangement. There are essentially three pair of ganglia :—

1. The Cerebral, which supply the eyes and olfactory organ, and give off the nerves to the buccal ganglia where they exist.

2. The Pedal Ganglia, which supply the foot with nerves, and always, save in *Heteropoda* and perhaps some Nudibranchs (where the exception is very possibly only apparent), give off the nerves to the auditory vesicles.

3. The Parieto-Splanchnic Ganglia, which supply the hæmal region of the body and many of the viscera.

There are never more than two pedal and two cerebral ganglia, but the parieto-splanchnic centres would seem to be capable of almost indefinite multiplication. These multiplied centres however may be reduced to two classes—Parietal Ganglia, which give nerves to the sides of the body, and Visceral Ganglia, which supply the heart, branchiæ, &c.

The accompanying diagramatic figures of the nervous systems of Molluscs of all classes, in which the Cerebral Ganglia are marked *x*, the Pedal *y*, and the Parieto-Splanchnic *z*, will render the great changes of position, while the essential parts remain the same, obvious without further description.

For the organs of sense of the *Mollusca* proper we must refer to the articles CONCHIFERA, GASTEROPODA, &c.

4. *The Development of the Mollusca*.—Those conceptions which the philosophical anatomist comprehends under the name of Archetypes, or Common Plans of Animal Forms, must always present a certain value and interest to all who regard anatomy as something more than an exercise of the memory; but the amount of the value of such conceptions, and of their beneficial influence on the forward progress of science, depends entirely on the extent to which they embrace the whole anatomical peculiarities of a group of animals. Now animals, like all living beings, not only are, but become; and their anatomy, in the widest sense of the term, is to be obtained, not merely by the study of their structure (which is their final anatomy), but also by that of their development, which is the anatomy of the successive states through which they pass in attaining their final condition. Now the Archetype or Common Plan professing to be the embodiment of the most general propositions which can be enunciated with regard to the anatomy of the group, its validity will depend upon its embracing both structural and developmental facts. If it neglect either of these, it will be theoretically imperfect, and will run the risk, at any rate, of being practically erroneous. Before the publication of Von Bär's great work, and unfortunately too often since then, the extant notions of archetypes, unity of organisation, &c., were open to precisely this objection, their authors having contented themselves with devising hypotheses to fit the facts of adult structure, without concerning themselves whether their hypotheses would or would not also fit the facts of development. Hence the infinite variety of baseless speculations of the 'Nature-philosophie' school; in botany, the unlimited and quite gratuitous demands upon 'abortion and fusion' of parts which Schleiden has so justly ridiculed; in zoology, such notions as that a Cephalopod is a vertebrate animal doubled upon itself, that an Insect is a vertebrate animal with free ribs, &c.

It is precisely on this footing however that at present our Common Plan or Archetype of the *Mollusca* stands. We have before us the evidence which might perhaps have satisfied Geoffroy and Oken. Given our plan and certain laws of modification, and all known molluscan forms may be derived from it; but it remains to be seen how far the evidence which would alone have satisfied Von Bär, the evidence of development, justifies the view which has been taken; how far in fact our hypothesis is capable of being elevated to the dignity of a theory.

To this end it is by no means requisite to show that every Mollusc has at one time the archetypal form, and is subsequently modified into its persistent condition; to maintain such a proposition it would be necessary greatly to simplify (though not essentially to alter) the archetype, and thus to do away with a great part of its utility in exhibiting the tendencies of every Mollusc. All that appears to be really necessary is to show:—first, that no molluscan form presents features in its development which cannot be reconciled with the archetype; and secondly, that the kind of modifications which have been supposed to take place in the conversion of the archetype into the special types are such as actually occur.

The first stage of development of the *Mollusca* resembles that of other animals. The yelk, at first a homogeneous mass, undergoes the process of division to a greater or less extent, its outermost layers eventually becoming converted into a blastodermic layer, the plastic material out of which the future animal is modelled.

Fig. 12.

Development of—I. *Clavelina*. II. *Lamellibranch* (Lovén). III. *Antiopa*. IV. *Sepia* (Kölliker).

a, oral aperture; *b*, anal aperture, or extremity of the intestine; *d*, cloacal aperture and atrium (Ascidians); *ep*, epipodium; *mt*, metapodium; *g*, hypopharyngeal band (Ascidians); *m*, mantle; *s′*, *s″*, anal and branchial siphons (*Lamellibranchiata*); *t*, branchiæ; *A*, anterior adductor (*Lamellibranchiata*); *B*, posterior adductor.

In the *Molluscoida* the rounded or oval embryo thus formed either becomes covered with cilia and swims away as a free form (*Polyzoa*, *Brachiopoda?*), or it gives rise from one portion of its surface to a long fin-like muscular process (*fig.* 12, I. 1.), by whose rapid vibration it is propelled (*Ascidioida*, in great part). With what organ of the *Mollusca* is this 'tail' or 'fin' of the Ascidian larva homologous? This is a very difficult point to ascertain, as the tail arises before the regions of the animal are differentiated. At first sight one might be tempted to consider it as a modification of the velum of the embryos of the *Mollusca* proper; but its relation to the middle of the neural surface, and its insertion close behind the ganglion, which may be readily observed in later stages, appear rather to indicate that it is the homologue of the foot proper, and probably of the metapodium, as this is the portion of the foot which in the *Mollusca* appears first.

In the further development of the *Molluscoida* there can be no question that, as regards the *Polyzoa*, the neural region soon almost ceases to grow, the further increase of the body taking place by the disproportionate development of the hæmal region, which constitutes almost the whole of the body of the adult animal, and presents the surface by which it becomes fixed. Again, simple inspection is sufficient to show that the intestine extends into the great abdomen thus developed; that it acquires herewith a neural flexure; that the tentacles are produced from the margins of its oral aperture; and that the pharynx acquires a large proportionate size.

In the *Ascidioida* the neural region remains in a like rudimentary condition, the hæmal region undergoing a similar disproportionate growth; but it is next to impossible to ascertain from the study of development whether this hæmal outgrowth is formed behind the anus or before it, inasmuch as the intestine has acquired its complete hæmal flexure when its parts are first distinguishable.

In the youngest state in which the different organs are distinguishable, the intestine is almost entirely bent up on to the hæmal side of the body; the pharynx is a wide cavity (not wider proportionally however than that of a Polyzoon); the tentacles spring from its margin in exactly the same relative position as in a Polyzoon, and there is no atrial cavity. By degrees the pharyngeal cavity enlarges still more, the tentacles remaining comparatively rudimentary (*fig.* 12, I. 2). Contemporaneously with these changes, the end of the intestine becomes more and more bent down towards the neural surface, and a cavity, which in another Mollusc would be the mantle-cavity, appears around its extremity; a single or two lateral apertures (subsequently uniting into one) are soon formed, and allow this cloacal portion of the atrial cavity to communicate with the exterior. At the same time the atrium extends on each side of the enlarged pharynx, detaching it from the side of the body, and enveloping it just as a serous sac invests the surface of a viscus. Ciliated apertures (at first one or two only on each side) now pierce the wall of the enlarged pharynx, and increase in number until it assumes the structure of the perfect branchial sac. Finally, it depends upon the proportional development of the branchial sac, and of the post-abdomen, whether the adult Ascidian shall belong to the Branchial or to the Intestinal subtype.

We unfortunately know hardly anything of the development of the *Brachiopoda*; but so far as the *Polyzoa* and *Ascidioida* are concerned, it is obvious that the hypothetical modifications of the Archetype do in fact faithfully represent the actual course of development. (See however the remarks, further on, as to the nature of the post-abdominal outgrowth in hæmal *Molluscoida* and *Mollusca*.)

Development of the Neural Mollusca.—The *Lamellibranchiata*.—The first step towards the production of the organs from the blastodermic layer in this group is the development of one portion of its surface into a disc with mixed edges provided with very long cilia (*fig.* 12, II. 1). Next in the inner substance of the germ the intestine appears as a solid mass, bent upon itself, towards what the eventual development of the foot proves to be the neural surface; its oral portion being placed immediately behind the ciliated disc (2). Finally, the hæmal surface behind the ciliated disc gradually gives rise to the two lobes of the mantle, upon each of which a thin transparent pellicle, the first rudiment of one valve of the shell, eventually appears. As development goes on (3), the neural surface between the primarily approximated oral and anal apertures becomes converted into the large foot and mesosoma of the Lamellibranchs, which serve to lodge the principal mass of the viscera, the abdomen never becoming developed into a great process as in Gasteropods. The great posterior adductor makes its appearance on the neural side of the intestine, and by its development the latter is thrown up so as almost to appear to have a hæmal flexure. The gills next appear as processes of the body within the mantle-cavity, and therefore have not the remotest homology with the pharyngeal branchial sac of Ascidians, any more than the two siphonal apertures which are essentially dependent upon the union of the two lobes of the mantle with the gills and with one another have anything to do with the oral and cloacal apertures of the Ascidians.

Finally, it is said that the ciliated disc becomes metamorphosed into the labial palpi. This is a point well worthy of further investigation; for the arrangement and form of the appendages in *Pecten* lead us strongly to believe, as we have said, that they are the homologues of the tentacles in the *Ascidioida* and *Polyzoa*. On the other hand, there can be no doubt that the ciliated disc of Lamellibranchs is homologous with the ciliated lobes of the Gasteropod embryos; and these, there is every reason to believe, are nothing but the specially modified anterior portion of the epipodium. The tentacles of the *Polyzoa* would thus come to be the homologues of the epipodium; but the validity of the whole chain of reasoning obviously depends upon whether the ciliated disc does or does not become metamorphosed into the palpi—a position which the more requires confirmation as in the *Gasteropoda* the ciliated lobes are now known entirely to disappear. However this may be, what has been stated with regard to the main steps in the development of the *Lamellibranchiata* fully confirms the hypothetical derivation of the type from the Common Plan.

Pteropoda and *Pulmonata*.—In the primary stages of their development no important distinction is to be drawn between the members of this division and those of the last, except that in the *Pteropoda* the ciliated disc is replaced by two ciliated lobes, one on each side; and in the Pulmonate embryos by a contractile expansion—their so-called 'yelk-sac.' The primarily neural flexure of the intestine in the *Pulmonata*, and the development of their mantle in front of the anus (that is, the development of an abdomen), are fully demonstrated by late observations upon their embryogeny. It is important to remark, that in the *Pteropoda* the ciliated lobes of the embryo do not become the lateral alæ of the adult form, but are a production of the anterior part of the epipodium, which usually disappears in the adult.

Cephalopoda.—In this group the embryo attains a much higher development before leaving the egg, and the modifications which its primary form undergoes are extremely instructive. The first organs of the Cephalopod which appear on the germ-disc are (*fig.* 12, IV. 1) the mantle, which is simply a thickening in the middle of the hæmal surface with somewhat raised edges; around this is a surface representing the mesosoma and foot, at one end of which is the mouth, and at the other or anal extremity are placed two little processes, the rudiments of the gills. Again, on each side of the mantle the mesosoma is produced into a longitudinal ridge occupying the precise position of the epipodium. As development goes on, the hæmal surface occupied by the mantle grows out, and becomes a prominent sac, whose free edges detaching themselves more and more for only a short distance anteriorly, but for almost the whole length of the sac posteriorly, give rise to the mantle cavity (IV. 2). The intestine passing into the abdomen thus formed becomes more and more bent upon itself, until at last it makes a complete loop, open towards the neural side. With all this the epipodium, remaining rudimentary in its anterior region, becomes a free process on each side posteriorly (representing for a time the alæ of a Pteropod), but after a while these processes unite, and form a hollow canal, the Funnel. The changes undergone by the margins of the foot are not less remarkable; they are produced from behind forwards into four or five digitations on each side, the anterior pair of which stretch in front of the mouth and unite over it; the digitations elongate more and more, and the mouth is in consequence at last placed in the centre of a sort of inverted cone, formed by the foot and its prolongations—the acetabuliferous arms (IV. 3).

Such may be taken as a very short abstract of Professor Kölliker's most valuable 'Entwickelungs-Geschichte der Cephalopoden,' and it is needless to point out that it is our hypothetical process of modification of the Archetype into the Cephalopod type, in other words.

The Hæmal Mollusca.—It is unnecessary to consider the development of the separate families of these Molluscs, as the process, as far as we know, is the same in all. We will take that of a Nudibranch (*Antiopa cristata*) as a type, having recently had occasion to go over it with especial reference to the points here under consideration.

The end of the process of yelk-division (which, we may remark in passing, results, not in the formation of 'nucleated cells,' but simply in that of smaller and smaller packets of yelk-granules) in this Mollusc, is the formation of a blastodermic layer investing the remainder of the yelk. The whole embryo next becomes more or less bell-shaped, a sort of rim, with very long cilia, appearing at the broader end, while a minute prominence is seen at the opposite extremity (III. 1). A straight line drawn from this prominence to the centre of the surface, surrounded by the rim, would have the body of the creature symmetrically disposed around it. On the one surface is a deep pit, formed by the edges of the blastodermic layer; on the opposite a delicate transparent cup, the rudiment of the future shell, and the indicator of the position of the hæmal surface and mantle, appears (III. 3). By degrees the hæmal surface becomes more and more prominent and the shell larger. With this the prominence above referred to is thrust more and more towards the right side, so that its position becomes quite asymmetrical (II. 3, 5). At the same time the ciliated rim from being circular is produced laterally into a lobe on each side—the ciliated lobes; the metapodium makes its appearance behind these as a small prominence; and a delicate operculum is formed upon the metapodium. The aperture of the mouth may now be observed behind the ciliated lobes and between them and the metapodium; and the internal substance of the germ is seen to present the outlines of an alimentary canal, consisting of a rounded gastro-hepatic mass and a narrower intestine, which turns abruptly forwards and upwards, to end on the right side more or less hæmally in the before-mentioned prominence, whose position has become thus extensively altered. The mantle cavity has begun to appear as a sort of pushing-in of the integument around the anal prominence.

Two things are obvious in this series of developmental changes. In the first place, the primary symmetricality of the embryo; secondly, the gradual asymmetry brought about by the development of that portion of the body which bears the shell, and which is a portion of the hæmal surface.

Now this is perfectly in accordance with our hypothetical derivation of the Hæmal *Mollusca* from the Archetype, and the only point which remains to be proved is, that this over-developed hæmal surface is to be considered as a post-abdomen, that is, as a post-anal portion of the hæmal surface.

This view has been taken in deriving these forms from the Archetype, because it is much the more readily comprehensible, and has many structural facts in its favour; but we are by no means prepared to assert that the post-anal position of the hæmal outgrowth in the Hæmal *Mollusca* may not be a secondary production, the result of a gradual twisting to one side and backwards of a primarily pre-anal outgrowth of the hæmal surface. The facts just detailed with regard to the development of *Antiopa* would favour this view; but, on the other hand, sufficient attention has not been paid to the process of development of other *Gasteropoda* to decide whether it is in these respects identical with that of the Nudibranchs or not. The anatomy of adult Pectinibranchs and Pteropods would lead one to believe that in these forms, at any rate, the hæmal flexure has been direct and primary; and it may be that a careful comparative study of development of the Pectinibranchs and Nudibranchs will lead to the translation of the Nudibranchs to the Neural division, the final hæmal flexure turning out to be a secondary modification. In the absence of sufficiently conclusive studies of this kind, however, we prefer to be guided by structural considerations, and thence to retain the Nudibranchs provisionally among the Molluscs with a hæmal flexure. It will probably be granted that the doctrine of a Common Plan among the *Mollusca*, which has been advanced, will have its value as a guide through the mazes of their varying organisation—even although the details of this first sketch should turn out to be even in many points erroneous.

MOLOCH. [DRACONINA.]

MOLOSSUS. [CHEIROPTERA.]

MO'LOTHRUS (Swainson), a genus of Birds placed in the subfamily *Icterinæ*, under the family *Sturnidæ*, with the following generic character:—Bill very short, thick, finch-like, conic, entire; the culmen not flattened, but slightly arched from the base, which is rather elevated. Wings lengthened, pointed; the first quill longest. Tail slightly rounded. Middle toe as long as the tarsus; lateral toes of equal length; hind toe shorter than the tarsus. All the claws rather small, and fully curved.

M. Pecoris, Sw., the Cow-Pen-Bird, Cow-Blackbird, Cow-Troopial, and Cow-Bunting (*Icterus Pecoris*, Temm.; *Emberiza Pecoris*, Wils.; *Fringilla Pecoris*, Gm.).

Male: Head and neck brown, inclining to black; the rest of the plumage shining black, glossy with violet reflections on the breast and shot with greenish above; irides hazel; legs and claws black.

Cow-Bird (*Molothrus Pecoris*).
a, male; *b*, female; *c*, young. Wilson.

Female: Sooty-brown above, pale beneath.

Young: Like the female, with the breast spotted.

This species is a native of America, and leads a wandering life, appearing in the middle and northern States of the Union at the end of March or the beginning of April. The winter is passed in the southern States and warmer parts of the continent, where they are to be seen with the Red-Wings (*Icterus Phœniceus*) and the common Blackbirds (*Quiscalus versicolor*) in the ploughed fields, according to Nuttall. They attend on the cattle constantly, like many of the *Sturnidæ*, intent on picking up the insects which are disturbed by the quadrupeds or haunt their droppings, nor do they in the colder weather refuse to hunt for aquatic insects and small molluscs on the margins of ponds, where, according to the author last quoted, they may be seen in the winter season industriously turning over the leaves of water-plants to glean such as may there adhere. But though they with their associates are occasionally found in the rice and corn fields, it seems that their depredations are not co-equal with those of their companions, for the food of the Cow-Bunting appears to consist chiefly of insects and such food as makes them for the most part independent of the farmer.

The most curious of its habits remain to be told; for this vagabond bird, like our cuckoo, never prepares a nest for itself, but drops its egg in another's nest. As a concomitant to this ordinance they do not pair, but polygamy prevails among the flock without exciting any great jealousy; though now and then there may be a battle, as is usual in such cases, in which the strongest generally prevails. The egg, which is nearly oval, varies in colour; sometimes the ground-colour is white tinged with green and sprinkled with spots of brown, and sometimes pure white with nearly black spots. It is a very little larger than that of the Blue-Bird. This supposititious egg is, it appears, always hatched before the legitimate ones. Were this not the course of nature, the species would probably perish; for the legitimate nestlings would suffocate the newly-hatched foundling, as the latter actually does suffocate the young of its foster-mother, when they afterwards come into existence.

The favourite nests appear to be those of the Red-Eyed and White-Eyed Flycatchers, and the Maryland Yellow-Throat; those of the Blue-Bird, the Indigo-Bird, the Chipping-Sparrow, the Song-Sparrow, the Blue-Eyed Yellow Warbler, the Blue-Gray Flycatcher, the Golden-Crowned Thrush, and Wilson's Thrush, are however also selected as places of deposit. From the various and interesting accounts of this curious phenomenon we select that of Nuttall, whose personal observations we proceed to lay before the reader:—

"When the female is disposed to lay, she appears restless and dejected, and separates from the unregarding flock. Stealing through woods and thickets, she pries into the bushes and brambles for the nest that suits her, into which she darts in the absence of its owner, and in a few minutes is seen to rise on the wing, cheerful and relieved from the anxiety that oppressed her, and proceeds back to the flock she had so reluctantly forsaken. If the egg be deposited in the nest alone, it is uniformly forsaken; but if the nursing parent have any of her own, she immediately begins to sit. The Red-Eyed Flycatcher, in whose beautiful basket-like nests I have observed these eggs, proves a very affectionate and assiduous nurse to the uncouth foundling. In one of these I found an egg of each bird, and the hen already sitting. I took her own egg, and left the strange one; she soon returned, and, as if sensible of what had happened, looked with steadfast attention, and shifted the egg about; then sat upon it, but soon moved off; again renewed her observation; and it was a considerable time before she seemed willing to take her seat, but at length I left her on the nest. Two or three days after, I found that she had relinquished her attention to the strange egg, and forsaken the premises. Another of these birds however forsook the nest on taking out the Cow-Bird's egg, although she had still two of her own left. The only example perhaps to the contrary of deserting the nest when solely occupied by the stray egg is in the Blue-Bird [BLUE-BIRD], who, attached strongly to the breeding-places, in which it often continues for several years, has been known to lay, though with apparent reluctance, after the deposition of the Cow-Bird's egg. My friend Mr. C. Pickering found two nests of the Blue-Eyed Yellow Warbler, in which had been deposited an egg of a Cow-Bird previously to any of their own; and, unable to eject it, they had buried it in the bottom of the nest, and built over it an additional story. I also saw, in the summer of 1830, a similar circumstance with the same bird, in which the Cow-Bird's egg, though incarcerated, was still visible on the upper edge, but could never have been hatched. At times, I think it probable that they lay in the nests of larger birds, who throw out the egg, or that they drop their eggs on the ground without obtaining a deposit, as I have found an egg of this kind thus exposed and broken. I have also remarked sometimes two of these eggs in the same nest, but in this case one of them commonly proves abortive." The same author in 1831 saw a hen Red-Eyed Flycatcher sitting on two eggs, and one of the Cow-Bird; and he adds that this species, *Vireo olivaceus*, and (more lately) *Vireosylva olivacea* of Bonaparte, *Muscicapa olivacea*, Linn., appears to be its most usual nurse. He has known this *Vireo* begin her incubation with only an egg of each kind, whilst in other nests he has observed as many as three belonging to the *Vireo*, as well as that of the intruder; and he suggests that, from the largeness of the egg, the nest probably immediately feels full to the incubating bird, so as to induce her to sit directly, when the larger egg, being brought nearer to the body of the nurse than her own, is first hatched, generally, as he believes, on the twelfth or thirteenth day. The legitimate eggs are hatched about a day later, are often stifled by the superior size of the stranger, which is affectionately nursed by the poor dupe of a dam, and when the young are dead are conveyed to a distance by the parent and dropped; but they are never found immediately below the nest, as would be the case if they were ejected by the young Cow-Bird, as is done by the young Cuckoo. [CUCULIDÆ.] "Indeed," continues Mr. Nuttall, "as far as I have had opportunity of observing, the foundling shows no hostility to the natural brood of his nurses, but he nearly absorbs their whole attention, and early displays his characteristic cunning and self-possession. When fully fledged they quickly desert their foster-parent, and skulk about in the woods, until at length they instinctively join company with those of the same feather, and now becoming more bold, are seen in parties of five or six in the fields and lanes gleaning their accustomed subsistence. They still however appear shy and watchful, and seem too selfish to study anything more than their own security and advantage." The Cow-Bird is but a poor songster. Its flitting migrations are generally made in the night or in the gray of the morning.

Besides the localities noted above, this species is also found in Mexico, but according to Audubon it is rare and a visitor only in Louisiana. Prince Bonaparte, in his 'Geographical and Comparative List,' gives "America generally" as its locality.

Mr. Darwin ('Journal and Remarks') states that another species (Le Troupiale Commun of Azara), of a purplish black-colour, with a metallic lustre, feeds on the plain near Maldonado in large flocks, mingled with other birds. Several, he says, may often be seen standing on the back of a cow or horse. While perched on a hedge, and pluming themselves in the sun, they sometimes attempt to sing, or rather to hiss: "the noise is very peculiar; it resembles that of bubbles of air passing rapidly from a small orifice under water, so as to produce an acute sound." Azara states that this bird, like the cuckoo, deposits its eggs in other birds' nests. "I was several times told by the country people that there was some bird with this habit; and my assistant in collecting, who is a very accurate person, found a nest of the sparrow of the country (a *Zonotrichia*) with one egg in it larger than the others, and of a different colour and shape." This egg is now in the museum of the Zoological Society of London.

MOLVA. [LOTA.]

MOLYBDE'NUM, a Metal discovered by Scheele in 1778, in a mineral which resembles and had been confounded with plumbago: he gave it the Greek name of Μολύβδαινα. This mineral is composed of sulphur and molybdenum; and it has also been met with in other states of combination presently to be mentioned. This substance was however first reduced to its metallic state by Hjelm, another Swedish chemist, and its properties have been since particularly examined by Bucholz and Berzelius.

The metal is obtained from the native sulphuret by reducing it to fine powder and heating it in aqua regia; by this the sulphur is converted into sulphuric acid, and the metal into molybdic acid, which remains in the state of a white powder after being heated to expel the sulphuric acid; when this is very strongly heated with charcoal, it is reduced to the metallic state; or the metal may be procured by passing hydrogen gas at a high temperature over the acid in a porcelain tube. This metal is obtained as a porous mass or in globules, and has not yet been procured in the state of a button or bar. The grains are somewhat crystalline; sometimes they are of a silver-white-colour. When obtained by the reduction of the oxide, this metal has not much lustre, but acquires it by burnishing. Its density is 8·6. When long exposed to the air at ordinary temperatures, it appears to tarnish, but the oxidation is superficial. By exposure to air and heat, it is first converted into brown oxide, afterwards it becomes blue, and eventually molybdic acid, which is white. This oxidation does not however take place completely, but only at the surface. Sometimes the metal takes fire at the moment of oxidation. It does not decompose water.

Ores of Molybdenum.—Oxide of molybdenum occurs encrusting the sulphuret of molybdenum, and also between its laminæ in thin layers. Its structure is thin fibrous, earthy, friable, and pulverulent. Colour pale-yellow or greenish.

It has been found only in small quantity in Scotland, Norway, and North America. Its composition has not been ascertained.

Molybdic Acid or Molybdic Ochre occurs in nature in combination with lead and silver.

Sulphuret of Molybdenum, Molybdenite, is the most common mineral of this metal. Occurs crystallised and massive. Primary form a rhomboid. Crystallises in hexagonal crystals. Cleavage very distinct, perpendicular to the axis. Fracture indistinct. Hardness, scratches talc, is scratched by calcareous spar. Colour lead-gray, and streak the same. Flexible in thin laminæ, but not elastic. Lustre metallic. Opaque. Specific gravity 4·591. Rubbed on paper, it leaves a gray metallic mark, and on porcelain a greenish one. Massive variety amorphous; structure foliated, granular. When heated by the blow-pipe on charcoal, emits a sulphurous vapour, and leaves a powdery residue. It occurs in various parts of the world—in England, France, Germany, and America; more especially however in Saxony and Bohemia. It contains, according to Bucholz, 60 parts of molybdenum and 40 of sulphur.

Molybdenum combines, as already noticed, with oxygen, and forms two oxides and one acid; but these we have not thought it requisite to describe, any more than its other compounds, for it is not used in any form whatever.

Molybdate of Lead occurs native. [LEAD.]

MOMORDICA, a genus of Plants belonging to the natural order *Cucurbitaceæ.* The flowers are monœcious, yellow or white; the staminiferous flowers have a 6-cleft calyx, with a very short tube, a 5-parted corolla, tridelphous stamens, with connate anthers; the pistilliferous flowers have three sterile filaments, the styles bifid, the ovary 3-celled; the fruit opens with elasticity when ripe; the seeds compressed, reticulated.

M. Elaterium, Linnæus (*Ecbalium, Elateum*, Prichard), the Wild or Squirting Cucumber. The plant is hispid, scabrous, glaucous; the stem prostrate, without tendrils; the leaves cordate, somewhat lobed, crenate-toothed, very rugose, on long stalks; the ripe fruit is about two inches long, roundish, muricate, green, and fleshy; possessing the power of ejecting, along with a mucilaginous greenish juice, the compressed ovate smooth seeds; on which account it is called the Squirting Cucumber. The juice has an extremely bitter taste, and even in very small quantity acts violently as a hydrogogue cathartic, producing numerous watery stools. It owes its power to an acrid and drastic bitter extractive, to which the name of Elaterin has been given. This is soluble in alcohol, ether, and fat oils, but scarcely soluble in water or dilute alkalies or acids, while strong acids destroy it.

The very minute dose which is required of Elaterin recommends it in many cases as a remedy in dropsy, especially ascites, but few persons can bear the violence of its action for any considerable time; two or three days should always be allowed to elapse before repeating the dose. It is apt to cause vomiting as well as purging, and a dose of even a quarter of a grain may produce such extreme action as to sink the patient into a state of alarming debility. It grows wild in the south of Europe, and is cultivated in England. The Elaterin was known to the ancients; it is ὁ Ἄγριος Σίκυος of Theophrastus and Dioscorides. It is the *Cucumus sylvestris* of Pliny. It was much employed by Hippocrates.

M. Balsimina, Linnæus, is supposed to be the plant *Neurosperma cuspidata* by Rafinesque, the fruit of which is stated to be a dangerous poison.

M. operculata, Linnæus, has 5-lobed toothed leaves; elliptical angular tuberculated fruit, with a deciduous rostrum-like lid, green, dry internally, and divided into 3 cells by a plexus of entangled fibres; seeds compressed, black. This plant is a native of South America, and is common on the coast of Essequibo. It is one of the bitterest of all known substances.

(Lindley, *Flora Medica;* Fraas, *Synopsis Floræ Classicæ.*)

MOMOT, or MOTMOT, the common name for the species of Birds belonging to the genus *Prionites*, Illiger. This genus has the following characters:—Both mandibles slightly curved and compressed; the margins with strong denticulations. Tongue long, slender; the sides ciliated. Wings short, rounded. Tail lengthened, cuneated. Feet gressorial, as in *Merops.* (Sw.)

Mr. Swainson ('Classification of Birds') remarks that every writer since the days of Linnæus (who at first actually classed them in the same genus) has placed the Motmots (*Prionites*) and the Toucans (*Ramphastos*) close together, not only from the similarity of their habits, but from the structure of the tongue, which in both is long, and so much ciliated at its sides as to resemble a feather; so far therefore, he observes, the resemblance is unquestionable. "But," continues Mr. Swainson, "the feet of the Motmot are totally different from the Toucan; they are not scansorial, but of that particular structure so common among the *Fissirostres.* The Toucans, we know, from personal observation, to be gregarious, living in flocks, and seeking their food from the tops of lofty trees; the Motmot is solitary, hiding in the deep shades of the forests, and, like other air-feeding birds, is always found sitting nearly motionless. Here then is a very obvious departure from the structure and habits of the Toucan. The question then is, to what does it lead? If to the Hornbills (which has been inferred from the structure of the feet), we should have no diminution in the size of the bill, which in both the Hornbills and Toucans is equally large, but in the Motmot of an ordinary and proportionate size: we should further expect a bird which was gregarious, since both these groups are so. Yet there is nothing in the Motmot, beyond its feet, which will at all assimilate it to the Perchers; while its fissirostral habit of catching its food upon the wing, and the discovery of the broad-billed species, *Prionites platyrhynchus*, seems to us a conclusive argument for placing this genus in the fissirostral order, as more intimately connected to the Jacamars (*Galbula*) [HALCYONIDÆ] than to any other known genus."

P. Mexicanus is green above, paler beneath; head and neck above crimson, ears black, varied, and tipped with bright-blue stripes; belly white. (Sw.)

Mr. Swainson ('Zool. Ill.') states that the Motmots, or Momots, "so named from their monotonous note, live only in the tropical forests of the New World, preferring those deep recesses of perpetual shade where a high canopy of matted foliage nearly excludes the rays of a vertical sun. They appear even more solitary in their disposition than the Trogons; their note may be heard, morning and evening, from the depths of the forests, but the bird is never seen, unless the hunter comes unexpectedly upon its retreat. This we have generally found to be a low withered branch completely shaded and just at the edge of such paths as are made by the Cavies or the Indians. The Jacamars and the Trogons both love these shady nooks, where they sit nearly motionless, watching for passing insects, on which they dart. Such is no doubt the manner in which the Motmot feeds; but his strong conformation enables him to capture larger game. Travellers assert that he also devours the eggs and young of other birds, like the Toucans; this we believe, as both have the same long and feather-like tongue."

Prionites Mexicanus.

Dr. G. R. Gray makes the *Momotinæ*, a sub-family of the *Todidæ*, consist of the genus *Crypticus*, Sw. (*Momotus*, Leadb.; *Prionites*, Sw.), and the genus *Momotus*, Briss. (*Baryphonus*, Vieill.; *Prionites*, Ill.; *Momota*, Shaw; *Ramphastos*, Linn.)

MONAS. [INFUSORIA.]

MONASITE, or MONAZITE, a Mineral with the following composition:—

Oxide of Cerium	26·00
Oxide of Lanthanum	23·40
Thoria	17·95
Phosphoric Acid	28·50
Oxide of Tin	2·10
Protoxide of Manganese	1·90
Lime	1·70
	101·55

It occurs in modified oblique prisms. It has a perfect and brilliant basal cleavage. It is only found in small imbedded crystals. It has a brown or brownish-red colour; subtransparent, or nearly opaque. The lustre vitreous, inclining to resinous. It is found near Platoust in Russia.

MONASSA, Vieillot's name for a genus of Birds (Hermit Birds of Swainson and others). [HALCYONIDÆ.]

MONESES (from μόνος, sole, or alone), a genus of Plants belonging to the natural order *Ericaceæ* and the tribe *Pyroleæ.* It has a 5-toothed calyx; 5-lobed corolla; 10 inclined stamens; the anthers dehiscing at the base by two holes, the cells elongated and tubular; the stigma 5-toothed; the capsule 5-celled; the valves dehiscing from the apex, destitute of tomentum. There is but one species of this genus, *M. grandiflora.* It has a creeping root; large solitary terminal drooping open white flowers, nearly an inch broad; very large stigmas. It is a native of Europe, Asia, and North America, in Alpine mossy woods. It is found in Great Britain, in the mountainous woods of Scotland.

MONEY-WORT. [LYSIMACHIA.]

MONGOOSE, or MONGOOZ, one of the names of a species of Macauco, *Lemur Mongoz*, Linn. [LEMURIDÆ.]

MONIMIA'CEÆ, *Monimiads*, constitute a little-known natural order of Plants, whose most striking distiuction consists in the flowers being naked and collected together into involucra, some male and some female; the male involucra having their inner surface thickly covered with numerous stamens; the female inclnding several carpels, each of which has a single ovule in its interior. The genera are eight and the species about forty in number, and are mostly South American woody plants, shrubs, or trees, with fragrant aromatic secretions. Their real affinity is unsettled. If the prevailing opinion as to their structure is correct, they must be regarded as near allies of *Urticaceæ*; but if what is now called the involucre should be shown to be a calyx, as it was considered till Brown suggested the contrary, they will take their station near *Lauraceæ*, with which their aromatic qualities assimilate them. Lindley regards their true station as near to *Myristicaceæ*. Boldoa, the Boldu of Chili, produces an aromatic succulent fruit, which is eaten. The wood and leaves of this plant are fragrant. The bark is used for tanning.

2 3 1 4 5

Monimia rotundifolia.

1, a male involucre; 2, a female involucre; 3, the last cut open to show the carpels; 4, a ripe fruit; 5, a view of the ripe carpels contained in the latter, the involucrum being partly cut away.

MONITORIDÆ, or MO'NITORS, a family of Lacertian Reptiles: the name Monitor has been given to the typical genus of this family in consequence of the supposed warning given by them of the vicinity of crocodiles. The warning of these Monitory Lizards was said to be a hissing or whistling; but the better opinion is, that they obtained credit for this monition solely from the accident of their haunts, which are for the most part in the neighbourhood of the waters, and consequently bring them sometimes into company with the destructive and gigantic reptiles above-mentioned.

The Monitors have teeth in both jaws, but none on the palate. Cuvier divides them into two groups, and Fitzinger into three, under the names of *Tupinambis*, *Varanus*, and *Psammosaurus*. Dr. J. E. Gray makes the *Monitoridæ* the first family of his *Leptoglossæ*, or Slender-Tongued Lizards.

Character of the Family.—Head with minute polygonal shields; teeth adnate to the inner side of the jaws; tongue elongate, slender, retractile into a sheath at its bases; scales small, roundish, placed in cross rings, those of the sides like those of the back; legs 4, strong; toes 3-5, compressed, unequal; thighs poreless; supraorbital plate bony.

The species are inhabitants of the Old World, and frequent the banks of rivers.

The genera and species of the 'British Museum Catalogue' are as follows:—

A. Tail round, without any keel above. Terrestrial.

Psammosaurus, Fitz.—Nostrils ovate, oblique, near the orbits. Tail roundish, not keeled above, with convex sides, unarmed. Scales not pierced. Toes unequal, rather elongate. Teeth slender, acute.

P. Scincus, Gray, the Ouaran (*Varanus Scincus*, Merrem; *Tupinambis griseus*, Daud.; *Monitor terrestre*, Cuv.; Ouran de Forskal, Geoff.; *Tupinambis arenarius*, I. Geoff.). Gray, obscurely banded with an obscure streak on each side of the head and neck. It is a native of Northern Africa.

P. (?) *Caspicus*, Eichw., the Caspian Ouaran. It inhabits the Caspian Sea.

Odatria, Gray.—Nostrils ovate, longitudinal, sub-anterior; teeth compressed, acute. Tail elongate, round, not keeled above; scales large, sharply keeled, sub-spinose. Back with elongate narrow keeled scales. Ventral shield elongate. Toes rather unequal, elongate.

O. punctata, Gray (*Monitor tristis*, Schlegel), the Dotted Odatria. Gray-olive, with narrow black reticulated lines, leaving large hexagonal spots; head, limbs, and tail blackish, with a few pale spots, dark-banded. Ventral shield twice as long as broad. Tail round, scales over the eye small, granular. Male (?) with a tuft of conical spine-like scales on each side of the vent. It is a native of Western Australia.

O. ocellata, Gray, the Eyed Odatria. Black, with rather large yellow rings; limbs and tail yellow-spotted. Tail round; scales of the tail broad, oval, spinose. Scales over the eyes small, granular. Ventral shields twice as long as broad. It is a native of the north-western coast of Australia.

O. Timorensis (*Monitor Timorensis*, Gray; *Tupinambis viridimaculatus*, Daud.), the Timor Odatria. Black, yellow-dotted, dots forming rings and spots; head yellow and black-dotted. Scales over the orbits small, granular; of forehead larger. Ventral shields nearly as broad as long. Tail slightly compressed above, sub-triangular; base of tail unarmed. Is is a native of Timor.

B. Tail with a compressed keel above, formed of two rows of scales. Nostrils large, oblong, oblique. Aquatic.

Regenia.—Nostrils large, oblong, oblique, near the orbit. Tail shortish, thick, doubly keeled above; scales oblong, bluntly keeled. Toes short, sub-equal. Teeth rounded. Scales large, convex, surrounded with numerous granulations. Head short.

R. albogularis (*Tupinambis albogularis*, Daud.; *Monitor Gillii*, A. Smith; *Varanus ornatus*, var. Merrem; *M. exanthematicus*, var. *Capensis*, Schlegel, 'Abbild.' 71), the White-Throated Regenia. Dark brown, with large white spots, pale beneath, with a dark streak on each side of the back of the neck. Nostrils near the orbit. Scales rather large—of the head convex. It is found in South Africa.

R. ocellatus (*Varanus ocellatus*, Rüppell; *Tupinambis exanthematicus*, Daud.; *M. exanthematicus*, var. Schlegel), the Eyed Regenia. Nostrils rather further from the orbit. Scales large—of the neck largest, of the head tubercular. It is a native of Senegal.

Empagusia, Gray.—Nostrils large, oblong, oblique, in front of the muzzle. Tail as long as the body and head, tapering, roundish, with a double-edged keel above; scales sharply keeled. Toes rather short, sub-equal. Teeth acute. Scales ovate, keeled. Head short.

E. flavescens, Gray (*Monitor flavescens*, Gray; *Varanus Russelii*, Schlegel; *V. Piquotii*, Dum. et Bib.; *M. exanthematicus*, var. *Indica*, Schlegel), the Indian Empagusia. Olive, with yellowish cross-bands. Head-shields sub-equal; eye-brows with a central series of larger plates. It is found in Nepaul.

Varanus, Merrem.—Nostrils oblong, rather oblique in the centre, between the apex of the muzzle and the orbits. Tail elongate, compressed, with a double-edged keel above. Toes elongate, unequal, strong. Head elongate.

a. Shields over the orbits small, sub-equal.

V. heraldicus; *Monitor heraldicus*, Gray; the Heraldic Uaran. Black, with cross rows of pale-eyed spots; pale beneath; black-banded. Shields over the orbits small, sub-equal. It is a native of India.

V. lunatus, the Lunated Uaran. Nostrils large, nearly central; shields over the orbit small, sub-equal. Dark brown, with lunate bands directed backwards on the neck and forwards on the body, and with cross-bands on the tail; belly and under side of tail whitish. It is found in India.

V. ornatus, the Philippine Uaran. Nostrils large, central; shields over orbit small, sub-equal. Olive; neck and front of the body with pale-spotted broad black cross-bands; the hinder part of the body and tail with pale spots. It is a native of the Philippine Islands.

V. Dumerilii; *Monitor Dumerilii*, Müller; Dumeril's Uaran. Brown, with obscure cross-bands, with a black spot on side of neck. Shields of the head and over the orbit nearly equal, moderate. Scales large, convex. It is a native of Borneo.

V. rudicollis, the Rough-Necked Uaran. Nostrils large, nearer the orbit than the end of the muzzle; shields over the orbits nearly square, the hinder central ones rather larger. Scales of the back triangular, keeled; of the neck large, prominent. Muzzle elongate. Black, with white streaks on back of neck, and bands across the back. It is found in the Philippine Islands.

b. Scales over the orbit small, with a central longitudinal series of larger plates.

U. nebulosus (*Monitor nebulosus*, Gray; *M. nebulatus*, Schlegel), the Coloured Uaran. Nostrils large, rather nearer the orbit than the end of the muzzle; orbital shield with a larger series; back of neck with converging dark streaks. It is a native of India.

C. Tail triangular, compressed, and with a doubly-toothed crest above. Nostrils small, round. Aquatic.

Monitor, Gray (*Polydædalus*, Wagler; *Uaranus*, Fitz.).—Nostrils small, round, in the middle, between the apex of the muzzle and the front angle of the eye. Tail elongate, compressed, with a double-edged keel above. Toes elongate, unequal, strong. Teeth rounded.

a. Scales over the eyes equal. Nape with lunate bands. African.

M. Niloticus (*Lacerta Nilotica*, Hasselq.; *L. Capensis*, Sparm.; *Tupinambis ornatus*, Daud.; *Stellio Saurus*, Laur.; *T. elegans*, Daud.; *T. stellatus*, Daud.; *M. pulcher*, Leach), the Nilotic Monitor. Head gray, when young with concentric rows of white spots. Back of neck with lunate cross bands. Under side of body and head grayish, white-spotted when young, black cross banded. The shield over the eyes flat, sub-equal, many-sided.

Nilotic Monitor (*Monitor Niloticus*).

It is found in Egypt, where the modern Egyptians have a fable that the animal is a young crocodile which has been hatched on dry land—as indeed all young crocodiles are—but they mean, we suppose, to convey the idea that it is a dwindled and neglected offspring. The species is to be found on the monuments of the ancient Egyptians, probably on account of its devouring the eggs of the crocodile.

a, skull of *Monitor Niloticus*, seen from above; *b*, under-jaw of same.

b. Scales over the eyes equal. Nape coloured like the back.

M. Dracæna, Gray (*Lacerta Dracæna*, Linn.; *Stellio Salveguardia*, Laur.; *Tupinambis Bengalensis*, Daud.; *T. Indicus*, Daud.; *T. Cepedianus*, Daud.; *Uaranus guttatus*, *U. punctatus*, and *U. Argus*, Merrem; *M. gemmatus*, Guérin), the Indian Monitor. Brown; black-spotted or yellow-eyed when young. Nostrils central; scales over the eyes flat, small, sub-equal; of the head rather larger. It is a native of India.

M. Gouldi, Schlegel (*Hydrosaurus Gouldii*, Gray), Gould's Monitor. Neck with two yellow streaks on the side; scales over the eyes small, granular; of forehead larger. Ventral shields small, longer than broad. It is found in north-western Australia.

c. Scales over the eyes with a larger central series.

M. chlorostigma, Cuv., the Dotted Monitor. Olive, with greenish dots. Nostrils rather nearer the muzzle than the eyes; head-scales flat; scales over the orbit unequal, the central series very large.

Hydrosaurus, Wagler (*Tupinambis*, Fitz.).—Nostrils oblong, longitudinal, near the apex of the muzzle. Tail elongated, with a double-edged keel above. Toes unequal, elongate. Teeth compressed, sharp-edged, denticulated. Scales small.

* Scales over the orbit equal. Neck with lunate bands.

H. varius, Gray, (*Lacerta varia*, Shaw; *Tupinambis variegatus*) Daud.; *Hydrosaurus*, var. Wagler), the Lace-Lizard. Scales over the orbit very small, equal. It is a native of Australia.

H. Bellii (*Uaranus Bellii*, Dum. et. Bib.), Bell's Lace-Lizard. Pale, body and tail with broad black cross bands; scales of the orbit dilated, equal.

** Scales on the orbit equal, small. Neck spotted like the back.

H. giganteus, Gray, the Gigantic Lace-Lizard. Brown, back and tail with cross bands of large black-edged white spots; neck and under side of body pale, with large black round reticulatious; legs white-spotted; toes rather short, strong; shields of the head sub-equal, convex, over the orbits very small, granular. Found on the coast of Australia.

*** Scales over the orbits with a larger central longitudinal series.

H. Salvator (*H. bivittatus*, Wagler, *Stellio Salvator*, Laur.; *Tupinambis bivittatus*, Kuhl; *Uaranus vittatus*, Lesson; *Monitor elegans*, Gray; *Lacerta Monitor* (?) Herm.; *M. marmoratus*, Weigmann; *U. Cumingii*, Martin; *Tupinambis exilis*, Reinw.), the Two-Streaked Lace-Lizard.

H. prasinus (*Monitor prasinus*, Müller), the Green Lace-Lizard. Green, with narrow dark cross bands, generally placed in pairs, those of the neck lunate, the rest transverse, with a brown streak on the cheek behind the nostril; head-shields flat, rather large, those over the orbits larger in a series. It inhabits the west coast of New Guinea.

The Great Fossil Lizard [MEGALOSAURUS] appears to have partaken of the structure of the Monitors and the Crocodiles. The *Mosasaurus* was also very nearly allied to the Monitory Lizards. [MOSASAURUS.] An account of the dissection, by Mr. Martin, of a *Monitor* that died at the Gardens of the Zoological Society in the Regent's Park, in 1831, will be found in the 'Proceedings of the Society' for that year.

MONK, a kind of Seal. [PHOCIDÆ.]

MONK-FISH. [SQUALIDÆ.]

MONK'S-HOOD. [ACONITUM.]

MONK'S-RHUBARB. [RUMEX.]

MONKEY, the name usually applied to those forms among the *Simiadæ* which posses a tail. [QUADRUMANA.]

MONO. [ATELES.]

MONOCEROS. [ENTOMOSTOMATA.]

MONOCHIROS. [PLEURONECTIDÆ.]

MONOCHLAMYDEÆ, a subdivision of the class of Exogenous Plants. The group is characterised by possessing a single perianth, that is, the calyx and corolla not distinguishable or wanting. [EXOGENS.]

MONOCHROITE. [CHROMIUM.]

MONOCONDYLÆA, M. D'Orbigny's name for a sub-genus of *Unionidæ*, which he describes as equivalve, inequilateral, sub-rotund or angulated with a hinge formed of a large, obtuse, round, cardinal tooth in each valve, but without lateral teeth. *M. Paraguayana*, D'Orbigny, is an example.

MONOCOTYLE'DONS are those plants which are now more commonly called Endogens. [ENDOGENS.] They derive their name from their seed having generally only one cotyledon; but there are exceptions to this, as in wheat, which possesses a second cotyledon in a rudimentary state. Usually the single cotyledon of these plants rolls up, inclosing the radicle and plumula, so that the embryo appears to be a cylinder with no interruption to the continuity of its surface; but there are many deviations from this, the most striking of which are those of Grasses and Aquatic Monocotyledons.

MONOCULUS. [DAPHNIA.]

MO'NODON, the Linnæan name for the Narwhal. [CETACEA.]

MONODONTA, Lamarck's name for a genus of *Trochidæ*, the columella of which terminates abruptly in a tooth or notch. It is the *Odontis* of Sowerby. [TROCHIDÆ.]

MONOI'CA, M. De Blainville's name for his second sub-class of the class *Paracephalophora*. [MALACOLOGY.]

MONO'LEPIS, a genus of Macrurous *Crustacea* intermediate between *Porcellana* and *Megalopa*, established by M. Say.

MONOMYA'RIA, Lamarck's name for his second order of *Conchifera*, consisting of those Conchifers which have but one principal muscular impression in each valve of the shell. [CONCHIFERA; MALACOLOGY.]

MONOPHYLLUS. [CHEIROPTERA.]

MONOPLEUROBRANCHIA'TA, M. De Blainville's name for his third order of *Paracephalophora Monoica*. [MALACOLOGY.]

MONOSTEGA. [FORAMINIFERA.]

MONOTHALA'MIA, Lamarck's name for his second division of *Cephalopoda*, including one genus only, namely, *Argonauta*. [CEPHALOPODA; MALACOLOGY.]

MONOTIGMA, Dr. J. E. Gray's name for a genus of turbinated shells allied to *Turritella*.

MONOTREMES, M. Geoffroy's name for certain Edentate *Mammalia* which have but one external aperture for the passage of the semen, the urine, and the other excrements.

The organs of generation of these extraordinary animals present, as might be anticipated, singular anomalies. The different canals terminate in the urethra, which last opens into the cloaca. Their intromittent male organ lies hid, when in repose, in a sheath which opens by means of a hole towards the bottom of the cloaca. Their uterus merely consists of two canals which open separately, and each of them by a double orifice into the urethra, which is large, and, as in the male, has its exit in the cloaca. It was for a long time doubted whether these animals were oviparous or viviparous, but there is now every reason for believing that the young are excluded from the body of the parent alive. Though they have no pouch, they still possess the supernumerary bones which exist in the *Marsupiata*. [MARSUPIATA.] In other parts of their osseous structure they are remarkable for possessing a sort of clavicle, placed more forward than the ordinary clavicle, and analogous to the os furcatorius, furciform bone, or merry-thought, in birds. The coracoid bone also reaches the sternum. The eyes are very small, and there is no external concha to the ear. Two genera only are known, *Echidna* and *Ornithorhynchus* [ECHIDNA; ORNITHORHYNCHUS.]

MONO'TROPA (from μόνος, one, and τρόπος, a turn), a genus of Plants belonging to the natural order *Ericaceæ* and the tribe *Monotropeæ*. It is often regarded as the type of an order, *Monotropaceæ*. It has a 4-5 parted calyx; a corolla of 4-5 petals each, with a hooded nectariferous base; 8-10 stamens with kidney-shaped 1-celled 2-valved anthers; a peltate stigma; the capsule 5-celled, 5-valved, many-seeded. The species of this genus are singular-looking plants, found growing at the roots of trees, and destitute of the green and bright colours which characterise the other forms of vegetation.

M. Hypopitys, Yellow Birds'-Nest, has the flowers in a drooping cluster, lateral ones with 8 stamens, the terminal ones with 10 stamens, the fruit erect, the bracts and flowers glabrous externally. The stem of this plant attains a height of 6 or 8 inches, is succulent, simple, clothed with ovate scales, terminating in a short cluster, dingy yellow, at length turning nearly black; the flowers with large scaly bracts. It is a native of Great Britain. This, with the other species of *Monotropa*, being constantly found at the roots of trees, was supposed to be parasitical upon them; recent researches have however led to the conclusion that in the case of this species such an opinion is erroneous. Mr. Rylands, in a paper published in the 'Phytologist,' page 341, has given the result of a very accurate investigation of this subject, and has proved that the fibrillæ of the roots of *Monotropa* possess spongioles and take up their nutriment in the same way as other plants. Most specimens of *Monotropa*, when recently dug up, present masses of a fibrous substance, which adhere to their fibrils and the roots of the plant near which they grow, so closely, that they were supposed to be portions of the roots of the *Monotropa*. On examining this fibrous substance with care, Mr. Rylands found that in all cases it consisted of a species of byssoid fungus which had been developed upon the roots of the *Monotropa*, having no organic connection with the plant. The species of fungus varied in different specimens, and were found to belong to hitherto undescribed forms of *Cryptogamia*. There can be little doubt that the other species of *Monotropa* are of the same nature as *Hypopitys*, and that their parasitism is imaginary. Some writers have referred the species here described, and two others, to a genus called *Hypopitys*. This includes the European species, whilst the old genus *Monotropa* embraces two American species, *M. Morisoniana* and *M. uniflora*. The last species have not the musky semi-fragrant odour of those belonging to the genus *Hypopitys*.

(Don, *Dichlamydeous Plants*; *Phytologist*, vol. i.; Babington, *Manual of British Botany*.)

MONOTROPA'CEÆ, *Fir-Rapes*, are a small natural order of Monopetalous Exogenous Plants, said to be parasitical upon the roots of pines and other trees, and covered with brown scales instead of leaves. They resemble *Orobanchaceæ*, from which they differ in their regular flowers and multilocular ovary. In natural classifications they are usually placed in the neighbourhood of *Ericaceæ*, on account of their flowers being monopetalous with hypogynous stamens. The species are natives of Europe, Asia, and North America in cool places, especially in fir-woods. There are only six genera, *Monotropa*, *Hypopithys*, *Pterospora*, *Schweinitzia*, *Corallophyllum*, and *Pholisma*. The species are about ten. Their uses are few. Some of them have a delicate smell of violets or pinks. The North American Indians are said to employ *Pterospora Andromedea* as an anthelmintic and diaphoretic. [MONOTROPA.] (Lindley, *Vegetable Kingdom*.)

MONRADITE, a Mineral belonging to the silicate of magnesia series. It occurs massive. Cleavage, one distinct, and another imperfect. Colour pale yellowish, verging on red. Hardness nearly that of felspar. Lustre vitreous. Specific gravity 3·2673. It is found at Bergen in Norway. Its analysis by Erdmann gives :—

Silica	56·17
Magnesia	31·63
Protoxide of Iron	8·56
Water	4·04
	100·40

MONSTER, or MONSTROSITY, a term applied to those individuals amongst plants and animals which present any irregularity in their general form or the form of the organs of which they are composed.

The term Monstrosity is often applied to those anomalies only which are apparent externally, and which produce more or less deformity; but, in a scientific point of view, it includes every variation, either external or internal, in any organ, from its most general or natural conformation; and it is in the latter sense that we shall here treat of it.

Monsters were formerly regarded as sports or prodigies of nature, and these ignorant notions, with respect to their true character, continued prevalent among all classes of people until the commencement of the last century, and are even now held by the uninformed. By the physiologist however the study of the various anomalies of organisation in plants, animals, and man are now viewed as a branch of natural science. An accurate anatomical examination of monstrosities and a minute acquaintance with embryology and structure, have shown that the formation of these different imperfect beings is governed by the same laws which preside over the formation of perfect individuals; the only difference being, that the process of development in the former cases has been perverted or arrested or increased in its course during the growth of the embryo or germ.

The true nature of monstrosities is more easily recognised in the vegetable than in the animal kingdom. We shall therefore speak first of monstrous growths in plants. The study of such growths is not a mere matter of curiosity, as their structure tends to throw light on the true laws of development amongst plants. Although direct observations are more easily made on plants than on animals for the purpose of ascertaining the facts of their history during growth, it is nevertheless interesting to obtain a confirmation of these facts from the forms which monsters assume, these forms in the majority of cases being permanent conditions of the stages of growth through which plants pass. In these forms nature presents us with as it were experiments to test the truth of the general laws of morphology.

This subject can perhaps be best illustrated by reference to special instances. To begin with the Leaves. [LEAF.] In the history of the normal development of the leaves, it is found that they are always arranged in an alternate manner, one leaf above the other, but subsequently in many plants, and even whole families, the leaves become opposite or whorled. In the case however of individuals it not unfrequently happens that the leaves of opposite or whorled-leaved families of plants become alternate. Thus an instance is recorded of *Hippuris vulgaris* (Mare's-Tail) which in its normal complete development has whorled leaves, presenting its leaves arranged alternately in a spiral upon the stem. (Lankester in the 'Report of British Association,' 18th meeting, p. 85.)

In the conversion of the leaf-bud into the flower, one of the earliest changes that takes place is the conversion of the leaves into the organs called Bracts. [BRACTS.] Instances are very often seen of monstrous forms of plants in which the leaves are not converted into bracts but retain their leaf-like character. This frequently occurs in the species of *Plantago*, giving the inflorescence a singularly different character to that which occurs under normal circumstances.

The leaf-bud is always seated in the axil of the leaf, but in the case of the bracts forming the involucre of the *Compositæ* neither leaf-buds or flower-buds are seated in their axils; but in the case of the monstrous variety of the common daisy [BELLIS], known by the name of Hen and Chickens, flower-buds are developed in the axils of the bracts.

Next after the bracts the Sepals are formed in the flower-bud. [CALYX.] It not unfrequently happens that during the growth of cultivated plants, the sepals are found assuming the appearance of leaves. This is especially the case with the cultivated roses. This tendency to recur to the condition of the leaf is sometimes a normal tendency of plants. Thus, in the case of *Calycophyllum Stanleyanum*, one of the sepals after the corolla drops off begins to grow into a beautifully rose-coloured leaf. Other instances of this kind are seen in the order *Cinchonaceæ*. In plants with inferior fruits [FRUIT] the germen seems to contract an adhesion with the lower part of the sepals which thus produces the peculiar character of these fruits, such as the gooseberry, the currant, the apple, and the pear. In these fruits it is not uncommon to find amongst them leaves growing from the surface of the fruit, indicating the tendency of this sepallary part of the fruit to assume the condition of the leaf. The most remarkable example of this tendency of the sepal to assume the condition of the leaf has been observed in the Goat's-Beard (*Tragopogon pratensis*), in which the pappus surrounding the minute flower which represents the calyx has been found to have assumed the character of the leaf.

It frequently happens where one of the parts of a flower have a tendency to relapse to the foliar condition, that the whole of them partake of this character. Thus Mr. Austen has recorded very accurately the changes observed in a monstrous form of the White Clover (*Trifolium repens*). The following changes were observed in his specimens :—

"1. Calyx.—The calyx-teeth often rise into single leaves, but when compound leaves are formed the division seems to be as follows: the two large equal teeth, which are opposite the vexillum, form one serrate leaf, and another leaf is formed from the three remaining teeth.

"2. Corolla.—The part which here most frequently reverts to a leaf is the vexillum, and this is a perfect one. Of these leaflets, the alæ are often seen forming simple leaves, as also the carina; but their perfect union into a ternate leaf is less common.

"3. Stamens.—Whatever changes the flower may exhibit, these organs are always in a state to be recognised, and their reversion to leaves less frequent than in any other part; so that there is more difficulty in determining the number of leaves which go to form this portion. As two ternate leaves form the calyx and corolla, it might be supposed that the stamens were constructed out of the same number. The figures represent cases of a stamen reverting to a leaf with a true stamen attached to its stalk on either side; the single anterior stamen, where it reverts, seems always disposed to form more than a simple leaf; and it is therefore probable that tho ten stamens (9+1) may be formed out of four sets of ternate leaves.

"4. Pod.—From the well-known character of the pod and pistil in *Leguminosæ*, it might be expected that instances of reversion to leaf would be most frequent in this part of the flower; and a series might easily have been produced which would have represented it in every stage of passage; some of these were given. From these it would appear that the pod is not formed of a whole compound leaf, as either two scales, or two abortive leaves, are constantly to be seen at the base of the imperfect pod on either side; the pod is therefore usually formed out of the middle leaflet. In one flower-head however each division of the pistil-leaf had become a pod, with a distinct stem and the ovules inwards.

"Ovules seem to be produced only when junction of the edges of the pistil-leaf takes place; in other cases leaflets are produced in the place of ovules.

"In cases where every other part of the floral series has been regularly developed, the Pistil occasionally will take the form of a perfect ternate leaf, and then the axis of the plant is continued through the flower." (Austen, 'British Association Report,' 19th meeting.)

Mr. Austen has likewise recorded in the same place an instance in which the staminiferous flowers of the Common Maize (*Zea Mais*) were converted into pistils. In this case we have an instance of the tendency of an organ not to relapse to a lower type, but to assume a higher type of development.

It is very frequently the case that stamens relapse to the condition of petals. This is the case with most of the double flowers of our gardens: and iu the case of the rose, the pæony, the bachelor's-buttons, and others, the anthers may often be found tipping the petaloid bodies in the centre of the flower. This is seen as a normal condition in the water-lily.

The recurrence of the pistil to the form of the stamen and corolla is not so frequent, as its assuming the form of the leaf. In the double cherry of our gardens this condition of the pistil is frequently presented. It is this same tendency which is seen in monstrous oranges, in which this fruit is split up into the samo number of parts as it possesses carpellary leaves. [FLOWER.]

The most central organ of the plant is the Seed, and its development is the great object of the production of the flower. In the seed is the young plant. The seed is however but a changed bud, and during the process of its development it sometimes recurs to the condition of the leaf-bud, and produces instead of an embryo a branch.

These instances will be sufficient to show how instructive the study of vegetable monstrosities really is. Many such have been recorded, and one of the best resumés of the whole subject will be found in Moquin Tandon's 'Teratologie Vegetale.' [METAMORPHOSIS.]

We now turn to the monstrosities observed in the Animal Kingdom. These have not been studied so accurately amongst the lower animals as to afford any important result. The investigation however of monsters amongst the invertebrate animals lead to the same general conclusions as that derived from the study of the same forms in plants. It is upon tho monstrous forms of the human being that we find the greatest attention has been bestowed, and we now proceed to give some account of these.

In consequence of the immense number and variety of forms of monstrosity amongst animals (there being scarcely any part in any species of animal which has not been observed to depart from its usual form and structure), it becomes absolutely necessary to arrange them according to some system. Though the necessity of a classification is generally admitted, authors greatly differ in the methods which they have adopted; some basing their arrangements upon the forms or peculiarities of the monsters themselves, and others upon the theoretical ideas which they may hold concerning the causes which produce them. The system most generally followed is that which was proposed by Buffon, and which has been adopted with some modifications by Blumenbach and Meckel. Buffon formed three classes: in the first he included all those cases in which the parts of the body are increased in number, constituting monsters by excess; tho second contained those beings in whom fewer than the usual number of organs are met with, or monsters by default; and in the third he placed the various irregularities in size, relative situation, and structure of parts, which so often occur. The classification proposed by Meckel ('De Duplic. Monst. Comment.,' p. 2) differs from that of Buffon in the addition of a fourth class, including the different forms of hermaphrodism only. The simplest classification, being that which excludes all theory as to their causes, is to distribute them according to some simple and obvious characters, either depending on the degree of unnatural change, or the region or system of organs affected; and such is the kind of classification which we shall adopt in the present article.

Animal monsters may be first divided into Simple and Compound, the first of which only contain the elements of a single individual, while in compound monsters the constituent parts of two or more beings are united. Simple monsters may be again distributed into three classes, which, though not all distinguished from each other by any precise characters, are yet sufficiently distinct for purposes of arrangement.

In the first of these classes may be included those congenital varieties of conformation which are simple and uncomplicated, only affecting one organ or system of organs, and in most cases not interfering greatly with the performance of any vital function.

The second class, on the contrary, contains all those cases in which the degree of malformation is so extensive as to produce great alteration in the anatomical and physiological relations of organs, as well as, in most cases, serious external deformity and disturbance of the vital processes. M. Isidore Geoffroy St. Hilaire ('Hist. des Anomalies,' tom. i., p. 79) is of opinion that the term Monster should be confined to these more complex cases, and thinks that all the other kinds of malformation, with the exception of the compound monsters, should be simply denominated anomalies; but this distinction is arbitrary and inconvenient; indeed, in dividing this class from the previous one it is exceedingly difficult to say where one begins and the other leaves off; and, consequently, to know in which of them to arrange many cases.

The third class may be very clearly defined, for all the malformations which it includes affect one system of organs, namely, those of generation. The monsters in this group are denominated hermaphrodites, the sex being imperfectly developed, and both sexes, or some of their characters, being present in one individual.

An immense number and variety of anomalies are included in the first class, which may be again subdivided into orders, according to whether the malformation affects the size, form, or structure of organs, or produces an alteration in the mode of arrangement and connection, or even in the number of parts. It is often found however that two or more of these varieties of malformation exist together in the same monster; thus in cretins and idiots, both the size and form of the skull and brain are frequently altered; and in club-foot we find a great change both in the form, structure, and position (or arrangement) of the affected limb. Simple alterations in the size or form of parts are so common that no other examples of them need be adduced, but some very interesting changes in the intimate structure of the tissues of the body have been met with; and particularly that peculiar absence of the colouring matter of the skin which characterises the state called albinism. A description of this curious anomaly has been given in the article ALBINO, and we shall only here state that its origin must be accounted for by simple arrest of the process of development. M. I. Geoffroy St. Hilaire says ('Hist. des Anom.,' tom. i. p. 319), "The pigment," or colouring matter of the skin, "is wanting in the fœtus up to a very advanced period of intra-uterine life, and even in black or dark people the integument remains, for somo time after birth, of the same colour as in the children of fair men. We can easily conceive therefore that the skin may stop in the series of its stages of development, before the period when, in the natural order of formation, the pigment is deposited in the mucous layer, and consequently it will remain uncoloured. The colouring matter of tho skin and hairs, the iris and the choroid, may thus be deficient in an individual (independently of any pathological alteration), in the same manner as any organ or part of an organ may be wanting from arrest of development. If any doubts remain regarding this explanation they are removed by the circumstance that the absence of pigment is not the only condition of fœtal life which is preserved in albinism. We know that the fœtus, during the latter part of pregnancy, has the skin covered with down; and this down is frequently preserved in albinos, particularly in those which are met with on the isthmus of Panama. Lastly, the persistence of the membrana pupillaris in some of these cases beyond the ordinary term of its existence, is another equally evident proof of arrest of development."

Many curious anomalies in the position and connection of parts have been met with, and it has been observed that organs are subject to changes of position in proportion as they are loosely connected with the surrounding parts at an early period of development. The walls of the thoracic and abdominal cavities are thus much less subject to alterations in the position of their component parts than the organs which are loosely contained within them. The viscera have been found removed from one part of their natural cavity to another, or transported into a neighbouring cavity, as from the abdomen to the chest; and some of the organs may protrude externally, when the malformation receives the name of a congenital hernia. But of all these anomalies the most curious is that in which the viscera are generally inverted, all the thoracic and abdominal organs presenting exactly an opposite arrangement to that which constitutes their natural state; the liver, cæcum, three-lobed lung, and all those parts usually found on the right side being transposed to the left; while the heart, spleen, sigmoid flexure of the colon, &c., are found on the right. It is the peculiar characteristic of this monstrosity, that though the actual situation of the viscera is changed, their relative situation and connections are preserved as in the natural state; and consequently their different functions are not in any way disturbed. In most, if not all, of those individuals in whom this transposition of organs has been observed, the existence of the anomaly has not even been suspected during life, which, as in the celebrated case communicated by Méry to the Academy of Sciences (of an invalid soldier, aged 72), may be prolonged to its ordinary term. The causes of this malformation are exceedingly obscure, but it seems probable that general change of position of all the viscera depends on some original alteration in the situation of one important organ, as the heart or liver; for we know that many organs are connected by their functions, or by the medium of large bloodvessels, in such a manner as to acquire a certain relative situation to each other, which also becomes necessary to preserve the general shape of the animal. Accordingly we find that when any important viscus is changed in its situation other viscera are affected in a similar manner. In the earlier periods of the evolution of the fœtus, several of those organs which afterwards incline to one side are naturally placed in the centre of the body, or in the median line: this is the case with both the heart and the liver. The knowledge of this fact enables us to understand more readily how these parts may at a subsequent period incline to the opposite side to that on which they are usually found; though we are unable to explain the mode in which they change the direction of all the other abdominal and thoracic viscera.

Together with the alterations of connection, we must place those cases in which, from arrest of development, different organs, naturally entire, are apparently divided into two or more portions, as in HARE-LIP and spina bifida. The latter of these malformations consists in a division or fissure of the posterior part of the rings of the vertebræ, either in one region of the back (as is most common) or throughout the whole spine. The mode in which the production of these and many other anomalies of the same nature can be explained by arrest of development, is by a knowledge of the method by which parts are formed. It has been observed in some organs (and the same thing is supposed by analogy to take place in almost all), that the growth goes on from the circumference towards the centre, and that the lateral parts of any single organ are developed before the central parts, and thus, at an early period of fœtal life, hare-lip and spinal fissure are natural conditions of the embryo. If the process of development becomes arrested by any accidental cause these states will become permanent, and the child will be malformed.

We have shown that arrest of development may produce unnatural separation of parts, and it may also occasion the closure or connection of parts naturally open or separate. Thus we frequently meet with deficiency of one or more of the orifices which open on the surface of the body, and particularly of the anus. In this case the intestinal canal may be perfect, and its orifice only closed by a membranous fold, or it may be very incomplete, and terminate in a cul-de-sac at a greater or less distance from the situation of its natural outlet. This anomaly is easily explained by the mode of formation of the alimentary canal, which is originally a prolongation of the intestinal vesicle, which gives rise in one direction to the stomach and upper part of the digestive tube, and in the opposite direction to the inferior or descending part of the intestines. The formation of either of these portions may be arrested in any part of its course (the canal terminating in a blind extremity), though the large intestines, as the colon or rectum, are most commonly the seat of this anomaly, which, on account of the serious interference which it occasions in the functions of nutrition, speedily destroys the life of the child, unless it can be removed by surgical art.

Monsters sometimes present irregularities in the number of parts which they possess, being either furnished with supernumerary organs or exhibiting some deficiency. An order of monsters thus composed of deviations from the natural number of parts seems to be clearly distinguished from all others; but if we carefully examine the different cases which it comprises, we shall find that a great many of them may be arranged together with cases belonging to other orders of monstrosity, being in fact referrible to some alterations of volume or change of connection in the affected parts. Thus when an organ is apparently deficient, it is often possible to detect the rudiments of it by a careful dissection, and therefore, though much diminished in size, it still exists. In the same manner when supernumerary parts are added to any organ, anatomical examination will sometimes show that there is no real formation of new parts, but only an increased development of those structures which commonly remain in a rudimentary state. In many cases also the deficiency or addition of organs, as supernumerary fingers or toes, and vice versâ, may be explained by the complete division of one part into two, or the intimate union of two or more parts.

The development of supernumerary mammæ is one of the most frequent anomalies of this kind which occur in the human subject. There is commonly only the addition of one extra gland in these cases, making three breasts, but both four and five have been occasionally seen. When four exist they are generally arranged symmetrically two on each side of the chest. When three or five are present, the odd one may be placed laterally beneath one of the others or in the median line: when in the latter situation, it has been remarked that it is generally small and rudimentary, which may be owing to the mode of distribution of the mammary arteries which run parallel down the sides of the chest. A very remarkable but rare anomaly in man is the existence of a mamma in the inguinal region; one or two authentic cases of this kind are recorded. ('Journal Gen. de Médécine,' tom. c., p. 57.) The only theory which explains these anomalies is that which Geoffroy St. Hilaire has denominated the "law of unity of organic composition." This naturalist supposes that the whole animal kingdom is formed upon a common type, the organs of different animals in the earliest states of the embryo being all similar, but during their development assuming different forms in different animals; some parts being highly developed in one species, and remaining in a rudimentary state in others. Almost all the *Mammalia* have several mammary glands disposed in two parallel series; and though two are only naturally developed in man, yet we may suppose that the elements of others have existed at an early period, which become developed in these anomalous cases by excess or irregularity of the formative process. The bones, muscles, vessels, viscera, and other organs, have all been frequently observed to present alterations in the number of their parts. Many cases are related by authors of an increase or diminution in the number of the cavities of the heart; three ventricles have been met with (Chemineau, 'Hist. de l'Acad. des Sciences,' 1699); absence of both the auricles has been observed (Turner, 'Journal Gen. de Médécine,' tom. xcvi.); and many anatomists have described hearts which were furnished with only a single auricle and ventricle, as in fishes: cases are even related in which two distinct hearts have been found in the same individual, but their authenticity must be doubted. An unnatural number of teeth has often been observed. Arnold ('Obs. Physic. Medic.,' p. 69) mentions a case in which there existed 8 incisor, 4 canine, and 24 molar teeth in each jaw—making together 72. The truth of this case may well be suspected, though many instances of the presence of several supernumerary teeth have been recorded by other authors.

The second class of simple monsters, comprising the various forms of extensive malformation, contains an immense number of different cases. Some monsters, though greatly altered both in form and structure, are yet capable of living for a considerable time after birth; others, on the contrary, are entirely destitute of the power of supporting an independent vitality, and may be so imperfectly formed that the symmetry of the body is lost, and nothing remains but an irregular shapeless mass. Malformation often affects only one region of the body in monsters, the other parts remaining comparatively natural: thus the limbs are frequently very much altered in structure and appearance, and may be even entirely deficient, in cases where the head and trunk preserve almost their regular form. Monsters have been seen in whom the hands or feet were alone developed and inserted immediately upon the trunk. From a fancied resemblance between the state of the limbs in these monsters and their natural state in the Seal and other amphibious animals, the name *Phocomeles* has been applied to them. M. Duméril ('Bull. de la Soc. Philomathique,' tom. iii., art. xi.) has described a man who was affected with this anomaly, and who died in Paris about the year 1800, at the age of 62. His body was carefully examined after death, when all four limbs were found alike deficient: the two clavicles were very short and thick; the humeri and bones of the fore arm did not exist at all, but the hands were articulated by the bones of the wrist immediately to the scapula. In the abdominal limbs the head of the femur and the trochanters were found on both sides, and a rudimentary tibia existed which was articulated with the foot, but had no connection with the short thigh-bone. The hands and feet have sometimes been found wanting in cases where the whole or part of the arms and legs were developed, which terminated in a rounded extremity or stump; and lastly, one or more of the limbs in man and different animals have been found entirely deficient. In another family of monsters, denominated *Symeles*, or Sirens, the two thoracic or abdominal limbs are fused together into a single member: thus the two legs have been seen united into one, and furnished with either a double or single foot, or terminating in a point or stump. These monsters are generally malformed in some other respects, and mostly die soon after birth.

The trunk may be the principal seat of malformation, while the head and limbs only slightly participate in it. In monsters of this kind eventration has generally been found, accompanied with other anomalies. Eventration consists in imperfect development of the walls of the abdomen, and consequently protrusion of the greater part of the viscera, which form a large tumour in front of the abdomen, which is only covered by a thin and delicate membrane, consisting of the dilated base of the umbilical cord. This anomaly may be solely confined to the abdomen, or it may also implicate the thoracic viscera: thus if the eventration occupies the upper part of the abdomen, the sternum may be divided by a fissure, or may even be completely wanting, so that hernial displacement of the heart will take place. Where the sternum and chest are implicated, the diaphragm is also imperfect, being partly wanting or divided. (I. Geoff. St. Hilaire, 'Hist. des Anom.,' t. xi., p. 283.) When the eventration occupies the inferior regions of the abdomen, the urinary and genital organs are often imperfectly developed, as well as in some cases one or both of the abdominal limbs.

Extroversion of the bladder is one of the best known anomalies of this class. In this malformation there is both displacement and imperfect development of the bladder itself, as well as of part of the walls of the abdomen, the front wall of the bladder is deficient, and the mucous membrane of its posterior side is retroverted, forming a soft, red, projecting tumour above the symphysis pubis. On the surface of this tumour, towards the lower part, two apertures may be observed, from which the urine is constantly trickling: these are the orifices of the ureters. Extroversion of the bladder does not seriously impede the performance of any of the vital functions, and therefore is not incompatible with prolonged life; but the more complicated forms of eventration are necessarily fatal.

In both the preceding families of monsters the head is slightly if at all deformed; but many instances have been met with in which the head and face are the parts most extensively altered, though it has been observed, that whenever serious malformation of the cerebral organs takes place, some other parts of the body participate in the anomaly. The brain has often been found imperfectly developed, and situated wholly or partly without the cranial cavity, the walls of which were incomplete. In these monsters, which have been named *Exencephali*, the brain may protrude through an opening in the posterior or occipital region of the skull, or in the anterior or frontal region. This hernial displacement of the brain is often complicated with eventration or spinal fissure. The brain in some cases has been found entirely deficient, and the vault of the cranium absent, a bright red-coloured tumour, composed entirely of vessels, lying on the base of the skull, and partly occupying the place of the brain: in a few monsters of this kind the vertebral canal has been seen widely open, and the spinal marrow also deficient, the vascular tumour sometimes existing and sometimes not.

The face in some monsters is the principal seat of anomaly, and no form of monstrosity has attracted more attention than that denominated *Cyclopia*, in which, from atrophy of the nasal organs, the eyes approach and unite in the median line. In some of these beings, which have also been called *Cyclocephali* by Geoffroy St. Hilaire, the two eyes are placed very close together, but still remain distinct, the bony parts of the nose being entirely atrophied, but the soft and tegumentary parts remaining in the form of a proboscis, or trunk, situated above the orbits, which, though closely in contact, are not blended together. In others only one orbital cavity has been found, containing a double eye, the component parts of which are sometimes so blended together, that only a few traces of duplicity remain; thus the cornea, pupil, and crystalline lens have been found quite single in these cases. (St. Hilaire, 'Histoire,' &c., t. ii., p. 387.) None of these single-eyed monsters have ever been known to live for more than an hour or two after birth, and their speedy death must be accounted for by the imperfect state of the brain, which constantly accompanies this anomaly. Malformation of the head is sometimes carried to such an extent, that the natural structure becomes completely lost, and a mere shapeless mass remains; and lastly, in those monsters to whom the denomination of Acephalous is correctly and should be exclusively applied, the head is entirely deficient, no external vestiges of it remaining. In these very imperfect beings other parts of the body always participate in the malformation; the symmetry of the form is lost, one or both of the superior extremities are generally deficient, and many of the thoracic and abdominal viscera wanting: the heart and lungs have been found absent in most cases; and some writers have remarked that the heart is never found in acephalous fœtuses, but the testimony of many observers has proved that this is incorrect. (St. Hilaire, 'Histoire,' tom. ii., p. 507.) M. Serres has related a curious case ('Bull. de la Soc. Méd. d'Emulation,' Sept., 1821), in which an acephalous fœtus was furnished with a simple tubular heart resembling the dorsal vessel of insects, into which the principal vascular trunks opened. This case is peculiarly interesting, since we know by the researches of embryology that the heart first appears in the embryo in the shape of a long tubular pouch, which ordinarily transient state had doubtless become permanent in the above monster by arrest of the process of development.

Some of the irregular shapeless masses generally called moles, consisting of different organic parts, as teeth, bones, hair, skin, &c., which are occasionally found in the uterus or ovaries, must be considered as the imperfect products of conception, and therefore arranged among single monsters. But we must distinguish these cases from others which often very closely resemble them, in which tumours of a similar kind have been found in the ovaries of virgins, and even of girls before puberty, the occurrence of which must be explained in quite a different manner, either by the action of some morbid process in the system, or by the theory of monstrosity by inclusion, which supposes that the elements of one being have been originally inclosed in the body of another, where they have remained in an imperfectly developed state.

The last class of simple monsters includes the various forms of hermaphrodism. An hermaphrodite was defined by the ancients as an individual capable of fulfilling by turns the reproductive functions of both sexes, or at least one who simultaneously possessed both the male and female organs fully developed; such a being however is not only unknown among the authentic details of anomalies, but is physically impossible in man and the higher orders of animals without extensive alteration in the connections of the bones and other parts of the pelvis. The signification of the term hermaphrodism is now much extended, and it is used to designate an individual who possesses any mixture of the characters of the two sexes. An immense variety of these malformations of the generative organs has been observed; but in most cases the malformed being belongs essentially to one or the other sex, and is only related to the opposite sex by some few characters. The two families of male and female hermaphrodites have been thus formed, which include a great proportion of the cases which have been met with. In both of these forms of anomaly, by a careful investigation during life, or dissection after death, it will be found that all these beings are essentially male or female.

In a few cases of what have been denominated neuter and mixed hermaphrodism, the organs belonging to the opposite sexes seem to have been so blended together in the same individual, that the being could not be referred to one sex rather than the other, but these instances are very rare. A most curious instance of this description is given by Schrele, a German anatomist. ('Med-Chir. prakt. Archiv. von Baden,' &c., t. i., 1804.)

The mode of origin of hermaphrodism is very obscure, though the first-mentioned forms of this anomaly may most probably be referred to some arrest or excess in the process of development, since in the early stages of embryonic life a very close resemblance exists between the generative organs in both sexes.

We now come to those curious and interesting anomalies in which the component parts of two or more distinct beings are united in one individual, forming a Compound Monster. The two subjects composing a double being may possess an equal degree of perfection, or be very dissimilar in size and structure, one appearing as a mere parasitical appendage of the other: thus two individuals nearly perfect and distinct may cohere together by one region only of the body, or an apparently single trunk may be furnished with two heads or four arms; the multiplication of one or more of the extremities constitutes in fact the first degree of double monstrosity. In some cases every limb is doubled, and the individual then has eight extremities; in others there is only one supernumerary extremity, which, in some cases, has been observed single at its origin and doubled or tripled towards its termination, as when two or three feet are attached to the same leg. (Audral, 'Anat. Pathol.,' vol. i.) It has been observed that in whatever manner or degree two beings are joined together, they are always united by corresponding aspects of the body, that is to say, side to side, face to face, or back to back: each part and each organ in the one corresponds to the same part or organ in the other; every vessel, nerve, or muscle situated in the line of union joins itself to the corresponding vessel, nerve, or muscle in the other subject, in the same manner as the two primitive halves of any single organ, which, according to M. Serres's theory of eccentric development, are originally separate, unite by the progress of development.

We have already said that the two subjects composing a double monster may be both nearly perfect and distinct, only adhering together by one region of the body. Beings of this description are sometimes capable of supporting an independent vitality for a considerable number of years, though they are mostly destroyed during parturition, their structure occasioning great difficulty to the process of delivery. One of the most remarkable cases of complete double monstrosity was that of the double female who was born in Hungary in 1701, and christened by the two names of Helen and Judith. This monster was shown about for seven years in almost all the countries of Europe, and lived to the age of 22 years. The two individuals, which were each quite perfect, except at the point of union, were here placed back to back, and united by the buttocks and part of the loins. The external organs of generation offered evident signs of duplicity, though there only existed a single vulva, which was placed inferiorly and hidden between the four thighs; the vagina was at first single, but soon divided into two distinct canals, which led to separate uteri. The two intestinal canals likewise terminated in a common anus, and the vertebral columns were united at their extremities. The aortæ and venæ cavæ communicated at their lower part, and thus established a large and direct communication between the two hearts, producing an intimate relation of life and functions between the two beings. Whenever one was ill the other felt so too, and participated in her sister's disease; it was therefore predicted that the death of one would necessarily destroy the other, which proved to be true. Judith, at the age of 22 years, was attacked with disease of the lungs and brain, of which she died. Helen, who, at the commencement of her sister's attack, was in perfect health, soon became ill, and both expired at almost the same instant. The Siamese twins who were exhibited in London in 1829-30 were an example of a less extensive union than the last. In their case a vital connection was established laterally, and the fleshy mass which united them was so small, that some surgeons who saw them thought it might be practicable to separate them by an operation.

The junction of two fœtuses may take place by almost any region of the body; thus they have been seen attached to each other by the crown of the head, both being placed in a straight line (Villeneuve, 'Description d'une Monstrosité, &c.,' 4to, Paris, 1831); by the anterior portion of the thorax, or abdomen, or by part of the front of both, as occurred in the Siamese twins. In this instance the two brothers were only furnished with a single umbilicus. Two varieties have been observed in the mode of junction wherever situated; in one the attachment is superficial, being effected only by the skin and bones; in the other it is more deeply seated, the cavities of the body at the point of union communicating in the two individuals, or being in fact converted into one; thus, the chests being united, the sternum may be altogether deficient; and the thoracic cavities thrown into communication, in which case the viscera frequently present some anomalies in form and arrangement. Sometimes there are two hearts, which are perfectly distinct, and inclosed in separate pericardia; sometimes the hearts, though both well formed, are contained in one common pericardium, in which they may be either distinct from each other, or superficially joined at some point. In other cases two hearts are found, but both in a very imperfect state; lastly, there may be only one heart presenting several vices of conformation, as three or four ventricles, or one of the two ordinary ventricles unusually large, and partly divided by a septum. In other cases of this description the heart has been found single and well formed, but the large vessels have been all double, so that two aortas sprung from the left ventricle, &c.

In some instances of double monstrosity the component individuals are distinct and separate at their lower halves, but more or less intimately united at the upper part of their bodies, so that they appear to have a double body and single head. In others, on the contrary, there are two distinct heads, and the upper part of the body is double, while the pelvis and inferior extremities are nearly or quite single. In some cases belonging to the former of these divisions the separation of the bodies is only complete inferiorly, all the parts above the umbilicus manifesting a tendency to coalesce: in others the separation is perfect as high as the neck. In all these instances however the head and upper part of the body, although apparently single, almost invariably present on dissection some supernumerary parts, which clearly indicate their double origin. Those compound monsters which are furnished with two heads and a single body offer numerous varieties; the head may be double, but not distinctly divided, there being two faces, more or less perfectly formed, placed side by side, and separated by a longitudinal division; each face is generally provided with a pair of eyes, but sometimes there are only three, one being placed in the median line and formed by the union of two together, as in cases of *Cyclopia*. The two heads may be completely double, but the body and extremities single. Lastly, the heads and upper halves of the bodies may be separate, there being four upper extremities, while the monster is only single by the pelvis and lower extremities. A human monster of the last kind, which lived to be nine months old, excited great interest in Paris in 1829; it was a double female, and denominated Rita-Christina. It was born in Sardinia, and was brought to Paris to be publicly exhibited. It was carefully examined after death, and a detailed account of its structure has been given by M. Serres, in his 'Recherches d'Anatomie Transcendante,' &c. The two vertebral columns were found quite distinct in their whole length, and a rudimentary pelvis separated them inferiorly: another fully developed pelvis was found in its natural position, which supported two well formed abdominal limbs. There existed a single bladder, uterus, and rectum, which were common to the two subjects, but behind these organs were found rudimentary traces of others. There were two distinct hearts, and all the other thoracic and most of the abdominal viscera were double.

A singular and unique case is recorded by Sir E. Home ('Philos. Trans.,' vol. lxxx. p. 296, and vol lxxxix. p. 28; also in 'Lectures on Comparative Anatomy,' t. iii. p. 334), of a fœtus with an accessory head, which was implanted by its summit on to the crown of the natural head. The body of this child was well formed in every respect, having no supernumerary parts, and the principal head was quite natural in appearance, except in the parietal region, where its integuments were continued into those of the accessory head. The latter was placed in an entirely inverted position, the neck, which terminated in a round tumour, being directed upwards and a little backwards. This monstrous child, which was born in Bengal in 1783, lived to be four years old, and then only died from the bite of a serpent. In this case, which must be included with those of double monstrosity, we must suppose that the body and limbs belonging to the accessory head had become completely atrophied, but it is exceedingly curious how this remaining part continued to live solely by means of vascular and nervous communication with the principal individual, and without any separate umbilical cord or special organs of nutrition.

The last variety of montrosity which we shall mention is that by inclusion. In these cases fragments of one fœtus have been found contained in the interior of another. A case of this kind is recorded by M. Dupuytren ('Bull. de la Faculté de Médécine,' vol. i.), who found a cyst in the transverse mesocolon of a boy 13 years of age, containing an organised mass, which, when carefully examined, presented traces of the brain, spinal marrow, nerves, muscles, and most of the bones of a fœtus, but no vestiges of the organs of digestion, respiration or circulation. Similar substances have been found in various situations in other subjects, and there is no doubt of their nature; though the mode in which the germ of one fœtus has become included in the body of another is at present entirely unknown.

Compound monsters, formed by the union of more than two distinct individuals are exceedingly rare, and very few authentic cases of such anomaly are on record.

None of the different theories which have been proposed in explanation of the mode of origin of single monsters throw any light on the causes of compound montrosity. It is very difficult to decide whether the germs have been originally double, or whether two or more have become united during the progress of development. The latter is the most general opinion; and the most probable idea respecting their mode of union is, that two ova become adherent whenever they are contained within the same membranes, and opposed to each other by corresponding aspects of the body.

Of the predisposing and exciting causes of monstrosity little is known; for while the influences determining the phenomena of normal development are hidden from us, those presiding over irregular formation must necessarily be involved in darkness. In the article FŒTUS it is stated that the organs of the embryo are generally considered to be successively developed, and not evolved from originally pre-existing elements: the notion therefore that the germ of the future embryo is ever originally monstrous previous to impregnation must be abandoned, and the causes giving rise to the various forms of congenital malformation must be sought for in some accidental influences disturbing or arresting the process of development in the embryo. Direct evidence has been afforded by experiment that the natural stages of formation may be so altered in the embryo of the chick during incubation by external injury. Geoffroy St. Hilaire injured several eggs in which the process of incubation had commenced, and had been going on naturally for several days. He shook some of them violently, he perforated the shell of others in different places with a sharp instrument, or kept them in a vertical position, upon either the large or small end, during the whole time of hatching; again, in some he covered part of the shell with wax, or a varnish impervious to the air. The constant effect of these injuries was the production of a very considerable number of anomalies, either simple or complicated, among which may be mentioned *Cyclopia* and other malformations of the face and head, eventration, and spinal fissure. In no instance was any case of double montrosity met with, which might, à priori, have been supposed; a double monster being composed of two distinct embryos, the germs of which must have previously existed in the same egg. ('Mémoires du Muséum,' tom. xiii. p. 289; also 'Journal Complément. des Sci. Méd.,' tom. xxxiv.)

The younger St. Hilaire repeated these experiments in a different manner, altering the structure of eggs previous to the commencement of incubation, and not during the course of this process, as had been done by his father. His experiments were attended with quite a different result: the more violent disturbing influences destroyed the vitality of the embryo altogether; others, less active, produced general retardation or arrest of the process of development of the whole body; but in no instance was malformation of any one region or part effected. ('Hist. des Anom.' tom. iii., p. 503.) These experiments confirm the opinion that anomalies involving a single individual must principally be referred to the influence of some disturbing causes occurring during the process of development. In some instances the birth of a monster has undoubtedly followed an accident received by the mother during the early months of gestation, such as a fall, a violent blow on the abdomen, or some long-continued mental impression or anxiety. The influence of such causes is however much weaker than has been supposed; for how many examples occur every day of women producing well-formed children who have been suffering under violent moral emotions, or who have received serious accidents during pregnancy. It is unnecessary to bring forward any arguments to refute the ancient superstitious notions of the vast influence which the imagination of the mother was supposed to exert over the formation of the fœtus. It is no longer supposed, except by the ignorant, that any object which has been seen or longed for by the parent can be depicted on the body of the child; and in most cases where the child has been supposed to have been deformed through the influence of any such cause, if the date of the impression received by the mother be carefully ascertained, it will be found that the organ supposed to be altered or marked by such impression must have been nearly or fully developed at the time that it was received, and therefore could be in no way affected.

Another very generally admitted cause for some malformations is the occurrence of disease in the fœtus itself, and there is no doubt but that some cases of anencephalia and other malformations of the brain and spinal chord must be referred to dropsical disease occurring in the interior of the skull and spine of the embryo; but in the majority of cases this explanation is inadmissible, and supported by no proofs. Many other hypotheses have been proposed to account for the production of monsters—as adhesions between the fœtus and its investing membranes; modifications in the quantity and quality of the nutriment received by the embryo; pressure made on the fœtus by tumours attached to the parietes of the uterus, &c. It is unnecessary to enter into the consideration of these causes; for, after all, we can only arrive at the conclusion that the development of the embryo in anomalous cases has been diverted from its natural course, or arrested by some accidental cause, which, whether taking its origin in the fœtus itself, or acting secondarily on the embryo, is involved in obscurity.

Though the occurrence of accidental causes acting during the process of development will account for most of the phenomena of monstrosity, yet it will not account for all. It has been observed that some malformations are hereditary—are transmitted from fathers to children; and since all influence of the father on the child must cease with the act of fecundation, these anomalies must be dated from the moment of conception.

From extended observation it has been found that all the forms and varieties which monstrosity presents are apparently under the control of certain fixed laws; or, in other words, there appear to be a number of general facts which are applicable to all cases of malformation. Some of these facts it is necessary to be acquainted with, since, by a knowledge of them, we may often be enabled to distinguish (when reading or hearing descriptions of monsters, or looking at figures in old works) those anomalous cases which may really have existed, from others which are only the fanciful and absurd productions of a fertile imagination. To one of these laws we have already alluded, for instance, the fact that union between two individuals forming a double monster always takes place by corresponding parts of the body; and we shall now briefly mention several others.

Monstrosity, however complicated and extensive, is never carried to such a degree as to remove the animal affected with it out of the series of natural beings in which it has been originally placed; no entire being nor organ has ever been met with so deformed that the species to which it belonged could not be recognised. Again, in the most extensively deformed monsters the relative connections between different organs are never so completely altered that it becomes impossible to distinguish them by the position which they occupy. Thus the heart has never been found in the cranium, nor the lungs in the pelvis.

Anomalies are more frequent in proportion as they do not affect vital organs nor interfere with any important functions. Thus we very commonly meet with irregularities in the course of bloodvessels, since it signifies little through what channels the blood is conveyed, so that it arrives at the organ which it is destined to supply. It has also been found that the parts most liable to vary are those which are the latest in attaining their complete evolution; and this fact may very readily be explained, for if the process of development be disturbed or arrested by any cause during the course of fœtal life, those organs which are already nearly or fully formed at the time of the occurrence of such disturbing influence will be little or not at all altered, while on the contrary complete suppression or a very marked alteration may be effected in other parts whose formation has not commenced or is very imperfect. This fact has been explained in another manner, by supposing that different organs are subordinate in their formation one to another, one being produced by another whose development preceded it. Thus the suppression of any part will not influence those which have been previously formed, while it must necessarily lead to the complete absence of all those which ought to have followed it in the order of development.

A kind of compensation or balancing has sometimes been observed between different organs in monsters; excess of development in one part being accompanied with a corresponding arrest of formation in some other organ. Thus an individual having several supernumerary fingers or toes on one hand, frequently has the opposite limb furnished with fewer than the usual number, and monsters deprived of the brain have been observed to have the face unusually large. Many other applications have been made of this law of compensation, as it has been termed by Geoffroy St. Hilaire.

It has been said that the left side of the body is more frequently deformed than the right, and that a greater number of monsters belong to the female than to the male sex, which last fact Meckel explains by the theory that the generative organs are in both sexes originally female, and that many monsters remain of that sex by arrest of development, who, if naturally formed, would have been males.

For further information upon the subject of Monstrosity the reader may particularly consult Haller's treatise 'De Monstris;' Meckel's 'Manual of Pathological Anatomy' (German); Geoffroy St. Hilaire's 'Anatomie Philosophique;' and his son Isidore Geoffroy St. Hilaire's 'Histoire des Anomalies;' and Carpenter's 'Human Physiology.'

MONTACUTA, a genus of Acephalous Lamellibranchiate *Mollusca*, belonging to the family *Kelliadæ*. The shell is small, thin, equivalve, inequilateral, transversely oblong or obliquely oval, surface smooth or concentrically striated, or rarely radiatingly furrowed; beaks inflected; inner margins smooth; hinge-margin with a trigonal incision and cartilage pit, and a pair of diverging laminar teeth in one or both valves; ligament internal; muscular scars suborbicular; pallial impression simple; animal oblong, its mantle freely open in front with simple margins, not furnished with siphonal tubes posteriorly; a single siphonal orifice, or none; foot very large, strong, and broad, furnished with a byssal groove. Such are the characters of this somewhat unsatisfactory genus as given by Messrs. Forbes and Hanley. They enumerate three species as British—*M. ferruginosa*, *M. bidentata*, *M. substriata*.

MONTAGNA, Dr. Leach's name for a genus of Macrurous Crustaceans allied to *Callianassa*.

MONTIA, a genus of Plants named in honour of Dr. Joseph Monti, professor of botany and prefect of the medical garden at Bologna. He paid much attention to the scientific arrangement of the *Graminaceæ* and *Cyperaceæ*. He published also a catalogue of the plants in the botanic garden at Bologna, in which he described several new species. The following are the principal works which he published:—'Catalogi Stirpium agri Bononiensis Prodromus, Gramina et adfinia complectens,' Bononiæ, 1719, 4to; 'Indices Horti Bononiensis ad Usum Demonstrationum quæ in Horto Bononiæ quotannis habentur,' Bononiæ, 1724, 4to.

The genus *Montia* belongs to the natural order *Portulaceæ*, and has a persistent calyx of 2 sepals; a corolla 5-parted with 3 segments smaller than the others, with the tube split to the base in front; 3 stamens inserted in the throat and opposite to the smaller segments of the corolla; the ovary turbinate; the style very short; the stigmas 3, downy; the capsule of 1 cell with 3 valves and 3 seeds. There is but one species of this genus, *M. fontana*, which is a native of Great Britain. It is also found in North and South America in bogs, ponds, and ditches; and is commonly known by the name of Water-Chickweed. It closely resembles the species of the genus *Claytonia*.

(Babington, *Manual of British Botany*.)

MONTICELLITE, a Mineral, occurring crystallised at Vesuvius. Primary form a right rhombic prism. Crystals small, and have usually the aspect of quartz. Colour generally yellowish. No cleavage planes have been observed. Hardness 5·0 to 6·0. Sometimes nearly transparent and colourless. It has not been analysed.

MONTICULARIA. [MADREPHYLLIŒA.]

MONTIPORA. [MADREPORÆA.]

MONTIVALTIA. [MADREPHYLLIŒA.]

MOON-SEED is the seed of various kinds of *Menispermum*, and is so called on account of its figure.

MOON-WORT. [BOTRYCHIUM.]

MOOR-BUZZARD, the English name for *Circus æruginosus* of Aldrovandus and authors. [FALCONIDÆ.]

MOOR-COCK, one of the names of the Red Grouse. [TETRAONIDÆ.]

MOOR-FOWL, one of the names of the Red Grouse. [TETRAONIDÆ.]

MOOR-HEN, the common English name for the Gallinule, or Water-Hen, *Fulica chloropus*, Linn. [RALLIDÆ.]

MOOR-TITLING, one of the names for the Chick-Stone, Stone-Chatter, Stone-Chat, Stone-Smith, and Stone-Smick, *Saxicola rubicola*, Bechstein. [SAXICOLA.]

MOOSE-DEER. [CERVIDÆ.]

MOSSES. [MUSCI.]

MORACEÆ, *Morads*, a natural order of Exogenous Plants which were formerly placed as a sub-order of *Urticaceæ*. The species are trees or shrubs, with a milky juice, sometimes climbing. The leaves are commonly lobed and rough. The flowers are small, monœcious, and collected in heads, spikes, or catkins. The ovules are solitary and suspended. The embryo lies in the midst of fleshy albumen, hooked, with the radicle long, superior, folded down towards the cotyledons.

Although the Mulberry and Fig grow in Europe, all the *Moraceæ* are extra-European. The species inhabit the temperate and tropical latitudes of both hemispheres, often forming vast forests. The genus *Ficus* is the most distinguishing feature of this order. [FICUS.] Most of the plants of this order furnish caoutchouc. [INDIA RUBBER.] The fruit of the Mulberry is edible, and the leaves of the genus *Morus* are the food of the Silk-Worm. [MORUS.] Several species of *Dorstenia* are used in medicine. [DORSTENIA.] Other genera of this order yielding useful products are *Broussonetia* and *Maclura*. [BROUSSONETIA; MACLURA.]

This order embraces 8 genera and 184 species.

MORCHELLA, a genus of *Fungi*, one of the species of which is eatable. *M. esculenta*, the Morel, springs up in orchards, woods, and cinder-walks, early in the spring and summer, and is believed to be most plentiful in places where fires have been made. The country people in Germany are so persuaded of this, that they formerly set fire to woods in order to obtain a crop of morels, of which they are very fond. At last the practice was put down by law. This fungus has a stalk from one to three inches long, and a spherical cap, from the size of a pigeon's egg to that of a swan's, hollow, pale-brown, or even gray, and deeply pitted all over its surface, the depressions being separated by raised anastomosing lines. The plant has a slight smell and an agreeable taste, and is employed for various purposes of cooking, both fresh and dried. In the former state it is most commonly stewed or stuffed with force-meat; in the latter it is employed as an ingredient in sauces. In this country it is of rather rare occurrence.

MOREL. [MORCHELLA.]

MORILLON, one of the names of the Golden Eye (*Clangula vulgaris*). [DUCKS.]

MORINGA. [MORINGACEÆ.]

MORINGACEÆ, *Moringads*, a small natural order of Exogenous Plants, embracing the species of the genus *Moringa*. They are characterised by the possession of a many-leaved calyx, perigynous petals and stamens, 1-celled anthers, stipitate and consolidated siliquose fruit, and seeds without albumen. This order is referred by most botanists to a position near *Leguminosæ*, but Lindley places them in his *Violales*. They are natives of the East Indies and Arabia.

The root of *Moringa pterygosperma* has a pungent odour with a warm biting and somewhat aromatic taste. The seeds of this plant are called by the French Pois Queinques and Chicot. They are the Ben-Nuts of old writers, from which the Oil of Ben was extracted. It is chiefly used by perfumers as the basis of various scents. It does not readily freeze and on this account is used by watchmakers. The flowers, leaves, and other parts of this plant are added to curries in India.

(Lindley *Vegetable Kingdom.*)

MO'RIO, De Montfort's name for *Cassidaria Echinophora*. [ENTOMOSTOMATA.]

MORMON, Illiger's name for a genus of *Alcadæ* (*Fratercula* of Brisson). [AUK.]

MORMOPS. [CHEIROPTERA.]

MOROXITE, a Mineral, a variety of Phosphate of Lime. [APATITE.]

MORPHNUS. [FALCONIDÆ.]

MORPHOLOGY is that branch of science which treats of the laws which regulate the forms assumed by Plants and Animals. When this term was originally introduced into natural history science, its application was confined to the explanation of the changes which occur in the conversion of the leaves into the parts of the flower in plants. It is now however generally recognised as the science of form in the organic kingdoms. Schleiden, in his 'Principles of Scientific Botany,' treats of what is usually called the structure of plants, under two heads, that is General and Special Morphology. The following are his definition and remarks upon this subject:—

"Morphology is the study of the forms of plants, and of their several parts. It is divisible into a general branch, which elucidates all that has reference to plants and their organs in general, and a special branch, which treats of plants according to their principal groups, as well as their individual organs; and this latter branch again is separable into two parallel sections, namely, the delineation of external form, and the delineation of internal structure, or of the peculiar composition of plants and their parts from various tissues.

"In my methodological introduction I have endeavoured to show that the external morphology of plants is really the most important section of botany. A mere glance at the history of the science will convince any one of the truth of this view, for it is truly wonderful to observe how far it has succeeded, to the almost entire neglect of all other scientific knowledge, in taking possession of the materials by merely examining its exterior, and arranging it in such a manner that the systems which in recent times have taken another path—I allude to the anatomico-physiological—have scarcely effected more than the introduction of extremely trifling changes, in some instances clearly untenable, and others at best of very doubtful validity. The morphological method of observation has certainly, from the origin of the science, been the basis of all treatises on botany: but those who have thus pursued it have been far from taking a strictly scientific view of the question, or seeking in this way for the solution of its difficulties. This task is two-fold, at once empirical and theoretical. In its first character the study requires us to examine into and characterise the fundamental forms which, as types, or conceptions of generic and specific shapes, constitute the basis of individual forms. In its second character this study has to unfold the natural laws according to which these types are formed, and which control and explain the deviations that occur in individual forms from their prototypes. For the first or empirical part of our researches, we may congratulate ourselves on having some little information, although of a very fragmentary nature; but in the second or theoretical department we have scarcely even an indication to guide us. That the solution of the difficulties must be sought by beginning from the simplest case is evident, and here Schwann has certainly shown eminent acuteness in establishing the analogy between the formation of crystals and that of cells; but unfortunately we have not yet brought the law of crystalline formation into the dominion of science. Thus at the present time we can do no more than specify the problem presented to botany, the solution of which is alone to be expected when the mathematical construction of the formation of crystals lies perfectly complete before us. If however this is ever to be effected, we must enter upon all possible construction in a very different way from what has hitherto been done. For this purpose we must consider somewhat more exactly the characteristics of organic form, especially the vegetable, as opposed to the inorganic. The inorganic form, the crystal, is permanent when once formed; it is unchangeable; the individual (the individual existence) is the form itself, and by its solution and change of form a new individual arises. In the plant, on the other hand, the form is not stable or permanent, but an ever-changing one. The analogies between the two hold good only in the simplest cases. The nucleus of a crystal originates in a definite form, and then passes through a series of forms, until it reaches the deduced crystalline form. As such it then remains unchangeable until the individual is destroyed with the form. Thus certainly it has a very simple history of development, but this continues merely so long as something is still being added to that which is already present, until the whole is completed. The cell is formed in a manner somewhat analogous to this, originating in a definite form, and passing through a series of changes, which, as it appears, only contribute new matter until the form is complete: this then remains stationary until its solution and the consequent destruction of its individuality. It is however wholly different in combined forms, and these it is which, with few exceptions, compose what we term plants. Here a number of cells combine together within definite external limits; but these cells themselves do not enter into the form as dead particles of the mass; they continue to develop new cells, whilst the old ones are partially destroyed: the newly originated cells change, by their arrangement, the form of the whole, and, since formation of new parts and destruction of the old are continually going on, the general boundary of the whole never appears as anything definitely fixed. As, however, this metamorphosis is constant in its nature, and only occurs in individual parts, we cannot regard each one of the forms resulting from this process as a new one, but merely as a slight modification of the one immediately preceding it; and this peculiar connection brings the whole to us as one individual, which, at its first appearance, may be entirely different in all its parts, both in shape and material, from what it is at last; but in the conception of which we must comprehend the whole series of changing forms, wherein the widely distant members have perhaps no element identical, if we would attain to scientific knowledge, if we would understand the object, and not merely acquire a disjointed, uncomprehended, and incomprehensible impression. From these considerations it follows, granting the paramount importance of the morphological method of observation, that we gain nothing by the comprehension of the forms complete at any one moment, but that we must trace out the law of morphological development, and direct our scientific inquiries, not to an individual complete at any one period, but to the comprehension of the collective constant series of normally changing forms. The conception of genera and species in botany is consequently, therefore, not merely the result of a comparison but also of a connection of the various individual characteristics with each other. In this manner we should lay a firm foundation for the inductions to lead us to a theory of organic morphology, if we could but succeed in completing the theory of the formation of inorganic forms. As yet we are far from this point, and simply because it is only in the most recent times, and yet very imperfectly, that the importance of the study of the history of development has been acknowledged: although, without this, botany would be wholly divested of all scientific principle. This deficiency renders it impossible as yet to treat morphology with scientific logical development, or in accordance with a perfectly systematic mode of arrangement, as will but too obviously appear in my manner of treating this subject, although the blame of this is only partially to be imputed to me. It seems however practicable perfectly to state the problem, and to this end I subjoin the following remarks:—

"We have to construct the laws of morphological formation, and to delineate the forms themselves. The first remains for the present a mere problem, the solution of which must be reserved for succeeding times. The second may be accomplished, although imperfectly. I say imperfectly, because, instead of those complete series of development of which we ought alone to treat, we only know a few individual conditions; and therefore the greatest portion of the task still lies unperformed before us. Here we must again distinguish between—1. Series of forms which occur in all or in very many plants of a very different nature, and may therefore especially serve as the foundation of the study of vegetable forms; that is, General Morphology. 2. Series of forms which are only peculiar to definite groups of plants: Special or Comparative Morphology. These two would further branch off into the consideration of form without reference to its composition from the different forms of the elementary organs: External Morphology; and into the consideration of the manner in which forms are composed from individual tissues: Internal Morphology (the theory of structure—'Comparative Anatomy'). This last part falls however away from General Morphology: for all that we can, for the present at least, say is, that every plant is composed of the different forms of the elementary organs which have already been treated of. Even with respect to the second part, in regard to Comparative Morphology, it appears to me unadvisable to divide the two sections, on account of our deficiency of material; I shall, therefore, in the examination of the individual groups and parts of plants, subjoin all that is known concerning their structure."

In this work, in the description of the organs of plants, the plan of Schleiden has been followed, and the morphology of the separate organs of plants will be found under the head of each organ. Illustrations of the general laws of morphology will also be found under the heads of METAMORPHOSIS, MONSTER, and UNITY OF ORGANISATION.

In the same manner the laws of morphology, as far as they are yet understood in the Animal Kingdom, will be found referred to in the descriptions of the great families, and in the articles MOLLUSCA and SKELETON.

MO'RRHUA, a genus of Fishes of the order *Malacopterygii* and section *Subbrachiales*. The Common Cod-Fish may be regarded as the type of this genus, which also contains the Haddock and several other species, all of which have the ventral fins pointed, and situated under or rather in advance of the pectorals; three dorsal fins, two anal fins, and the chin furnished with a barbule.

M. vulgaris, Cuv. (*Gadus Morrhua*, Linn.), the Common Cod, is usually about three feet in length, but sometimes attains a much larger size, and weighs from 60 to 70 lbs. The upper parts of the head and body are of an olive-brown colour, mottled with yellowish; the under parts and the lateral lines are white, and the fins are dusky. The proportions of a specimen three feet in length are as follows:—The length of the head compared with that of the body (not including the tail-fin) is as one to two and a half; the depth of the body is equal to the length of the head; the first dorsal fin commences in a vertical line just behind the origin of the pectorals; the second dorsal commences in a line over the anal opening, and terminates opposite the hinder point of the first anal fin; the third dorsal and the second anal both commence and terminate in the same vertical line; the tail is truncated.

The Cod-Fish is an inhabitant of the northern soas. In this country it is found on all parts of tho coast; and "in the United Kingdom alone this fish, in the catching, curing, the partial consumption, and sale, supplies employment, food, and profit, to thousands of tho human race."

The account of the mode of fishing, &c., given in that most excellent work the 'History of British Fishes,' is as follows:—"The Cod-Fish is very voracious, a favourable circumstance for the fishermen, who experionce little difficulty in taking them with almost any bait, whenever a favourable locality is ascertained. As these fishes generally inhabit deep water, from 25 to 40 and even 50 fathoms, and feed near the ground on various small fishes, worms, *Crustacca*, and *Testacea*, their capture is only attempted with lines and hooks. Two sorts of lines, adapted for two very different modes of fishing, are in commou use. One mode is hy deep-sea lines, called bulters, on tho Cornish coast; these are long lines, with hooks fastened at regular distances along their whole length by shorter and smaller cords called snoods; these snoods are 6 feet long each, and placod on the long line 12 feet from each other, to prevent the hooks becoming ontangled. Near the hooks these shorter lines, or snoods, are formed of separate threads loosely fastened together, to guard against the teeth of the fish. Some variations occnr at different parts of the coast as to the number of hooks attached to the line, as well as in the length of the snood; but the distance on the long line between two snoods is always double the length of the snood itself. Buoys, buoy-ropes, and anchors or grapples, are fixed one to each end of tho long line. The hooks are baited with sand-launce, limpot, whelk, &c. The lines are always laid, or, as it is termed, shot, across the tide, for if the tide rnns upon the cnd of the line, it will force the hooks together, by which the whole tide's fishing is irrecoverably lost: they are depositod generally about tho time of slack water, between each ebb and flow, and are taken up or hauled for examination after having beeu left for about 6 hours, or one flood or ebb.

"An improvement upon this more common plan was some years ago suggested by Mr. Cobb, who was sent to the Shetlands by the Commissioners appointed for the Improvement of the Fisheries. He fixed a small piece of cork within a certain distance of the hook (about 12 inches), which suspended and floated tho bait so as to prevent its falling on the ground, by which method the bait was more freely shown to the fish, by the constant and variable motion producod upou it hy the tidc. In the old way the hait was frequently hid from the fish by being covered with sea-weed, or was consnmcd by some of the numerous star-fish and crabs that infest the ground.

"The fishermen, when not engaged in shooting, hauling, or rebaiting the long lines, fish with hand-lines, armed with two hooks kopt apart by a strong piece of wire; each fisherman manages two lines, holding ono line in each hand; a heavy weight is attached to the lower end of the line, not far from the hooks, to keep the bait down near the ground, where the fish principally fced. These two modes of line-fishing are practised to a great extent nearly all round the coast; and onormous quantities of cod, haddock, whiting, coal-fish, pollack, hake, ling, torsk, and all the various flat-fish, usually called by the general name of white-fish, are takcn.

"Of cod-fish alone the number taken in one day is very considerable; from 400 to 550 fish have been caught on the banks of Newfoundland in 10 or 11 hours by one man; and a master of fishing-vessels trading from the London market told me that oight men fishing under his orders off the Dogger Bank, in 25 fathoms water, have taken eighty score of cod in one day. Theso are brought to Gravesend in stout cutter-riggod vessels of 80 or 100 tous burthen, called store-boats, built for this traffic, with a largo well, iu which the fish are preserved alive; aud of these a portion is sent up to Billingsgato market by each night-tide.

"Well-boats, for preserving alive the fish takon at sea, came into uso in this country early in the last centnry; thoy are said to have been first built at Harwich about 1712. The storo-boats remain as low down as Gravcsend, because the water there is sufficiently mixed to kcep the fish alive. If they were to come higher up, it would kill them.

"A change has lately taken place from the cod having shifted their ground. Formerly the Gravesend and Barking fishermen obtained no cod nearer than the Orkneys or the Dogger Bank; but for the last two or three years the supply for the London market has bcen obtained by going no farther than the Lincolnshire and Norfolk coasts, and even between that and London, where proviously very few fish could be obtained . . . .

"In a natnral state the cod spawns about February; aud nine millions of ova have heen found in the roe of one female. The cod is in the greatest perfection as food from the end of October to Christmas. It may, in fact, be said of the whole of the family of *Gadidæ*, that they are in the best condition for the table in the cold months of the year. The young of the cod, about 6 inchos long, abound at the mouth of the Thames and Medway throughout the summer: as autumn advances they gain sizc and strength, and are caught, from 12 to 16 inches in length, by lines, uear the various sand-banks in the channel. When of whiting size, they are called Codlings and Skinners; and when largor, Tamlin Cod."

M. æglefinus, Cnv., the Haddock, a common fish in our markots, is of a smaller size than the cod, which it greatly rosembles. In a spocimen 20 inches long, the length of the head, compared with that of the body, without including the tail, is as one to two and a half; the depth of the body is less than the length of the head: the fins are situated ncarly as in the cod, but they arc proportionally higher, especially the anterior dorsal, which is pointed: the tail fin has its posterior edge emarginated. Its colour is usnally paler than the common cod, the back is palish-brown, the belley is silvery white, and the lateral line is black; a blackish patch is situatod on the side of the body behind the pectoral fins, and sometimes extends over the back, and unites with the corresponding spot on the opposite side; the dorsal fius and tail are grayish, and the poctoral and ventral fins are paler.

This fish frequonts for the most part tho same localities as the common cod, being found in the northern seas. It occurs all round the coast of Great Britain and Ireland, but is said not to exist either in the Baltic or Mediterranean. It is chiefly caught with long lincs baited with pieces cut from a herring or sand-launce.

In the 'Règne Animal,' it is said that wheu the Haddock is salted, it is called Hadou, after the English name Hadok; and in the 'History of British Fishes,' Mr. Yarrell states, that "the French fishermen call the haddock Hadot," wheuce probably onr name was derived.

M. callarias (*Gadus callarias*), the Dorse, the Variable Cod. This species is admitted by Mr. Yarrell into the list of British species, although the only authentic instances of its captnre have been at Antrim and Cork in Ireland. It appears to be a well-known fish in the Baltic, and is frequently callod the Baltic Cod. It differs from the common Cod, and is subject to great varieties in its characters, hence its name of Variable Cod.

M. lusca (*Asellus luscus*, Willughby; *Gadus luscus*, Linnæus), the Bih-Pout and Whiting-Pout. The Bib and Pont havc sometimes boon regarded as different fishes, hnt Yarrell describes them as one. This fish is woll known on the English coasts. From a dark spot at the origin of the pectoral fin in which it resembles the Whiting, it is ofton called Whiting-Pont. It is called Pout, Bib, Blens, and Blinds from tho power it possessos of inflating a membrano which covers the eyes and other parts about the head. The flesh is excellent, and like most of the *Gadidæ* it is bost eaten in November and December. In form the Whiting Pout is the deepest for its length of the British *Gadidæ*. The upper jaw is the longest; the baud of teeth of several rows, those forming the onter row the largest; under jaw with a single row; the barbule at the chin rather long; various mucous poros abont both jaws; the cyes large; the orbits oovered with a loose membrane which the fish has the power of distonding; the diameter of the eye equal to one-third of the length of the head; the irides orange colour; the dorsal and abdominal lines exhibit considerable convexity; the body tapers rapidly from the line of the onding of the second dorsal and first anal fins; the colour of the head, back, and upper part of the sides, a yellow roddish-brown, becoming lighter on the bolly, and tinged in places with blnish-gray; at the base of the pectoral fins a black spot; scales small and deciduous; posterior half of the lateral line straight, then rising in a curve over the pectoral fin; all the fins, except the vontrals, dnsky-brown; the ventrals nearly white; the first anal fin in large-sized specimens edged with fine blne.

M. minuta (*Gadus minutus*, Linnæus), the Poor or Power-Cod. Though similar to the Pout it diffors in many points. It is not so deep when of the same length; the first aual fin does not bogin so far forward as in the Pout by nearly the whole length of the base of the first dorsal fin; tho longest rays of the third dorsal fin aud the second anal fin are shorter than the bases of the respective fins, and do not, thereforc, prodnce the same vertically truncated appearauce as in the same relative fins of the Pout; and tho barbule at tho chin is much shorter.

This fish is abundant in the Baltic, where its prescnce rejoioes the fishermon, as it is usually the precnrsor of the Cod. It is the smallest of the Cod family, and although on account of its sizc it is more usnally employed for bait, it is very good eating. It is scarco in America.

(Yarrell, *British Fishes.*)

MORSE. [PHOCIDÆ.]

MORUS, a genus of Plants belonging to the natural order *Moraceæ*. The flowers are monœcious; the staminiferous flowers spiked; calyx 4-parted, spreading, membranons; the stamens 4, larger than the calyx, with the rudiments of an ovary between their bases; the pistiliferous flowers clustered; sepals 4, scale-like, imbricating each other, 2 being opposite and external to the other 2; stigmas 2, linear, glandnlar; ovule solitary, suspendod. Fruit consistiug of the latter flowers become fleshy and grown togother, each inclosing a dry membrauous poricarp. Seed pendulous; embryo curved like a horse-shoe, amongst fleshy albnmen, with the radicle dircctod to the hilum. The species are trees.

M. nigra, the Black or Common Mnlberry, is a small tree with very rugged bark. The young shoots aro downy; the leaves roundish, cordate, pubescent, coarsely serrated, rough to the touch, slightly acuminate; stipules oblong, membranous, downy, the length of the petiole or longer, deciduous.

The Black Mulberry is the only species of *Morus* worthy of being cultivated as a fruit-tree. It is a native of Persia, and its indigenous range appears to be extensive. Its introduction to this country dates about the middle of the sixteenth century. Under great vicissitudes it proves very tenacious of life; and under ordinary circumstances it attains, even in this climate, a considerable age, for some trees planted in 1548 are still alive. The fruit is used at the dessert, fresh gathered, and at the same time it ought to be so ripe as to be just ready to drop from the tree; indeed the fruit may be said to be in the highest perfection with regard to ripeness when it actually drops, and hence a grass plot surrounding the trunk is desirable; but the trees are found to thrive better when the soil is kept stirred; however, as grass will be generally preferred, all strong-growing sorts of grasses should be avoided; and it should also be kept very closely mowed till at least immediately before the fruit ripens. By this means the sun's rays will be permitted to penetrate the soil to a greater depth than when obstructed by a covering of long grass. Mulberries are also preserved in the form of a syrup; and their juice, mixed with that of apples, forms a beverage of a deep port-wine colour, called Mulberry-Cider.

The soil for mulberry-trees should be of a light, rich, and moderately dry nature. If the subsoil be not naturally pervious, it should be rendered as much so as is possible. A good bottoming of brick rubbish will prove beneficial with regard both to the growth of the tree and the flavour of the fruit.

Propagation of the Mulberry may be effected either by seeds, cuttings, or layering. The last is the preferable mode, where it can be conveniently adopted; and the shoots or branches used for this purpose, as also those intended for cuttings, should be selected from those trees, or parts of a tree, that have been observed to be most fruitful; for although the plant is generally monœcious, yet some trees occasionally assume a diœcous character. Hence, likewise, seedling plants are not so desirable as those propagated from trees previously ascertained to be prolific; and moreover seedling plants are a greater number of years in attaining a bearing state.

As the acquisition of a good mulberry-tree is very desirable, the following directions for obtaining a bearing tree readily and quickly will be useful. If a tolerably large branch of a vigorous tree is 'ringed,' and the annulation is inclosed in a box filled with rich soil, sufficiently large to hold as much as will preserve a somewhat uniform temperature, or at least an approximation to that which the roots of a tree naturally experience in the ground, roots will be readily emitted into the earth, and in due time the branch may be cut off and planted. A covering of moss is useful, partly for maintaining an equable temperature, and partly for preserving moisture.

The Mulberry-Tree requires very little pruning beyond that of regulating the head. The season for this operation should be always mid-winter; for if in a growing state, this plant bears amputation very ill, especially as regards large limbs. Mulberries have been trained against south walls, over which a single plant has been known to extend upwards of ninety feet horizontally; additional size and flavour are said to have been gained, but certainly not so much over a standard on a proper bottom as to compensate for the great extent of wall-room occupied.

M. alba, the White Mulberry, is a native of China, where it forms a small tree, and whence it has been gradually carried westward till it has become a common plant in most of the temperate parts of the Old World, forming in the south of Europe a pollard-tree by roadsides. Its leaves are smooth and shining, usually heart-shaped at the base, and on old trees ovate or oblong, but on young vigorous shoots as frequently divided into deep lobes. The fruit is white, insipid, and of little value except for feeding poultry; in this country it is seldom formed. It is on this species that the silk-worm is chiefly fed; and in silk countries many varieties are cultivated for the purpose, some of which are said to be much better than others. The common wild kind is said to suit the silk-worm as well as or even better than any other kind; but as it yields only a small quantity of foliage, compared with other sorts, it is principally employed as the source of seeds from which stocks are raised for grafting more productive varieties. Of the latter each silk country has its own fancy kinds, which there would be little advantage in noticing here; but there is among them an exception of importance, the value of which has been recognised wherever it has been cultivated. Some years since a mulberry was introduced into France from Manilla, whence it has gained the name of the Phillppine Mulberry, the great excellence of which seems universally acknowledged. It has straight smooth branches, oval heart-shaped leaves tapering to a point, thin, rather soft, a little blistered and puckered in the middle, often drooping, and sometimes more than six or even nine inches broad in the dry climate of the south of France. It grows much faster than the White Mulberry, and strikes from cuttings as freely as a willow, which is not the case with the latter. The abundance of its leaves is much greater than any other known variety, and, what is most important, it is not only freely eaten by the silkworms, but perfectly agrees with them. Its culture is now superseding that of all others in the south of Europe, and it is even taken as a stock on which to graft the common White Mulberry, when the latter is wished for. According to M. Bonafous this may be done either upon layers of the Philippine Mulberry, headed down to one or two eyes above the ground, or upon cuttings seven or eight inches long, which may be planted immediately after having been grafted: the young plants will be five or six feet long the first year, and three or four inches in circumference. This mulberry is sometimes called *Morus multicaulis*.

In this country the White Mulberry and all its varieties suffer a good deal from our winters, but not so much as to prevent its cultivation. Some years ago an attempt was made to introduce it and the rearing of silkworms into Great Britain; but the attempt failed, owing partly to unskilful management, but more to the soft juicy condition of the leaves in this damp climate, which rendered them unfit for the food of the worm.

(Loudon, *Arboretum Britannicum*.)

MOSANDERITE, a Mineral belonging to the Cerium series. It occurs massive and fibrous, and crystallised in flat prisms. Cleavage in one direction distinct, in others indistinct. Colour dull reddish-brown. Streak grayish-brown. Hardness 4·0. Lustre of cleavage-face between vitreous and greasy; of other surfaces resinous. Thin splinters translucent, and showing a bright red colour by transmitted light. Specific gravity 2·93 to 2·98. It is found at Lammanskaret in Sweden. According to Erdmann it consists mostly of silica, titanic acid, and the oxides of cerium and lanthanium, with some oxide of manganese, lime, a little magnesia, potash, and water.

MOSASAURUS, Mr. Conybeare's name for a gigantic extinct aquatic Saurian, the *Saurochampsa* of Wagler. It was at first considered by Faujas St. Fond to be a Crocodile, but its true position among the Saurians was pointed out by Camper and confirmed by Cuvier. Indeed, previous to their investigations, the nearly perfect head of this Saurian, known as the great animal of Maestricht, and found near that city in the calcareous freestone forming the most recent deposit of the cretaceous formation, was a stumbling-block to naturalists, some of whom were of opinion that it was a whale. The zoologists last named, and especially Cuvier, have satisfactorily proved that it was a great marine reptile, and very nearly allied to the Monitor. [MONITORIDÆ.] The teeth are without true roots, not hollow as in the Crocodile, but solid throughout, and joined to the sockets by a broad bony basis, the result of the hardening of the pulp from which the teeth were formed, and likewise attached to the jaw by the ossification of the pulp that had furnished the enamel. "This indurated capsule," writes Dr. Buckland, in his 'Bridgewater Treatise,' "passed like a circular buttress around its base, tending to make the tooth an instrument of prodigious strength. The young tooth first appeared in a separate cell in the bone of the jaw, and moved irregularly across its substance until it pressed against the base of the old tooth; causing it gradually to become detached, together with its base, by a kind of necrosis, and to fall off like the horns of a deer. The teeth in the roof of the mouth are also constructed on the same principle with those in the jaw, and renewed in like manner."

The last-mentioned writer places its organisation and its zoological and geological relations in so interesting a point of view in the treatise above mentioned, that we select his account as the best calculated to inform the general as well as the philosophical reader on these points.

"The geological epoch at which the *Mosasaurus* first appeared seems to have been the last of the long series during which the oolitic and cretaceous groups were in process of formation. In these periods the inhabitants of our planet seem to have been principally marine, and some of the largest creatures were Saurians of gigantic stature, many of them living in the sea, and controlling the excessive increase of the then extensive tribes of fishes. From the lias upwards to the commencement of the chalk formation the *Ichthyosauri* and *Plesiosauri* were the tyrants of the ocean; and just at the point of time when their existence terminated, during the deposition of the chalk, the new genus *Mosasaurus* appears to have been introduced, to supply for a while their place and office, being itself destined in its turn to give place to the *Cetacea* of the tertiary periods. As no Saurians of the present world are inhabitants of the sea, and the most powerful living representatives of this order, namely the Crocodiles, though living chiefly in water, have recourse to stratagem rather than speed for the capture of their prey, it may not be unprofitable to examine the mechanical contrivances by which a reptile, most nearly allied to the Monitor, was so constructed as to possess the power of moving in the sea with sufficient velocity to overtake and capture such large and powerful fishes as, from the enormous size of its teeth and jaws, we may conclude it was intended to devour. The head and teeth point out the near relations of this animal to the Monitors; and the proportions maintained throughout all the other parts of the skeleton warrant the conclusion that this monstrous Monitor of the ancient deep was 25 feet in length, although the longest of its modern congeners does not exceed 5 feet. The head here represented measures 4 feet in length, that of the largest Monitor does not exceed 5 inches. The most skilful anatomist would be at a loss to devise a series of modifications by which a Monitor could be enlarged to the length and bulk of a Grampus, and at the same time be fitted to move with strength and rapidity through the waters of the sea; yet in the fossil before us we shall find the genuine characters of a Monitor maintained throughout the whole skeleton, with such deviations only as tended to fit the animal for its marine existence.

"The *Mosasaurus* had scarcely any character in common with the Crocodile, but resembled the Iguanas in having an apparatus of teeth fixed on the pterygoid bone, and placed in the roof of its mouth, as in many serpents and fishes, where they act as barbs to prevent the escape of their prey.

"The other parts of the skeleton follow the character indicated by the head. The vertebræ are all concave in front and convex behind; being fitted to each other by a ball and socket joint, admitting easy and universal flexion. From the centre of the back to the extremity of the tail they are destitute of articular apophyses, which are essential to support the back of animals that move on land: in this respect they agree with the vertebræ of dolphins, and were calculated to facilitate the power of swimming; the vertebræ of the neck allowed to that part also more flexibility than in the Crocodiles.

"The tail was flattened on each side, but high and deep in the vertical direction, like the tail of a crocodile, forming a straight oar of immense strength to propel the body by horizontal movements analogous to those of skulling. Although the number of caudal vertebræ was nearly the same as in the Monitor, the proportionate length of the tail was much diminished by the comparative shortness of the body of each vertebra; the effect of this variation being to give strength to a shorter tail as an organ for swimming; and a rapidity of movement, which would have been unattainable by the long and slender tail of the Monitor, which assists that animal in climbing. There is a further provision to give strength to the tail, by the chevron bones being soldered firmly to the body of each vertebra, as in fishes."

The total number of vertebræ was 133, nearly the same as in the Monitors, and more than double the number of those in the Crocodiles. The ribs had a single head, and were round, as in the family of Lizards. Of the extremities sufficient fragments have been found to prove that the *Mosasaurus*, instead of legs, had four large paddles, resembling those of the *Plesiosaurus* and the Whale: one great use of these was probably to assist in raising the animal to the surface, in order to breathe, as it apparently had not the horizontal tail by means of which the *Cetacea* ascend for this purpose. All these characters unite to show that the *Mosasaurus* was adapted to live entirely in the water, and that although it was of such vast proportions compared with the living genera of these families, it formed a link intermediate between the Monitors and the Iguanas. However strange it may appear to find its dimensions so much exceeding those of any existing lizards, or to find marine genera in the order of Saurians, in which there exists at this time no species capable of living in the sea; it is scarcely less strange than the analogous deviations in the *Megalosaurus* and *Iguanodon*, which afford examples of still greater expansion of the type of the Monitor and Iguana into colossal forms adapted to move upon the land. Throughout all these variations of proportions, we trace the persistence of the same laws which regulate the formation of living genera, and from the combinations of perfect mechanism that have in all times resulted from their operation, we infer the perfection of the wisdom by which all this mechanism was designed, and the immensity of the power by which it has ever been upheld.

"Cuvier asserts of the *Mosasaurus*, that before he had seen a single vertebra, or a bone of any of its extremities, he was enabled to announce the character of the entire skeleton from the examination of the jaws and teeth alone, and even from a single tooth. The power of doing this results from those magnificent laws of co-existence which form the basis of the science of comparative anatomy, and which give the highest interest to its discoveries."

Head of *Mosasaurus Camperi* (*Lacerta gigantea* of Sömmering).

The noble specimen from which the cut is taken was discovered in 1780, and is in the Museum at Paris. At the capture of Maestricht by the French army it was given up to them for the purpose of being placed in the museum, according to Cuvier, by Goddin, dean of the chapter of that town, which, in virtue of some droits of the chapter, had taken it from Hoffman, of whose collection it formed the principal feature. It is said that the French cannoneers had directions not to point their artillery towards that part of the town in which this precious specimen was deposited.

A cast of the above specimen, presented by Baron Cuvier to Dr. Mantell, is now in the British Museum. In the same collection is also part of a lower jaw of *Mosasaurus*, presented by Dr. Peter Camper in 1784. There are also several vertebræ found by Dr. Mantell in the Chalk of Lewes. Casts are also preserved in the museums of the Geological Society and of the Royal College of Surgeons. Teeth in every respect similar to those found in the Maestricht reptile have been discovered by Dr. Harlan in Philadelphia, and other remains of this animal have been found in the same district.

(Mantell, *Fossils of the British Museum.*)

MOSCHATA. [ACTINIADÆ.]

MO'SCHIDÆ, a family of Ruminant Quadrupeds familiarly known as Musk-Deer.

Linnæus defines the genus *Moschus*, which he places between *Camelus* and *Cervus*, under his order *Pecora*, as having no horns, and the upper canine teeth solitary and exserted—"Cornua nulla. Dentes Laniarii Superiores solitarii, exserti."

Pennant, in the 'Systematic Index,' gives it nearly the same position, the only difference being that the Deer precedes it, and the Camel follows it.

Cuvier, in his last edition of the 'Règne Animal,' gives it the same position that Linnæus assigned to it; the Llamas (among the Camels) immediately preceding it, and the Deer (*Cervus*, Linn.) being next in succession to it. The French zoologist states that the Musks are much less anomalous than the Camels, and only differ from the other Ruminants in the absence of horns, in having a long canine tooth on each side of the upper jaw, which comes out of the mouth in the males, and finally, in having in their skeleton a slight fibula, which has no existence in the Camels. He adds that they are charming animals in regard to their elegance and lightness. The distinction of the exserted upper canine tooth, noticed by Cuvier, is not confined to the Musks; such a conformation exists in some of the males of the *Cervidæ*, the Munjak for instance.

Mr. Swainson is of opinion that the *Moschidæ*, or Musk-Deer, constitute the most aberrant group of the Ruminants, and he places them between the *Cervidæ* and the *Camelopardæ*, the last family being the terminating group of his fourth tribe, or Ruminants.

M. F. Cuvier enumerates *Moschus Moschiferus*, *M. Meminna*, *M. pygmæus*, *M. Javanicus*, and *M. Napu*, as the only species known at present.

Dr. J. E. Gray, in his 'Disposition of the Mammalia' ('Annals of Phil.,' 1825), divides the family *Bovidæ* into two sections, the first with persistent horns, and the second with either no horns or deciduous horns. [BOVIDÆ.] He makes *Moschina* the fourth sub-family, and arranges it between *Camelina* and *Cervina*, in the second section. The genera of *Moschina*, in this arrangement, are *Moschus* and *Meminna*. The same author, in June, 1836, read to the Zoological Society of London some observations 'On the genus *Moschus* of Linnæus, with descriptions of two new species.' He remarked that the only character by which this genus, as established by Linnæus and others, differs from the genus *Cervus*, consists in the absence of horns; for the elongated canines are common to it and most of the Indian species of *Cervus*, especially the *C. Muntjac*. [CERVIDÆ.]

The character of the fur, the degree of hairiness or nakedness of the metatarsus, and the presence or absence of the musk-bag of the male, offer however, he observed, good characters for the sub-division of the group into three very distinct sections or sub-genera.

The first of these divisions, for which Dr. Gray would retain the name of *Moschus*, comprehends only the Tibet Musk, *M. Moschiferus*, Linn. In common with the Deer and Antelopes, it has, he pointed out, the hinder and outer side of the metatarsus covered with close erect hair, and, like many of the Deer also, its fur is quill-like and brittle; the throat moreover is entirely clothed with hair, and the males are provided on the middle of the abdomen with a large pouch secreting musk. Its young, like those of most of the Deer, are spotted, whilst the adult animal is plain-coloured.

Dr. Gray further stated that the division to which, in the year 1821, in a paper in the 'Medical Repository,' he gave the name of *Meminna*, also consists of but a single species, the *Moschus Meminna*, Linn. In this group the hinder edge of the metatarsus is, he observed, covered with hair; and there is no musk-bag in either sex. The false hoofs, he remarked, are distinct, although Linnæus and Buffon denied their presence.

The third and last sub-division is characterised by Dr. Gray, under the name of *Tragulus*, as having the hinder edge of the metatarsus nearly bald and slightly callous, a character which distinguishes them at once from all other Ruminants; the fur is soft, and adpressed like that of *Meminna*, but not spotted even when young; the throat is provided with a somewhat naked, concave, sub-glandular, callous disc, placed between the rami of the lower jaw, from which a band extends to the fore part of the chin; and they have no musk-bag. Like all the other species of the Linnæan genus *Moschus*, they have false hoofs; and most of them have the edges of the lower jaw, three diverging bands on the chest, and the under surface of the body, more or less purely white. The species of this division scarcely differ in colour in the various stages of their growth, the young fawn resembling the adult in every particular except in size.

In this division, the synonymy of which is stated to be extremely confused, Dr. Gray reckons four species, two of which he describes as new. Dr. Gray stated that he was unable to identify with any of the four species mentioned by him on this occasion, or to separate from them as distinct, the Palendoc, figured in Marsden's 'Sumatra,' or Pygmy Musk of Sumatra, figured in Mr. Griffith's edition of Cuvier's 'Animal Kingdom,' on which Fischer has established his *Moschus Griffithii*. The *M. pygmæus* of Linnæus, in Dr. Gray's opinion, belongs to the genus *Antilope*; the hinder part of the tarsus being covered with hair, and the false hoofs very small and rudimentary, and entirely hidden under the hair of the feet. He thinks that the *M. Americanus* appears by its spotted livery to belong to a species of Deer; and that the *M. delicatulus*, or Leverian Musk of Shaw, is undoubtedly the fawn of a deer. Dr. Gray further observed that it is curious that Dr. Shaw quotes as a synonym of the last-named species the figure of Seba, on which alone the *M. Americanus* is founded, while at the same time he enumerates the *M. Americanus* as a distinct species. ('Zool. Proc.,' 1836.)

In the same year Mr. Ogilby, in his paper on the 'Ruminantia,' read before the Zoological Society, makes the *Moschidæ* the third family of that order, with the following character:—

Feet bisulcate; horns none; incisor teeth (primores), above none, beneath eight. Two genera.

1. *Moschus*.—Rhinaria large. Lachrymal sinuses none; interdigital fossæ none; inguinal follicles none; teats four. Type *M. Moschiferus*.

2. *Ixalus* (?).—Rhinaria none. Lachrymal sinuses small and distinct; interdigital fossæ none; inguinal follicles small; teats two. Type, *I. Probaton*. ('Zool. Proc.,' part iv. p. 119.)

Mr. Ogilby goes on to state that the genus *Ixalus*, founded upon the observation of a single specimen, may eventually prove to belong to a different family: and indeed he observes that it differs little from the true antelopes; but even supposing it to be correctly placed among the *Moschidæ*, other forms, Mr. Ogilby remarks, are still wanting to fill up the chasms which evidently exist among the characters of that group. "Two," continues Mr. Ogilby, "are more especially indicated, and our knowledge of the laws of organic combination, and of the constituent parts of other groups, gives us every reason to believe in their actual existence, and to anticipate their discovery." He then proceeds to characterise the genera *Hinnulus* and *Capreolus*, observing that they will probably be found, one in the tropical forests of the Indian Archipelago, and the other on the elevated table-lands of Mexico or South America.

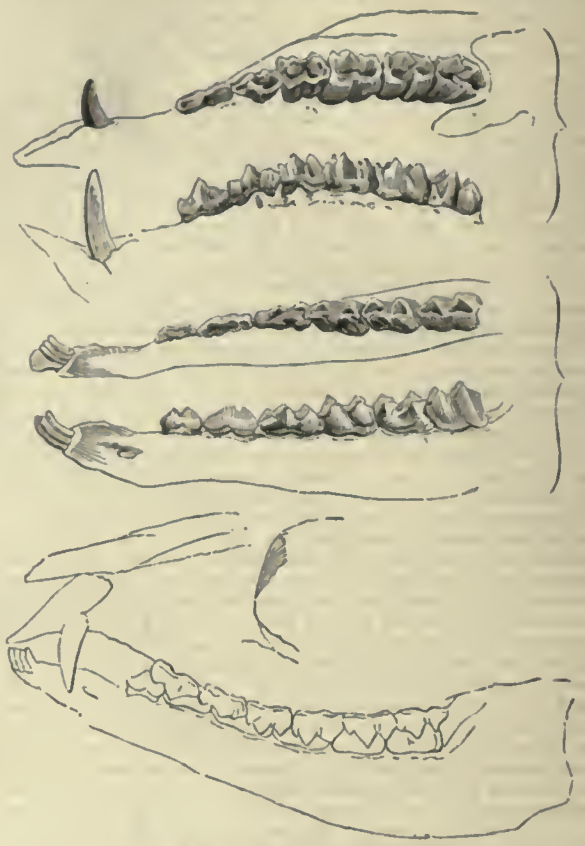
"It may appear a bold, perhaps a presumptuous undertaking," says Mr. Ogilby, "thus to predict the discovery of species and define the characters of genera, of whose actual existence we have no positive knowledge; but, as already remarked, all the analogies of nature, whether derived from organic combination, or from the constituent members of similar groups, are in favour of the supposition; and I may observe further, that the recent discovery of the genus *Ixalus*, if indeed it eventually prove to be a genus, of which I had long previously defined the characters, as I have here done for the presumed genera *Hinnulus* and *Capreolus*, strengthens my belief in the actual existence of these forms, and increases the probability of their future discovery." The family is placed by Mr. Ogilby between the *Cervidæ* and *Capridæ*.

The same author makes *Tragulus* (type *Antilope pygmæa*) the first genus of his family *Bovidæ*.

The *Moschidæ* do not differ much from the other Ruminants; the leading differences are given above, and the general osseous structure of the form may be collected from the following cuts:—

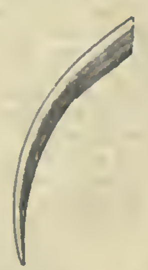
Skeleton of *Moschus Moschiferus*.

Dental Formula:—Incisors, $\frac{0}{8}$; Canines, $\frac{1-1}{0-0}$; Molars, $\frac{6-6}{6-6}$ = 34.



Teeth of *Moschus Moschiferus*. F. Cuvier.

The canine teeth go far back into the upper jaw, as will be seen from the following figure of one of them. It is not impossible that the so-called canine teeth of *Ursus cultridens* may be the canine teeth of an extinct ruminant allied to this family, or that of the *Cervidæ*. [MACHAIRODUS.]



Canine Tooth of *Moschus Moschiferus*.

Moschus Moschiferus, the Musk, or Tibet Musk. It has somewhat of the form of a Roebuck; but higher behind than it is at the shoulder, from the upper part of which to the sole of the foot it measures about 2 feet 3 inches; whilst from the top of the haunches to the soles of the hind feet the measurement is about 2 feet 9 inches. Ears long and rather narrow, in the inside pale-yellow and dark-brown outside. Hair on the body suberect, long, each hair marked with short waves from top to bottom, ash-coloured near the base, black or blackish near the end, and rusty at the tips. Chin yellow. The colours vary. Most of the adults are plain-coloured. In some, and such is the individual figured by Pennant, the fore part of the neck is marked on each side with long white stripes from the head to the chest, the back striped transversely with pale-brown reaching to the sides, which are also dappled with a lighter colour. Hoofs very long and deeply divided, spurious hoofs very long. Tail about an inch long, concealed in the hair. Scrotum rutilum. Penis vix percipiendus. (Pennant.)

Female less than the male, and wants the two tusks.

Young, spotted.

The Musk is a mountain animal, timid and shy, and a lover of solitude. Precipices covered with pines and almost inaccessible crags are its favourite haunts; and the musk-hunter often perils his life in the dangerous chase; for when hotly pursued the animal takes refuge frequently in the highest fastnesses, leaving men and dogs with scarcely the possibility of access to the precipitous summits to which it flies. And yet the slanghter made among them must at one time have been great, and the animals abundant; for Tavernier bought in one journey 7673 musk-bags. The hag, or tumor, containing this well-known drug is peculiar to the male: it is kidney-shaped, pendulous, of the size of a hen's egg, and sitnated beneath the abdomen. There are said to be two apertnres, the larger oblong, the smaller round, and covered with hair: and on the application of pressure the musk may he forced throngh the apertnres. It is hrown and unctuous. This bag the hunters cut off, and tie it up for sale, hut, like everything that is calculated for the use of man and is the object of commerce, it is said to be adulterated by the admixtnre of foreign matter, and pieces of lead are stated to have heen fouud enveloped in it, for the purpose of increasing the weight. The musk which comes from Tibet is considered the best, and used to hear the highest price; the bag is more or less full, and the qnality more or less good, according to the age and health of the animal. Whcn dry, musk is dark-brown, inclining to red, or rusty-black, and appears more or less granulated. To the taste it is rather hitter and somewhat acrid. It is perhaps the strongest and most pungent of perfnmes, and so suhtle that every thing near it becomes infected, and for a long time retains the odour; vessels of silver even, a metal which, as mnch as if not more than others, readily becomes purified from odorous substances, do not part with the scent of musk, which may have been placed in them, for a long time. When fresh, or exposed in large quantities, its effects upon the nervons system are said to he absolutely violent; and it is stated that hlood has been forced from the nose, eyes, and ears, of those who have imprudently iuhaled the vapour of a considerahle quantity. When Chardin made his purchases, he secured himself from the sudden effects of the smell by covering his face with a handkerchief several times folded. The mere skin of the animal fills the place where it is kept with the perfnme for a long period. In medicine it is used for nervons and convulsive cases in considerahle doses. The flesh of the animals, though that of the males is rather highly flavoured with musk, is eaten hy the Russians and Tartars. In rutting-time this flavour is most predominant.

It is a native of Tibet; the province of Mohang Meng in China; Tonquin, and Bootan; ahout the lake Baïkal; and near the rivers Yenesei and Argun. Found from lat. 60° to 44° or 45°; hnt never wanders so far south, except when forced through hunger, hy great falls of snow, when it migrates to feed on corn and new-grown rice. (Pennant.)

Musk, or Tibet Musk (*Moschus Moschiferus*).

The description given by Linnæus of this species is an example of his great neatness. He describes the Tibet Mnsk as *Moschus folliculo-umbilicali;* and this is the distinction of the species, as far as we yet know. It does not appear to have beeu known to the ancients, but seems to have been first mentioned by the Arabians. Serapion described it in the 8th century.

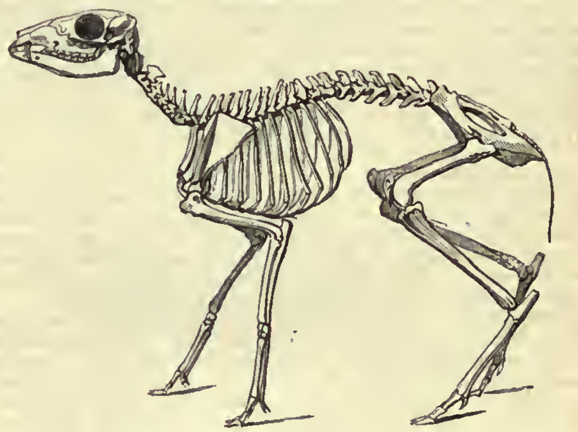
There are three other species of *Moschus—M. Sibiricus*, the Kubaya, a native of Siberia; *M. leucogaster*, tho White-Bellied Musk, a native of Nepaul; *M. chrysogaster*, the Golden-Eyed Musk, also from Nepanl. The *Moschus aquaticus*, Ogilby, the Boomorah of West Africa, is the *Hyemoschus aquaticus* of Gray.

Meminna Indica (*Moschus Meminna*, Linu.). It is the only species known.

Length about 17 inches. Ashy-olive; throat, hreast, and belly white, sides and haunches spotted and harred transversely with white: ears large and open, tail very short. Weight about 5¼ lbs.

It is a native of Ceylon and Java. (Pennant.) Colonel Sykes informs us that it is the Pecsoreh of the Mahrattas, and that it is found in considerable numbers iu the dense woods of the Western Ghauts, hut never on the plains. ('Zool. Proc.,' 1831.) Pennant described it from a drawing communicated hy Governor Loten, of Ceylon.

Meminna Indica.



Skeleton of *Meminna.*

Tragulus Javanicus, Pallas (*Moschus Javanicus*, Gmelin and Raffles; *M. Napu*, F. Cuvier), is the size of a large hare. Body heavy. Limbs very delicate. Head arched and long. Eyes large, but uot expressive. General colour brown mixed with hlackish-gray or yellow reflectious; yellow predominating along the hack and tail, on the legs, the neck, and head; the gray and hlack prevail on the lower part of the shoulders, on the sides, and thighs. These different tints are the resnlt of the colonring of the hairs, which on those parts which are yellow are of that colour for the greatest part of their length aud black at the point, and where the hairs lie very thick and one on the other, some of the parts appear hlack. Lower jaw white; two white lines which spring from it extend thence beyond the cheeks; two other white hands spring from the same point as the first, aud terminate at the shoulders; a middle hand descends on the breast, widening in its descent, and is lost in the white of that part. The upper edge of the first two white bands is bordered with black, and the other bands are all separated from each other by hairs of a hrowuish-black colour. Belly, anterior and upper part of the hind legs, posterior and upper part of the fore legs, and the under part of the tail, white. End of the muzzle naked. Eyes surrounded with a naked part, from which springs a band without hairs which goes to the muzzle. These naked parts are hlack with a slight tint inclining to violet. The toes are united, by a rather loose membrane, nearly to the origin of the hoofs, which are very long and pointed; the spurious hoofs are also long, cylindrical, aud pointed. Length abont 24 inches. Height to the shoulder rather more than 9 inches, to the top of the haunches rather more thau a foot.

Mr. Bennett observes that M. F. Cnvier regards five radiating hands as the distinctive character of the Napu, and three as that of the Kanchil; whereas, in truth, the number is the same in hoth, and the difference is only in their disposition.

The Napu comes from Java aud Sumatra.

Sir Stamford Raffles states that this species frequents thickets near the sea-shore and feeds principally upon the herries of a species of

Ardisia. He adds that it can be easily trained, when taken young, and will become quite familiar.

Napu (*Tragulus Javanicus*).

Dr. Gray refers also to this genus *Moschus Kanchil* (Javan Musk of Shaw, Le Chevrotain de Java of Buffon); *M. fulviventer* (Le jeune Chevrotain of Buffon); and *M. Stanleyanus*, of which last, in 1836, there were four living specimens in the magnificent collection of the Earl of Derby at Knowsley; and two others, consisting of a specimen of each of the varieties, in that of the Zoological Society of London, the gift of her present Majesty. With the exception of the last, whose locality is not known, these are Oriental, the Kanchil being an inhabitant of Java, and the *Tragulus fulviventer* a native of the Malacca Islands and the East Indian Peninsula, but the habitat of *T. fulviventer* is given by Dr. Gray with a query.

Fossil Moschidæ.—The following species are recorded: *M. antiquus*, Kaup (Epplesheim Sand); *M. Bengalensis* (Tertiary, north-east border of Bengal, Pentland); *M. Prattii* (Tertiary, Isle of Wight, Pratt). Dr. Schinz also mentions the teeth of these ruminating animals as occurring in the Tertiary Coal of Zürich; of which, one, he says, is scarcely larger than the teeth of the small musk; the other belongs to a species of deer. Remains of *Moschus* are also mentioned by Jäger (Tertiary, Bean Iron-ore (Bohnerz) of the Rauh Alp).

MOSQUITO, a term applied to certain stinging Flies belonging in all probability to several distinct genera. The mosquitoes are either gnats or gnat-like insects, which are furnished with a proboscis adapted for piercing the flesh, and at the same time forming a kind of siphon through which the blood flows; this instrument moreover injects into the wound which it makes a poison which causes inflammation.

Many insects called Mosquitoes probably belong to the same tribe as the Common Gnat (*Culex*, Linn.); Humboldt however asserts that the insects known by that name in America belong to the genus *Simulium*, and that the *Culices*, which are equally numerous and annoying, are called Zancudoes, which means long legs. The former are what the French call Moustiques, and the latter Cousins.

The genus *Simulium*, according to Macquart ('Suites à Buffon; Hist. Nat. des Insectes—Diptères'), belongs to the family *Tipulariæ* and section *Tipulariæ-florales*, and is thus characterised:—Fourth joint of the palpi rather elongated and slender; antennæ cylindrical, 11-jointed; eyes round, ocelli wanting; basal joint of the tarsi as long as the others taken together; wings very broad, basal and marginal cells very narrow.

M. Macquart, in his account of the habits of the species of this genus, says, "They frequent the leaves of shrubs under trees, and live upon the juices found upon those leaves, especially such as are produced by the plant-lice; they do not however confine themselves to this kind of nourishment, but when opportunity offers, like gnats, they suck the blood of animals, and produce an equally painful wound. Their proboscis is much less complicated than that of the gnats, consisting, as in other *Tipulariæ*, merely of a labrum and lingua; these parts however are more developed than usual. These minute flies are constantly in motion, and in running apply the whole sole of the anterior tarsus to the plane upon which they may be moving; they moreover appear to use their fore legs as feelers."

The following is an account of the structure of *Culex Mosquito*, the Mosquito of the Americans, by an American observer:—

"The male mosquito differs considerably, as is well known, from the female; his body being smaller and of a darker colour, and his head furnished with antennæ and palpi in a state of greater development. Notwithstanding the fitness of his organs for predatory purposes he is timid, seldom entering dwellings or annoying man, but restricts himself to damp and foul places, especially sinks and privies. The female, on the other hand, gives greater extension to her flight, and, attacking our race, is the occasion of no inconsiderable disturbance and vexation during the summer and autumn months.

"The head of the male mosquito, about 0·67 mm. [millimètres] wide, is provided with lunate eyes, between which in front superiorly are found two pyriform capsules nearly touching each other, and having implanted into them the very remarkable antennæ.

"The capsule, measuring about 0·21 mm., is composed of a horny substance, and is attached posteriorly by its pedicle, while anteriorly it rests upon a horny ring, united with its fellow by a transverse fenestrated band, and to which it is joined by a thin elastic membrane. Externally it has a rounded form, but internally it resembles a certain sort of lamp-shade with a constriction near its middle; and between this inner cup and outer globe there exists a space, except at the bottom or proximal end, where both are united.

"The antennæ are of nearly equal length in the male and the female.

"In the male the antenna is about 1·75 mm. in length, and consists of 14 joints, 12 short and nearly equal, and 2 long and equal, terminal ones, the latter measuring together 0·70 mm. Each of the shorter joints has a femestrated skeleton with an external investment, and terminates simply posteriorly, but is encircled anteriorly with about 40 papillæ upon which are implanted long and stiff hairs, the proximal sets being about 0·79 mm. and the distal ones 0·70 mm. in length; and it is beset with minute bristles in front of each whorl.

"The two last joints have each a whorl of about 20 short hairs near the base.

"In the female the joints are nearly equal, number but 13, and have each a whorl of about a dozen small hairs around the base. Here, as well as in the male, the parts of the antennæ enjoy a limited motion upon each other, except the basal joint, which, being fixed, moves with the capsule upon which it is implanted.

"The space between the inner and outer walls of the capsule, which we term confidently the auditory capsule, is filled with a fluid of moderate consistency, opalescent, and containing minute spherical corpuscles, and which probably bears the same relation to the nerve as does the lymph in the scalæ of the cochlea of higher animals. The nerve itself of the antenna proceeds from the first or cerebral ganglion, advances towards the pedicle of the capsule in company with the large trachea which sends its ramifications throughout the entire apparatus, and, penetrating the pedicle, its filaments divide into two portions. The central threads continue forwards into the antenna and are lost there; the peripheral ones, on the contrary, radiate outwards in every direction, enter the capsular space, and are lodged for more than half their length in sulci wrought in the inner wall or cup of the capsule.

"In the female the disposition of parts is observed to be nearly the same, excepting that the capsule is smaller, and that the last distal antennal joint is rudimental.

"The proboscis does not differ materially in the two sexes; but the palpi, although consisting in both instances of the same number of pieces are very unlike. In the female they are extremely short, but in the male attain the length of 2·73 mm.; while the proboscis measures but 2·16 mm. They are curved upwards at the extremity.

"If an organ of hearing, similar to that described by Treviranus as belonging to the *Blatta orientalis*, exist in the head of the Mosquito, the tympanum must be of exquisitely minute proportions, because the head, which has a diameter of only 0·67 mm., is almost entirely occupied by the corneal plaques, the capsules, and the attachments of the neck and of the buccal apparatus. The membrana tympani must therefore be so small as to preclude the idea of its being put in vibration by any sounds other than those infinitely more acute than are produced by the insect itself, and the use of such an organ for the purposes of intercommunication must be highly problematical. But no trace of such a disposition is to be found in the head, nor very certainly, also, in the body; and we are obliged to look for some organ which may answer the requirements of an effective auditory apparatus.

"The position of the capsules strikes us as extremely favourable for the performance of the function which we assign to them; besides which there present themselves in the same light the anatomical arrangement of the capsules, the disposition and lodgment of the nerves, the fitness of the expanded whorls for receiving, and of the jointed antennæ fixed by the immoveable basal joint for transmitting, vibrations created by sonorous modulations. The intra-capsular fluid is impressed by the shock, the expanded nerve appreciates the effect, of the sound, and the animal may judge of the intensity, or distance, of the source of sound, by the quantity of the impression: of the pitch, or quality, by the consonance of particular whorls of the stiff hairs, according to their lengths; and of the direction in which the modulations travel, by the manner in which they strike upon the antennæ, or may be made to meet either antenna, in consequence of an opposite movement of that part.

"That the male should be endowed with superior acuteness of the sense of hearing appears from the fact, that he must seek the female for sexual union either in the dim twilight or in the dark night, when nothing save her deep sharp humming noise can serve him as a guide. The necessity for an equal perfection of hearing does not exist in the female; and accordingly we find that the organs of the one attain to a development which the others never reach. In these views we believe ourselves to be borne out by direct experiment, in connection with which we may allude to the greater difficulty of catching the male Mosquito.

"In the course of our observations we have arrived at the conclusion that the antennæ serve, to a considerable extent, as organs of touch in the female: for the palpi are extremely short, while the antennæ are very moveable, and nearly equal the proboscis in length. In the male however the length and perfect development of the palpi would lead us to look for the seat of the tactile sense elsewhere; and in fact we find the two apical antennal joints to be long, moveable, and comparatively free from hairs; and the relative motion of the remaining joints very much more limited." (Dr. Christopher Johnston, *Quarterly Journal of Microscopical Science.*)

MOSS-AGATE. [AGATE.]

MOSSES, [MUSCI.]

MOTACILLA. [BLUE-BIRD; BLUE-BREAST; ERYTHACA; MOTACILLINÆ.]

MOTACILLINÆ, or MOTACILLIDÆ, a sub-family of Birds belonging to the family *Sylviadæ*. [SYLVIADÆ.] They are an active graceful race, tripping it along the smooth shaven grassplots, edges of ponds, and sandy river-shores in unwearied search for their insect-food, and with tails which never cease to vibrate as long as their restless little bodies are in action. The species are natives of the Old World only—Europe, Asia, and Africa. At least the form does not appear to have been hitherto detected in America, and that continent has now been much searched by zoologists.

The genus *Motacilla*, as it was left by Linnæus, in his last edition of the 'Systema Naturæ,' comprised the following species:—

M. luscinia.	*M. icterocephala.*
M. calidris.	*M. Dominica.*
M. modularis.	*M. Canadensis.*
M. schœnobenus.	*M. maderaspatana.*
M. campestris.	*M. aurocapilla.*
M. curruca.	*M. petechia.*
M. hippolais.	*M. dumetorum.*
M. salicaria.	*M. cinnamomea.*
M. sylvia.	*M. caparata.*
M. ficedula.	*M. phœnicurus.*
M. alba.	*M. erithacus.*
M. flava.	*M. guira.*
M. tiphia.	*M. Suecica.*
M. stapazina.	*M. sialis.*
M. œnanthe.	*M. fulicata.*
M. rubetra.	*M. Cayana.*
M. rubicola.	*M. velia.*
M. atricapilla.	*M. cærulea.*
M. Pennsylvanica.	*M. sibilla.*
M. chrysoptera.	*M. rubecula.*
M. coronata.	*M. troglodytes.*
M. Senegalensis.	*M. calendula.*
M. varia.	*M. regulus.*
M. Capensis.	*M. trochilus.*

Here we find assembled with the true Wagtails, the Nightingale, the Redstart, the Robin, the Wren, the Whitethroat, the Black-Cap, the Stonechat, the Blue-Bird, the Hedge and other warblers, and the Golden-Crested Wren.

It may well be supposed that many a group, not to say family, has been formed at the expense of this genus *Motacilla;* and in this work the arrangements of more modern ornithologists will be found under the title SYLVIADÆ.

In the present article we propose to restrict ourselves to the True Wagtails.

These have been thus sub-divided by Cuvier:—

1. Les Hochequeues (*Motacilla*, Bechst.).—The Wagtails, according to Cuvier, join to a bill still more slender than that of the Fauvettes, a long tail which they elevate and depress incessantly, lengthened legs, and, especially, scapular feathers long enough to cover the end of the wing when folded, which gives them a certain degree of aproximation to the greater part of the Waders. The following are Cuvier's subdivisions:—

2. The Wagtails properly so called, or Lavandières. (*Motacilla*, Cuv.).—These have still the claw of the hind-toe curved like the other Bec-Fins. They live near the water-side. Ex. *M. alba.*

3. The Bergeronettes (*Budytes*, Cuv.).—The Bergeronettes have, with the other characters of the Lavandières, the claw of the hind toe elongated and but little arched, which approximates them to the Pipits. [ANTHUS; ALAUDINÆ.] They haunt pastures and seek for insects among the flocks, whence their French name. Ex. *M. (Budytes) flava.*

The genus *Motacilla* thus limited, including the sub-genus *Budytes* may be thus characterised:—Bill slender, subulate, straight, carinated, angulated between the nostrils, emarginated at the tip; the edges of both mandibles slightly compressed inwards. Nostrils basal, lateral, oval, and partly concealed by a naked membrane. Wings of moderate size; the first quill-feather the longest, the second and third equal in length and nearly as long as the first; the tertials very long. Tarsus much longer than the middle toe; the outer toe of the three in front joined to the middle toe at its base; the claw of the hind-toe sometimes elongated. Tail, of 12 feathers, long and nearly even at the end. (Yarrell.)

M. Yarrellii (Gould), the Pied Wagtail.—Spring Plumage.—Male.—Forehead, cheeks, sides of the neck, and lower parts, pure white; occiput, nape, throat, breast, feathers of the middle of the tail and its upper coverts, deep black; back and sides ash-colour, coverts of the wings blackish bordered with white; the two external tail-feathers white. Length rather more than seven inches.

Female.—Forehead and cheeks of a less clear white; the black patch on the occiput less, and the borders of the wing-coverts verging to gray.

Complete Winter Plumage.—Throat and front of the neck pure white, spotless; on the lower part of the neck a deep black band, the sides of which ascend towards the throat. The ash-colour of the upper parts less deep than it is in summer.

Young.—Lower parts dirty-white; on the breast a crescent, more or less large, of a brown ash-colour. In autumn the young begin to put on the livery of the adults; those of the second hatch quit our climates, says M. Temminck, in their youthful garb, and even come back sometimes in the same state at the return of spring. In this state it is the *M. cinerea* of Gmelin, *Sylvia cinerea* of Latham, *Bergeronette grise* of Buffon. (Temm.)

This bird is common and stationary over the whole of the southern part of the European continent, remaining during winter dispersed over the southern counties of England. "Yet," says Mr. Gould, in continuation, "we learn from Mr. Selby and Bewick, that, even so far north only as Durham, it migrates southward in October, and does not again make its appearance till the following March; and Mr. Low, in his 'Natural History of Orkney,' tells us that it continues there the shortest time of any of the migratory birds that come to build, and is never to be seen after the end of May. It is also known to migrate still farther north; but, as might be expected, the higher the degree of latitude attained, the shorter is the duration of the visit. ('Birds of Europe.')

Pied Wagtail (*Motacilla Yarrelli*).
Lower figure, winter plumage; upper figure, summer plumage.

The same author however, in the 'Magazine of Natural History' (1837), thus writes of the genus *Motacilla*:—"While engaged upon this tribe of birds during the course of my work on the 'Birds of Europe,' I was equally surprised to find that the sprightly and Pied Wagtail, so abundant in our islands at all seasons, could not be referred to any described species; and that it was equally as limited in its habitat; for, besides the British Islands, Norway and Sweden are the only parts of Europe where I have been able to procure examples identical with our bird, whose place in the temperate portions of Europe is supplied by a nearly allied but distinct species, the true *Motacilla alba* of Linnæus; which, although abundant in France, particularly in the neighbourhood of Calais, has never yet been discovered on the opposite shores of Kent, or in any part of England. As therefore our bird, which has always been considered as identical with the *M. alba*, proves to be a distinct species, I have named it after my friend W. Yarrell, Esq., as a just tribute to his varied acquirements as a naturalist."

Mr. Gould then proceeds to point out the characters by which these two species, as he terms them, may be readily distinguished. The Pied Wagtail of England, he observes, *M. Yarrellii*, is somewhat more robust in form, and in its full summer dress has the whole of the head, chest, and back of a full deep jet-black; while in the White Wagtail, *M. alba*, at the same period, the throat and the head alone are of this colour, the back and the rest of the upper surface being of a light ash-gray. In winter, he remarks, the two species more nearly assimilate in their colouring; and this circumstance has, in his opinion, been the cause of their having been hitherto considered identical; the black back of *M. Yarrellii* being gray at this season, although never so light as in *M. alba*. Additional evidence of their being distinct is, he adds, that the female of our Pied Wagtail never has the back black, as in the male; this part even in summer being dark-gray, in which respect it closely resembles the other species. This colouring of the female, Mr. Gould observes, has doubtless contributed to the confusion.

Mr. Yarrell, although he concurs in opinion with Mr. Gould, that these birds are distinct, gives figures and descriptions of both birds in their summer and winter plumage to invite investigation to the subject; and he quotes the Supplement of Temminck's 'Manual,' in which that ornithologist refers to Mr. Gould's figure in the 'Birds of Europe,' and also to that in Werner's Atlas of Illustrations to the 'Manual,' which, Mr. Yarrell says, although there called *Motacilla lugubris*, is certainly our Pied Wagtail, as representations of varieties of *Motacilla alba*. Prince Bonaparte, he remarks, has considered our Pied Wagtail to be distinct from *M. alba*, and has admitted it as a species in his 'Geographical and Comparative List of the Birds of Europe and North America.' ('British Birds,' 1838.)

M. Temminck, in the fourth part of his 'Manual' (1840), states, under the head of *Motacilla Yarrellii* (Bonap.), that recent observations upon this black variety, and his certainty that it forms a constant race habitually found in England, where the continental *M. alba* is never seen, determine him to arrange it as a local variety or race, which he characterises as having the wings of a complete black, and all the coverts bordered with pure white. He also details the summer and winter plumage.

Belon thinks that the *M. alba* of the continent is the Κνιπολόγος of Aristotle. ('Hist. Anim.,' viii. 3.) It is the Cotremola, Codetta, Codetta di Pecore, Ballarina, Monachina, and Cuttretola, of the Italians; Lavandière of the French; Die Weisse Bachstelze and Weiss und Schwartze Bachstelze of the Germans; Arla of the Swedes; Vipstiert and Havre-Sæer of the Danes; Erle and Lin-Erle of the Norwegians; Kwikstaart of the Netherlanders; Brith y Fyches and Tinsigl y Gwys (probably our Pied variety only) of the Welsh; and (our Pied variety) Dish-Washer and Washerwoman of the English.

The figure in Belon's folio work, as well as that in the 'Portraits d'Oyseaux,' evidently refers to the continental variety. The French names which are placed over the figure in the last-named book are, Lavandière, Battequeuë, Battelesiue, and Haussequeuë. Below it is the following quatrain:—

> "*La Lavondière* hante le bord de l'eau,
> Hochant tousiors la queuë et le derrière,
> Ny plus ny moins que fait la lavandière
> Lavant son linge aupres d'un clair ruisseau."

Speaking of its habits, Mr. Yarrell says, "It is ever in motion, running with facility by a rapid succession of steps in pursuit of its insect food, moving from place to place by short undulating flights, uttering a cheerful chirping note while on the wing, alighting again on the ground with a sylph-like buoyancy, and a graceful fanning motion of the tail, from which it derives its name. It frequents the vicinity of ponds and streams, moist pastures, and the grass-plots of pleasure-grounds; may be frequently seen wading in shallow water, seeking for various aquatic insects or their larvæ: and a portion of a letter sent me lately by W. Rayner, Esq., of Uxbridge, who keeps a variety of birds in a large aviary near his parlour window, for the pleasure of observing their habits, seems to prove that partiality to other prey, besides aquatic insects, has some influence on the constant visits of Wagtails to water:—'I had also during the summer and autumn of 1837 several Wagtails, the Pied and Yellow, both of which were very expert in catching and feeding on minnows which were in a fountain in the centre of the aviary. These birds hover over the water, and, as they skim the surface, catch the minnow as it approaches the top of the water in the most dexterous manner; and I was much surprised at the wariness and cunning of some Blackbirds and Thrushes, in watching the Wagtails catch the minnows, and immediately seizing the prize for their own dinner.'"

The nest of the British Pied Wagtail is made up of root-fibres, withered grass, and moss; the lining consists of hair and a few feathers. A bank, a hole in some old wall, the thatch of a cart-shed or other farm-building, faggot-piles or woodstacks, and hayricks, are all localities where it is generally placed, and almost always near water; but Mr. Jesse mentions in his 'Gleanings' the nest of a Water-Wagtail in one of the workshops of a manufactory at Taunton, amid the incessant din of braziers who occupied the apartment. It was built near the wheel of a lathe which revolved within a foot of it, and here the bird hatched four young ones. She was perfectly familiar with the well-known faces of the workmen, and flew in and out without fear of them; but if a stranger entered, or any other persons belonging to the same factory, but not to what may be called her shop, she quitted her nest instantly, and returned not till they were gone. The male however had less confidence, and would not come into the room, but brought the usual supplies of food to a certain spot on the roof, whence it was brought into the nest by his mate. The eggs are from four to five, white with ash-coloured speckles.

"While the cows are feeding," says White, "in the moist low pastures, broods of wagtails, white and gray, run round them, close up to their noses, and under their very bellies, availing themselves of the flies that settle on their legs, and probably finding worms and larvæ that are roused by the trampling of their feet. Nature is such an economist, that the most incongruous animals can avail themselves of each other! Interest makes strange friendships.'

The habits of the Continental *Motacilla alba* are similar to those of our Pied variety.

The British species figured and described by Yarrell are four in number:—The Pied Wagtail (*M. alba; M. Yarrellii*, Bonap. and Gould); the Gray Wagtail (*M. boarula*); the Gray-Headed Wagtail (*M. neglecta*, Gould; *M. flava*, Temm.; *Budytes* of Prince Bonaparte's 'Comparative List'); and Ray's Wagtail (Yellow-Wagtail of Pennant; *Budytes Rayi* of the Prince's 'Comparative List').

M. alba, La Bergeronette Grise, the True or Continental White Wagtail. It inhabits Europe; the high lands of India and Africa. Eggs about six in number, bluish-white spotted with black. Nest very variously placed, in fissures of rocks, in old towers, under arches of bridges, about hollow trees.

True or Continental White Wagtail (*Motacilla alba*).

Enicurus (Temminck).—Bill rather strong, lengthened, very straight, abruptly bent and notched; culmen straight from the base; gonys thickened, ascending; rictus bristled; wings rather short, the three first quills graduated; tail lengthened, deeply forked; feet strong; tarsus lengthened, the scales entire; middle toe shorter than the tarsus, outer toe longest; legs pale. (Sw.)

E. speciosus (*Motacilla speciosa*), the Chenginging or Kingking of the Javanese.—Crest, lower part of the back, rump, belly, vent, two exterior tail-feathers entirely, and other tail-feathers at their extremity, a broad band extending obliquely across the wings, and the axillæ, white; head, except the crest, breast, back, and greatest part of wings and tail, black. The white is the purest snow-white; the black is of different shades, more intense on the head and breast, having a slight reflection of dark-blue, inclining to purple on the extremity of the wings, tinted with brown. A few minute black plumes bound the crest behind and at the sides, extending to the base of the bill. Three or four of the last secondary feathers with a narrow band of white, but the succession not regular. Plumes of the hypochondriæ elongated and delicately villous. Length of body and head $4\frac{1}{2}$ inches; of tail 6 inches; of bill, which is black, 10 lines. Tarsi nearly twice as long as the middle toe, pale flesh-coloured with a yellow tint. (Horsf.)

Dr. Horsfield states that this species in its habits and manners resembles several European species of the genus *Motacilla*. "It is," says he, "found near small rivulets; in the beds of these, particularly where they abound with rocks and gravel, it is seen running along with alacrity, moving its tail incessantly, and picking up worms and insects. It is very locally distributed, and uniformly deserts the neighbourhood of populous villages. It is almost entirely confined to the southern coast of Java, which abounds in small streams, descending rapidly from the southern hills, and shaded by luxuriant shrubs. Here I first discovered this bird, in the district of Pajittan, in the year 1809. I afterwards met with it again along this coast, in the district of Karangbollong, and in the provinces south of Kediri. Among more central situations it frequents the banks of an elevated lake near the declivities of the mountain Prahu, where I found it more numerous than in any other part of Java. In the extensive forests of Pugar and Blambangan I never noticed it, although I devoted a considerable time to their examination." ('Zoological Researches in Java.')

Motacilla (*Enicurus*) *speciosa*, Horsfield.

M. lugubris (Pallas); Schwarze Bachstelze of the Germans; the White-Winged Wagtail.

Summer Plumage.—Back of head and neck, line from bill to eye and from eye to hinder part of the head, back, rump, six middle tail-feathers, throat, and chest, black; shoulders, tips, and outer edges of the primaries, dark grayish-brown; remainder of wings white, except the tertiaries, which are brown in the centre; bill and feet black.

Winter Plumage.—Upper part of throat pure white; back and scapulars uniform gray, instead of black. (Gould.)

White-Winged Wagtail (*Motacilla lugubris*).

M. Temminck states that individuals which are marked with black and gray on all the upper parts are passing from one state of plumage to the other.

Young of the Year.—Lore and stripe behind the eyes black, but very narrow; top of the head and all the upper parts, to the upper tail-coverts, gray-ash; nuchal collar very narrow, indicated in great part by black spots; coverts of the wings always pure white. Length of the species about 7 inches 8 lines. (Temm.)

It is found in Eastern Europe, seldom advancing farther west than the central parts; Russia; Southern Siberia; Egypt; Hungary; the Crimea; Asia Minor probably; scarce in Italy, Provence, and Picardy; very common in Japan, especially in winter, where it is called Sekirei, and frequents the streams of mountainous valleys.

MOTELLA, a genus of Fishes belonging to the family *Gadidæ*. It has the following characters:—Body elongated, cylindrical, compressed posteriorly, the first dorsal fin very slightly elevated, delicate in structure, scarcely perceptible; second dorsal and anal fins long, continued nearly to the base of the tail.

M. vulgaris, *Mustela marina* (Ray), *Gadus tricirratus* (Bloch), the Three-Bearded Rockling, Sea-Loche, Whistle-Fish, Three-Bearded Cod, Three-Bearded Gade, has the following characters:—The length of the head compared to the length of the body alone, without the caudal rays, is as one to four; the depth of the body equal to the length of the head; the first dorsal fin delicate in structure; the first ray elongated, the rest hair-like: the second dorsal fin commencing immediately behind the end of the first, and reaching along the back to the tail, but ending a little short of the base of the caudal rays; ventral fins with the first two rays elongated, the second most so, the two disunited; the other five rays nearly equal, united, and short; pectoral fins rather large and rounded; the vent half-way between the point of the chin and the end of the fleshy portion of the tail; the anal fin commences immediately behind it, is one-fourth less in length than the second dorsal, and ends on the same plane with it; the tail moderate in size, and rounded at the end. The fin rays in number are—2nd D. 55; P. 20; V. 7; A. 49; C. 18. The head is depressed; the mouth wide; the jaws nearly equal, but when separated the lower jaw is the longest, with one barbule at the chin; a mixture of large and small teeth in each jaw; the upper jaw with one barbule on each side the middle, between the lip and the nostril; inner part of the upper lip crenate; the irides golden yellow; the anterior portion of the body of the fish cylindrical, or slightly depressed; the tail compressed; the general colour of the body and head is a rich yellow-brown, spotted on the top of the head, along the back, the pectoral, dorsal, and caudal fins, with rich chestnut-brown; the lower part of the sides, the ventral and anal fins pale yellow-brown approaching to white, and without spots.

Young fish of this species are of a uniform brown colour, until they have acquired 6 or 7 inches in length; in this condition they are the *Mustela alia* of Ray. (Yarrell.)

This fish is common on the coasts of Cornwall, and also on the coasts of Ireland.

M. cimbria (*Gadus cimbrius*, Linnæus), the Four-Bearded Rockling. This fish has been taken in Scotland, and is common in the Baltic and the southern coast of Sweden.

M. quinquecirrata (*Gadus mustela*, Linnæus), the Five-Bearded Rockling. This fish is common on the British coast. Its habits resemble those of the Three-Bearded Rockling, and by some naturalists it is regarded as a variety of that species.

M. glauca (*Ciliata glauca*, Couch), the Mackerel Midge. This fish has been taken on the coasts of Cornwall by Mr. Couch. It dies instantly on being taken out of the water. It is like the young of some of the other species, but it has not been observed to grow.

M. argenteola (*Gadus argenteolus*, Montagu), the Silvery Gade. This fish is a miniature representative of the Three-Bearded Rockling, as the last is of the five-bearded species. It was first described by Montagu, and is admitted as a distinct species by Yarrell.

MOTH, the English name of the Insects belonging to that section of the *Lepidoptera* called *Nocturna*. [LEPIDOPTERA.]

MOTHER-OF-PEARL. [SHELL.]

MOTHER-WORT. [LEONURUS.]

MOTIONS IN PLANTS. It was at one time considered a distinctive mark of the animal kingdom that it had a power of locomotion which was denied to plants. It was however gradually discovered that plants had within a limited space a considerable power of self-generated or automatic movement. It is now believed that these movements originate in the protein which constitutes the protoplasm or nucleus, in connection with which all vegetable cells are formed. This substance is the material which, being conveyed into the system, becomes the material out of which the nervous and muscular systems of animals are formed. This substance possesses an inherent power of movement under all circumstances; and in the movements of plants and their susceptibility to the action of heat and light, we see the first dawnings of a nervous and muscular system. It is thus that the plant, though not actively locomotive, becomes the source of all locomotion and sensation in the animal kingdom.

The instances in which movements of various kinds have been observed in plants are very numerous. Amongst *Confervæ* is a genus named *Oscillatoria*, consisting of green articulated filaments. These plants derive their name from the oscillating motion observable in them. They not only move their limbs, but shift their station with some rapidity; for example, if a patch of them is placed in water in a plate, and a black bell-glass is inverted over them in such a manner that its edges do not quite touch the plate, the Oscillatorias will remove from where they were first placed, and glide out on the side of the bell-glass which is exposed to light. The late Captain Carmichael observed their motions with great care, and sufficiently proved that they were not owing to external causes of any kind; especially not to agitation of the water in which the Oscillatorias are placed. Let, he says, a small portion of the stratum be placed in a watch-glass nearly filled with water, and covered with a circular film of talc, so that its edge may touch the glass; the water will be rendered as fixed as if it was a piece of ice. The glass may now be placed under the microscope, and the oscillation of the filaments viewed without risk of disturbance from the agitation of the water. By following this course, it will be speedily perceived that the motion in question is entirely independent of that cause. The action of light, as a cause of motion, cannot be directly disproved, because we cannot view our specimens in the dark; but indirectly there is nothing easier. If a watch-glass, charged as above, be laid aside for a night, it will be found that, by the next morning, not only a considerable radiation has taken place, but that multitudes of the filaments have entirely escaped from the stratum, both indicating motion independent of light. Rapidity of growth will show itself in a prolongation of the filaments, but will not account for this oscillation to the right and left; and still less for their travelling, in the course of a few hours, to the distance of ten times their own length from the stratum. This last is a kind of motion almost unexampled in the vegetable kingdom.

Another kind of locomotion has been seen in the reproductive particles or spores of *Confervæ*. At a particular period of their life these spores move about spontaneously inside the tubes in which they are generated, and at length force themselves out into the water wherein the mother-plant is floating. Once plunged in this element, the spores move about with velocity, in a gyratory manner, till they reach a shaded place, when they fix themselves by one end, produce a root, and lose all power of after-motion, so that such plants have locomotion when young, and are destitute of it when old. Many such phenomena are known to occur in plants of the same low kind of organisation. [ALGÆ; FUCACEÆ; ACHLYA.]

But while locomotion thus unquestionably occurs among some kinds of plants, vegetable movements are more commonly confined to the limbs, in which they are visible in different ways. A kind of motion occurs in roots, although not perceptibly, except by its effects. Many kinds of Orchidaceous plants appear one season in a spot at some distance from that which they occupied in the previous season, and thus appear to travel; in such cases however the shifting of place is effected by means of underground suckers, annually formed by the parent, which projects them to a certain distance from herself, and then perishes. The cormi, or bulbs, as they are called, of many Iridaceous plants exhibit the same kind of property, raising themselves upwards year after year, so that if originally buried some inches under ground, they at last travel upwards into the air; this is effected by each cormus forming a bud at its apex, which bud grows into a new cormus, and kills its parent, forming a new cormus at its own apex, and then perishing in its turn. This power of rising upwards is possessed in a most singular manner by palms, but in those plants takes place in a different way. Some palm-trees, which originally had their stem resting by its base on the surface of the ground, force it upwards by protruding the bases of their roots, till at last a kind of plinth is formed of many irregular arches, upon which the column or trunk of the palm-tree is upheaved. A case of this kind is mentioned by M. Poiteau, in the 'Annals of the Horticultural Society of Paris,' vol. iv. p. 4, f. 16, where the arches of the roots were high enough to allow a man to pass beneath them. Here it is evident that the elevation of the trunk is caused by the extension of the roots, which exercise that power in the direction of least resistance, namely, of the air, rather than of the solid earth.

The phenomena of flowers unfolding or closing under sunshine, of which everybody is aware, are strictly referrible to the class of vegetable motions. With the unfolding and closing of flowers must also be arranged those singular motions in the parts of fructification which occur upon their being touched. If the filaments of the Barberry [BERBERIS] are irritated, they rise up and strike the anthers against the stigma; if the sexual column of *Stylidium*, which is bent over one side of the flower, is touched, it swings over instantly to the other side. Several cases of this power of motion occur in *Orchidaceæ*: if the caudicula of the pollen masses of *Catasetum* is disturbed, it springs up so violently as to separate itself from the column on which it grows, and to dart to a considerable distance. A very singular instance of motion in the flowers of another plant of this kind growing in the Swan River Colony, has been described by Mr. Drummond. ('Gardeners' Gazette, vol. xiv., p. 428.) The lower lip, he says, in which the anthers are placed, is a boat-shaped box; the upper lip, which he supposes to be the stigma, forms a lid which exactly fits it; the hinge on which the lid moves springs from the upper part of the flower, and is attached to its centre; and when it opens the upper part turns round within the box, comes out at the bottom, turns up and back; so that when fully expanded it stands fairly over the flower. The moment a small insect touches the point of the lid it makes a sudden revolution, brings in the point of the lid at the bottom of the box, so that it has to pass the anthers in its way, and makes prisoner any small insect which the box will hold. When it catches an insect it remains shut while the insect moves about; but if the insect be not caught the box soon opens again.

Another kind of motion, more resembling spontaneous action, especially as it is not apparently connected with the application of stimuli, is that which occurs in the sexual apparatus of many plants at the period of impregnation. In *Armeria*, at this time, a short column below the stigmata lengthens, so as to close up the foramen of the ovule, and at the same moment the cord on which the ovule is suspended slips aside and elevates the ovule, so as to enable it to present its foramen to the column. The same phenomena are visible in *Daphne Laureola* and other plants; and something of an analogous nature occurs in *Zygnemata*, which at the period of fructification bring themselves together, and effect a kind of spontaneous vegetable copulation. The most striking phenomena of this nature occur however in *Asclepiadaceæ*, which have their pollen-grains closely packed in bags, from which it would seem that there is no escape: at the period of impregnation each of these pollen grains projects one tube from its side, and these tubes all direct themselves spontaneously towards a thin space on the side of the bag that holds them. Piercing this bag, they succeed in extricating themselves and reaching the vicinity of the stigma, but are still at some distance from it; they then direct themselves towards that organ, and succeed in reaching it, wherever it may be, either by directing themselves at right angles, or downwards, or even upwards, as the peculiar structure and location of the stigma may require.

In the Sensitive Plants, various species of *Mimosa* [MIMOSA], especially *M. pudica*, the leaves fold up on being touched, and this so slowly, that it is easy to perceive that the folding is effected by the gradual communication from leaflet to leaflet of the shock produced by the touch. If a portion of the end of one of the leaflets of the *Mimosa* is cut off the whole of the leaflets of that pinna gradually fold up, one after the other, from the point to the base; then the neighbouring pinnæ will fold up their leaflets from the base to the point, and presently the petiole itself will suddenly bow itself down whereupon the folding up of the remainder of the pinnæ will take place. Sometimes, after a little space, the leaves above and below will also close up, all under the influence of the one original injury. These curious phenomena have been watched with care by Dutrochet, in whose little book ('Sur la Motilité des Plantes') a long and particular account of the phenomena will be found. Many other plants possess this kind of sensitive power in their leaves: *Smithia sensitiva*, *Æschynomene sensitiva*, *Porlieria hygrometrica*, and *Biophytum sensitivum* are well-known cases; and it is recorded that in Senegal there grows a plant which the natives call by a name equivalent to 'How d'ye do?' as if it offered a friendly salutation by its bowing to those who touch it. (See De Candolle's 'Physiologie Végétale,' p. 857, where several of the modes are enumerated in which leaves having motion close up.) The 'sleep of the leaf,' that is, their folding up and drooping at night, while they raise themselves and unfold by day, are powers of motion in the limbs of plants, which are doubtless of the same nature as that of the Sensitive Plant and its allies. To the same class also must be assigned the fly-catching leaves of *Dionæa*. [DIONÆA.] This plant, which grows wild in the marshes of Carolina, has a leaf which is bordered with a row of strong teeth, and when spread open is strikingly similar to one of the toothed iron traps when set as used for catching game, that is, it consists of two roundish sides, each furnished with a row of strong teeth. Near the middle of each side there grow three stiff bristles, placed in the form of a triangle; if one of these bristles is touched by an insect or any other means, the two sides of the leaf spring up instantly, the teeth cross each other, and the insect is held so fast that it can only be extricated by forcing the sides of the leaf asunder, an operation of some difficulty, so great is the muscular force with which the contraction is effected. These movements are all owing to a specific irritability resident in the moving organ, and must be distinguished from the following, which takes place, to all appearance, spontaneously.

Desmodium gyrans, the Gora-Chand of Bengal, was first mentioned in systematical botany by the younger Linnæus, who speaks of it as a wonderful plant, on account of its singular motion. "No sooner," he says, "had the plants he raised from seed acquired their ternate leaves, than they began to be in motion in every direction. This movement did not cease during the whole course of their vegetation, nor were they observant of any time, order, or direction. One leaflet frequently revolved, while the other on the same petiole was quiescent; sometimes a few leaflets only were in motion, then almost all of them would be in movement at once. The whole plant was very seldom agitated, and that only during the first year. It continued to move in the stove during the second year of its growth, and was not at rest even in the winter."

"The irritability of the *Desmodium*," Burnett adds, "is never so great, even in our best houses, as it is said to be in its native climate, and its motions here are very seldom so lively as those described by Linnæus. Warmth appears essential, for its movements are always the most observable when the heat is greatest; that they are not attributable to the sun's rays, nor to any currents of air, is shown from the fact that the plant loves the shade, and that the motion is most evident when the stove is closed and the atmosphere quite still. These movements have more the semblance of spontaneity than any others that have been observed in the more perfect plants; for the leaflets, if held quiet between the fingers for a short time, and their movements thus prevented, are said immediately on their release to revolve with accelerated force, as if to make up for the time lost during the forcible interruption." De Candolle describes the motion thus:—The leaves consist of three leaflets, two of which are lateral, very small, linear, and oblong, and an odd one, separated from the two others, much larger and oval-oblong. The two side leaflets are in almost continual motion, which takes place by little starts, like the small hand that marks the seconds of a watch. One of these rises so as to mount about 50 degrees above the level of the petiole, and the other falls on the opposite side to about the same distance; when the latter rises the other falls, and thus a constant oscillation is maintained. The central leaflet also moves, but much more slowly, sloping first to the right, then to the left, and so on.

In the above instances we see, as it were, the natural tendency to mobility in the plant developed. The reason why no greater amount of movement occurs in the vegetable appears to be the nature of the cell-wall, which being composed of the unyielding material cellulose in sufficient quantities, resists all attempts at movement from the imprisoned protein. [PROTEIN; CELLS.]

MOUFLON. [OVEÆ.]

MOUGEOTIA. [ALGÆ.]

MOULDINESS is a name applied to all minute *Fungi* which appear in masses upon organic bodies. It appears to be caused by a damp atmosphere and a diminution of light, both which conditions are favourable to the development of those bodies whose spores or reproductive particles are floating everywhere in the atmosphere, ready to spring rapidly into growth whenever they chance to fall upon suitable situations.

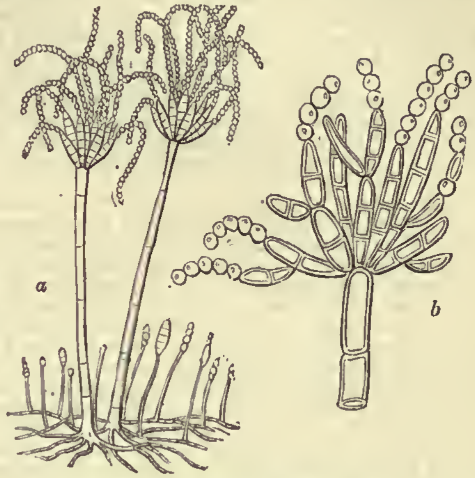
All the *Fungi* that constitute mouldiness are so small as to escape observation, except when from their numbers they form microscopical forests; and then they clothe the surface of the body which they attack with light patches of yellow, blue, white, green, red, and various other colours. The species of these plants are extremely numerous, and are distributed by writers on *Fungi* into many genera, chiefly belonging to the Hyphomycetous division of the order, the combining character of which is, that the plants are flocculent, naked (that is, not inclosed in a case or seated upon a peculiar receptacle), distinct, but interwoven into a general mass, which looks like a thin web, or a collection of cobwebs.

One of the most common is the *Ascophora Mucedo*, which forms a blue mould upon bread, paste, and similar substances prepared from flour. This plant forms a fine horizontal cobweb-like bed, from which rise up slender branches terminated by an expansion which bears the spores.

Ascophora Mucedo, very highly magnified.

a is a sporiferous branch arising from the horizontal bed; *b* is the termination of a branch covered with spores.

Another form is that of *Penicillium*, in which we have the same entangled flocculent bed, and a similar elevation of perpendicular branches; but the latter are not terminated by a disc covered with spores; on the contrary, they end in a jointed tuft, every division of which produces at its point a necklace of spherical sporules. The plant called the Vinegar Plant, which possesses the power of converting sugar into vinegar, appears to be an undeveloped form of *Penicillium glaucum*.



Penicillium verticillatum, highly magnified.

a represents a cluster of perpendicular branches springing up from the horizontal bed; *b* is one of the pencil-like heads which terminate the branches.

Mouldiness is occasionally produced by Coniomycetous *Fungi*—that is, by those very imperfectly organised species which have no flocculent bed, nor any special part on which the spores are generated, but which merely consist of a series of joints within which reproductive bodies are formed. Of these, the *Torula Casei*, found in the crevices of putrid cheese, may serve as an example.

A morsel of *Torula Casei*, very highly magnified, after Corda.

Many of these plants are capable of living under circumstances that would be fatal to any other form of vegetation; for example, *Ascophora Mucedo* springs up plentifully in paste poisoned with corrosive sublimate.

Their general station is upon decaying animal or vegetable matter; but one species, the *Botrytis Bassiana*, attacks the living silkworm and kills it; others destroy house-flies, which may be seen in the autumn glued by these parasites to the window, on which they have alighted in a semitorpid state.

The following are the botanical names of some of the more common species of *Fungi* that cause mouldiness:—

Hydrophora stercorea (yellow, turning black), on the dung of various animals; *Mucor mucedo* (bluish-black), on fruit, pastry, &c.; *Eurotium herbariorum* (white, yellow, or orange), on damp plants in *Herbaria*; *Cladosporium herbarum* (green, turning black), on various decaying bodies, damp paint, &c.; *Aspergillus candidus* (white), very common; *Aspergillus glaucus* (blue), very common.

MOULTING. [BIRDS.]

MOUNTAIN LIMESTONE is a term employed by Dr. Smith to designate the calcareous rocks which underlie the coal strata in England. It is the equivalent of the Carboniferous Limestone of Conybeare and many other geologists in England. It is the Calcaire Carbonifère of the French, and the Berg-Kalk of the Germans.

In England the Mountain Limestone forms the true base of the upper part of the Palæozoic Series. [GEOLOGY.] It is not however always present. From the character of the limestone it is inferred, that the whole mass of this formation has been deposited by the agency of the coral-forming *Polypifera*. Embedded in the limestone are found numerous shells and remains of Encrinites and Fishes. These are common to it and the coal-beds. [COAL FORMATION.] It not unfrequently presents bands of impure coal, which in other countries are of more value than in England. In the south of England imperfect coal-beds called Culm replace the limestone. This also occurs in Russia and elsewhere. In Ireland this rock is abundant, and the series of beds are terminated by a peculiar sandy deposit.

The Culmiferous Series of Devonshire occupies a great trough, the axis of which ranges east and west and extends for about 50 miles, with a breadth of between 30 and 40 miles. Crossing the edge of this trough, we find a black limestone, overlaid by siliceous flagstones; and these are followed by sandstones and carbonaceous and calcareous shales, which gradually become harder, and pass into siliceous bands of a dark colour, with earthy carbonaceous partings, surrounded by a regular thick-bedded sandstone, resembling the gritstones of the coal-measures.

The beds, the order of whose superposition has been just mentioned, form, with a black carbonaceous shale and a black limestone, the lower subdivision of the whole Carboniferous System, as developed in the south-west of England. The order is somewhat different however towards Dartmoor, for there an irruption of granite has taken place since the deposition of the strata, and the vicinity of the crystalline rock has produced confusion and violent distortion. Notwithstanding this, and the frequent repetition of these beds by faults and disturbances, they are satisfactorily proved to be of great thickness; but they contain few fossils, and differ in lithological character from the rock, probably of the same age, in the middle and north of England.

The upper Culm-Measures of Devonshire are the newest beds of the district, and occupy nine-tenths of the whole surface of the carboniferous deposit. This group is composed of sandstones and indurated shales (the latter containing the culm), and is of great but unascertained thickness, being perpetually interrupted, coiled upon itself, and repeated over again, forming an incredible number of anticlinal and synclinal lines, all of them ranging east and west, parallel to the strike of the beds.

There is however no difficulty with regard to the general order of superposition, or the extent and real thickness of this part of the deposit; for both on the northern and southern outskirts of the formation a great ascending series is seen, throughout the whole of which the dip is tolerably regular.

The sandstones of this group are generally close-grained, and of a gray or greenish-gray colour, passing occasionally into flagstone and laminated arenaceous shale, with fine ripple marks at the partings. The shales vary in appearance from sandy beds to soft slaty clays, not to be distinguished from the common coal shales; and amongst these latter are occasionally found dark carbonaceous bands, containing obscure vegetable markings discoloured by pyrites.

Such are the prevailing characters of the beds which form the Culmiferous Series of Devonshire: these beds being the true representatives of the Carboniferous System. Notwithstanding the general paucity of fossils, one or two species of shells are not to be distinguished from species well known in the Mountain Limestone; and the result of a comparison of the remains of plants from the culm, with those commonly met with in rocks of the carboniferous period, tends yet more strongly to establish the contemporaneity of the two deposits. Considering the thickness of these Culm-Measures in Devonshire, they might represent the whole mass of the Mountain Limestone; and the different mineral character of the rocks dependent on the circumstances under which they were respectively formed, might account for considerable alterations in the fossils, and must have had great influence in modifying the forms of animal life.

The Carboniferous System, as exhibited in Yorkshire and Derbyshire, consists of a magnificent development of Mountain Limestone, to whose presence the picturesque scenery of those counties is due; the limestone being partly overlaid on the east, west, and north, by the millstone-grit. The lower part of the millstone-grit however is sometimes represented by a series of laminated and often bituminous shales, which rest immediately on the limestone, and contain some bands of iron-stone, and a few thin black limestones; while the upper part consists of several hundred feet of pebbly grits and other sandstones alternating with thin bad coal.

Farther north, and in the north-western part of Yorkshire, the Mountain Limestone becomes a still more important and prominent member of the Carboniferous Series, and is capable of local subdivisions. It is here subdivided into two groups, whose total thickness is about 1800 feet. Of these two the lower, the Scar Limestone, forms bold bluff precipices, and is pierced in many places by large natural caverns; and both here and in the upper stratas (the Yoredale Rocks), the limestone is remarkably different from the contemporaneous beds in the south, containing thin seams of coal, sometimes worked, and divided into several beds by partitions of grit and shale. The Yoredale Rocks thus contain at least five distinct beds of limestone, alternating with freestones, flagstones, &c., and attaining a thickness of as much as 1000 feet. In the north-west of England, where the Mountain Limestone is developed in the same manner, the upper beds of the series, the millstone-grit and the true coal-measures, are scantily exhibited; but in the north-east, as in Northumberland, the Scar Limestone is much broken by the interposition of pebbly grits, shales, and coal-seams, which entirely change the character of the formation.

In Ireland the Mountain Limestone occupies an important place, and consists of two great bands of limestone, with a considerable thickness of shale and argillaceous limestone and sandstone interspersed, which are known by the name of calp, or calp-slate. It is chiefly however in the northern and middle districts that the calp is found, and it gradually thins out towards the south. Beneath the lower limestone another series of schistose beds (the Carboniferous Slate) occurs, and this rests on sandstone beds, often alternating with shale, and occasionally with limestone. The Carboniferous Slate of the south of Ireland differs in lithological character from that of the middle and northern regions, but from the evidence of fossils, the two must be looked on as contemporaneous.

On the continent the carboniferous beds are similarly developed; the lower beds in Westphalia passing into calcareous shales, containing fossil remains of the carboniferous type. These therefore are assumed as the base of the Carboniferous System. They are immediately succeeded by a group of black imperfect limestone and siliceous schists (Kiesel-Schiefer of the Germans), considerably expanded and traceable for some distance, and looked upon as the equivalents of the English Mountain Limestone, the underlying beds representing the shales occasionally met with in England when the sequence to the older rocks is complete.

The Black Limestone is extremely carbonaceous, argillaceous, and fetid, and it corresponds so entirely in mineral character with the Culm Limestone of Devonshire, that the description of the one rock might almost serve for the other, not merely as regards its general appearance and lithological character, but also because the organic remains—the Goniatites and *Posidoniæ*—with which the rocks in Devonshire are loaded, are in Westphalia also by far the most abundant fossils of the deposit. On the continent however, the Culm Limestone passes upwards into another limestone of a lighter colour, and this bed contains all the most characteristic fossils of the true English Mountain Limestone.

Advancing still farther eastward we find in Russia that the lower carboniferous beds consist of incoherent sandstone, alternating with a bituminous shale, which sometimes contains thin bands of impure coal and impressions of plants; the whole being surrounded by various beds of limestone, which form the central group of the Carboniferous System. Of these beds, the lowest is usually of a dark colour, as in other parts of Europe; but the middle, and most extensive, differs entirely from any contemporaneous rock, being of a milk-white colour, resembling chalk, and loaded with flints. It is also of considerable thickness, and extremely fossiliferous, and alternates with beds of compact yellow magnesian limestone, and bands of red or greenish shale or marl, while associated with it there are splendid masses of white gypsum and thin bands of limestone interstratified. The third or upper division of the series is scarcely less remarkable than the central, being almost entirely made up of myriads of fossil bodies (called *Fusulina*) resembling grains of wheat, and forming a limestone, which is of considerable thickness, and appears in the lofty cliffs which occupy the banks of the Volga, and also in the coal region between the rivers Dnieper and Don.

In Northern Russia, and in the upper beds of the Volga, the central limestone of the Carboniferous System is totally devoid of coal, which is found in shales and sandstones, interstratified with thin courses of limestone in the lower part of the series, and in this respect exhibits a resemblance to the lower beds of the Mountain Limestone in Yorkshire. In the south of Russia, on the other hand, the central beds of the Carboniferous System are occasionally productive of good bituminous as well as anthracitic coal, offering in some points very striking analogies in mineral condition to the great South Welsh basin. The northern beds are nearly horizontal, but the coal-field in the south appears to have been disturbed, and to have been broken up by faults.

North America presents some interesting points with respect to the rock now under consideration. The Carboniferous Series of Pennsylvania is based upon massive sandstones, conglomerates, and shales, overlying a bed of fossiliferous limestone. Resting upon this group, which is of great and uniform thickness, there is a deposit of red shale, which varies in thickness from 3000 feet to less than 100 feet, and is supposed to thin out and disappear to the south-west; and this is partly overlaid and partly replaced by a hard coarse conglomerate, very thin towards the north-west, but rapidly swelling out and becoming from 800 to 1200 feet thick towards the south-east. None of these formations contain profitable coal, although the remains of plants are found in them, and a few seams, about a foot thick, occur in the red shales. The coal-measures themselves form the uppermost part of the series, and consist of micaceous sandstones, arenaceous, argillaceous, and carbonaceous shales, and valuable beds of limestone.

In other parts of the same wide area the Carboniferous Series manifests similar peculiarities of structure. Thus, in Nova Scotia, and elsewhere in Canada, the lower beds consist of Carboniferous Limestone; but at Cape Breton the millstone-grit appears to terminate the sequence. Newfoundland also, which presents not less than 5000 square miles of country, occupied by contemporaneous beds, has hitherto afforded no coal.

(Ansted, *Elementary Course of Geology.*)

MOUSE. [MURIDÆ.]

MUCOR. [ENTOPHYTA.]

MUCORACEÆ, an order in Lindley's alliance *Fungales.* The species have a floccose thallus and the spores surrounded by a vesicular veil or sporangium. They are amongst the smallest forms of *Fungi*, and attack decaying vegetable and animal matters. They are frequently known by the name of Moulds. [MOULDINESS; FUNGI; ENTOPHYTA; MILDEW.]

MUCOUS MEMBRANES. [MEMBRANE.]

MU'CUNA, a genus of Plants belonging to the natural order *Leguminosæ.* The calyx is campanulate bilabiate, with two very caducous bracteoles as long as the tube; the upper lip broad, entire, and obtuse; the lower lip trifid, with acute segments. The corolla is papilionaceous, with a cordate vexillum incumbent on the wings, much shorter than the wings and the keel, and without callosites. The stamens are diadelphous, with five of the anthers oblong, linear, and the other five ovate and hairy. The seeds oval, roundish, or reniform, with a narrow, oblong, or linear hilum. The species are climbing herbs or shrubs, with pinnately-trifoliate leaves and axillary racemes, which hang down when bearing fruit.

M. prurita, Cowitch, has purple flowers in compact ovate racemes; leaflets hairy beneath, the middle one rhomboidal and obtuse, the lateral ones dilated on the outer edge; the legumes are oblong, curved, compressed, not keeled, and covered all over with a thick coating of erect white stinging hairs, which turn black in drying and brown when ripe. It is a native of the hedges and banks of the East Indies.

M. pruriens, Common or Stinging Cowitch, has entire ovate-acute leaflets, smooth above, hairy beneath, the lateral ones oblique at the base, the middle one slightly rhomboidal. The racemes are from 12 to 18 inches long, lax, and many-flowered. The calyx is hairy, pink, with narrow lanceolate segments. The flowers have a disagreeable alliaceous smell; the vexillum is flesh-coloured, the wings purple or violet, and the keel greenish-white. The legumes about 3 inches long, the thickness of the finger, closely covered with strong brown stinging hairs. The seeds oblong, variegated with a white hilum. A mixture of the hairs of these two species form the Cowitch of commerce. The ripe pods are dipped in syrup, which is scraped off with a knife, and when the syrup has attained the thickness of honey, by means of the hairs becoming mixed with it, it is used as a medicine, and is considered a good anthelmintic, as it occasions no uneasiness. It is given from a tea-spoonful to a table-spoonful in the morning, fasting. The hairs, when applied to the skin, produce an intolerable and painful itching. A vinous infusion of the pods, 12 to a quart, is said to be a certain remedy for dropsy. A strong infusion of the roots, sweetened with honey, is used by the native practitioners in India in cases of cholera. It is likewise considered a powerful diuretic.

M. urens has racemose flowers and legumes clothed with stinging bristles; the leaflets have a shining tomentum beneath. The flowers are large, white or yellow, with the lower edge of the wings red. The seeds, from their resemblance to an eye, are called by the French Yeux Bourrique, or Ass's-Eyes, and for the same reason the seed has the name Ox-Eye-Bean in our colonies in the West Indies, where the species is a native.

A rich soil suits these plants, and they are easily raised from cuttings, but are not worth the trouble of cultivation, excepting for botanical gardens.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica;* Burnett, *Outlines of Botany.*)

MUCUS. The fluid which is found on the surface of mucous membranes is thus named. The chemical composition of this fluid has not been very accurately ascertained, but its morphological elements have been investigated by Henle and others with much care.

Dr. Henle of Berlin ('Ueber Schleim- und Eiter-Bildung,' in Hufeland's 'Journ. der Practisch. Heilk.,' 1838), was one of the first who determined the true composition of this substance, which had previously presented many qualities that appeared anomalous. He has proved that it always at least contains the scales or cells of epithelium, which cover all the open cavities of the body, suspended in a considerable quantity of watery fluid.

The epithelium, or cuticular covering of all mucous membranes, consists of one or more layers of minute cells; and it is deposited not only on the free surfaces of the large open cavities, but is continued into all the canals and ducts of glands that open on the mucous membranes. In different situations the form of the epithelium-cells varies considerably; in some parts they are rounded, or polygonal, and flat, adhering to each other in a continued membrane by their adjacent edges; in others they have a cylindrical or conical form, and are only attached to the mucous membrane by one of their extremities; in others they have also a cylindrical or conical form, and their free margins are beset with vibrating ciliæ. [EPITHELIUM.]

By the contact of the foreign matters to which all the mucous membranes are exposed in the performance of their functions, or by other processes, the epithelium cells are constantly being removed, and their place is as constantly supplied by the formation of new cells from the surface beneath. Thus on all the mucous surfaces a more or less rapid process of desquamation and reproduction of cuticle is ever going on; the superficial layers scaling off, and deep layers being produced in a manner exactly similar to that in which, as the outer surface of the cuticle of the skin (the epidermis) is removed, fresh layers are deposited on the inner surface to replace them and maintain the thickness of the membrane.

The superficial layer of epithelium-cells thus removed, not in dry scales, like the epidermis, but mixed with a quantity of watery fluid secreted by the surface of the mucous membrane, constitutes healthy mucus—a viscid, ropy, transparent, and apparently homogeneous substance, which is distinguished more especially by the presence of minute epithelium-cells either floating separately or united into small membranous flocculi. Its chief chemical properties are that it mixes with any quantity of water without being dissolved, but swelling up and forming flocculi, does not dissolve in alcohol, and is not coagulated by heat.

In addition to the epithelial cells mucus frequently contains round corpuscles, called mucus-corpuscles, which are not easily distinguished from pus-cells. These corpuscles are abundantly secreted in common catarrh. They are regarded as abortive epithelial cells. As these cells increase in diseased conditions, the mucus assumes more decidedly the character of pus.

It frequently happens that fibrinous coagula are found in the mucus, constituting the peculiar character of the mucus in croup, diphtheritis, pneumonia, Bright's disease, dysentery, and other affections of the mucous membranes. In these cases after the active inflammation has ceased, cells are observed in the mucus, which have been called inflammatory globules, or granular cells. Besides these bodies mucus contains fat-globules, and frequently molecular or elementary granules. The latter are seen in incipient diseased conditions of the mucous membranes, as in tuberculosis or cancer. It sometimes contains living beings, as *Vibriones* and fungoid threads of various kinds.

The chemical element which forms the basis of mucus is called Mucin, but unfortunately it has not been separated from the morphological elements. In addition to mucin, the mucus contains various extractive matters. It also contains potash and soda, and frequently gives an acid re-action; this arises from the presence of free acids. Albumen is also present in mucus, and frequently in considerable quantities. With regard to the origin of mucus, Lehmann, in his 'Physiological Chemistry,' has the following remarks. After stating that it does not appear that mucus is formed by any of the glands of the mucous membranes, he says:—"Tilanus has drawn especial attention to the circumstance, that epithelial structures are always present wherever there is true mucus. This observation might lead to the assumption that the formation of mucus is connected with the development of certain cells, that is to say, that its production occurs simultaneously with the development of certain morphological elements. Two views here present themselves for our consideration; one of which is, that the albuminates of the liquor sanguinis become decomposed, under certain hitherto unknown conditions, into the substratum of the epithelial cells and into mucus, whence the latter substance might in some respects be considered as a secondary product of this cell-formation, so that the mucous juice in the mucus would hold the same relation to the epithelial cells as the spirituous fluid does to the yeast-cells in a mixture which has undergone fermentation. The other view, which seems to be supported by numerous observations made by Scherer and Virchow, refers the origin of the mucus to a partial disintegration of the epithelial cells. All who have followed Frerichs in his observations on the metamorphosis of the cells within the gastric juice, or who have examined them by the microscope in the preparation of artificial gastric juice, will easily comprehend the gradual solution of the gastric cells and their conversion into a mucous fluid. Such a conversion of cells into a mucous substance would therefore at all events not be wholly without analogy. Scherer and Virchow however go still further, and advance the opinion, based upon several pathologico-histological observations and chemical experiments, that certain colloid substances, and others adapted for the formation of urine, may be converted into mucus under certain conditions which still remain to be explained, and even without any cell-formation; and hence they regard the latter mode of development as associated with the existence of colloid or cartilaginous substances. This view is not only supported by the absence of epithelial structures in many cysts containing mucus, but more especially by the frequently noticed conversion of the gelatin of Wharton into perfect mucus. It appears to us still to require accurate chemical experiments to decide which of these two hypotheses deserves the preference. The elementary analyses which were made by Scherer on a single variety of mucous juice unfortunately do not enable us to decide the question, both because the atomic weight could not be determined, and because we are still entirely deficient in an accurate analysis of the epithelial cells, the colloid substance, &c. It remains for us to hope that the investigating powers of men like Scherer may before long enrich science with the knowledge necessary for elucidating a subject which is so intimately associated with the advancement of physiology.

"The localities in which mucus occurs clearly demonstrate that it is especially designed to serve as a protecting medium to all the parts which are placed in a reciprocal connection with the outer world."

MUDSTONE, a local name for part of the Upper Silurian Rocks of Sir Roderick Murchison.

MUDWORT, the common name of the species of the genus *Limosella.* This genus belongs to the natural order *Scrophulariaceæ.* It has a 5-cleft calyx; a 5-fid bell-shaped equal corolla; a globose 2-valved capsule, with a central placenta, free, or connected with a short dissepiment below, 1-celled.

L. aquatica is the only British species. It has lanceolate spathulate leaves on long stalks; pedicles axillary, crowded, shorter than the petioles. It has small white or rose-coloured flowers. It is found growing in muddy places, where water has stagnated.

MUGI'LIDÆ, the Mullet Tribe, a family of Fishes of the order *Acanthopterygii*. This family may be distinguished by the following characters:—Body nearly cylindrical, covered with large scales; dorsal fins (two in number) separated, the first with only four spinous rays; the ventral fins have their origin a little behind the line of the pectorals; branchiostegous rays, six. The head is somewhat depressed, and, like the body, is covered with large scales or polygonal plates; the muzzle is very short; the mouth is transverse, and when closed forms an angle, the lower jaw having an eminence in the middle, which fits into a corresponding hollow in the upper; teeth very minute; pharyngeal bones much developed.

There are three genera belonging to this family—*Atherina*, *Mugil*, and *Tetragonurus*.

Atherina has the body rather elongated; two dorsal fins widely separated; ventral fins placed far behind the pectorals; sides with a broad longitudinal silver band; teeth minute; branchiostegous rays 6.

A. presbyter, the Atherine, or Sand-Smelt. It was at one time supposed that the Atherine of the British coasts was the *A. hepsetus* of Linnæus, but after a close examination Mr. Yarrell comes to the conclusion that the British species is *A. presbyter* of Cuvier.

The British Atherine is a handsome small fish from 5 to 6 inches in length. It is found on the coast of Cornwall at all seasons of the year. It is also frequently caught at Brighton, where large quantities are eaten in the winter season by the inhabitants and visitors. Dr. Parnell has taken it in Scotland, and Mr. Thompson in Ireland.

Mugil has the body nearly cylindrical, covered with large scales; two dorsal fins widely separated, the rays of the first fin spinous, those of the second flexible; ventral fins behind the pectorals; middle of the under jaw with an elevated angular point, and a corresponding groove in the upper; teeth small; branchiostegous rays 6.

M. capito (Cuv.), the Gray Mullet, or Common Mullet, is not uncommon on many parts of the British coast. It is rather more than a foot in length; the length of the head compared with that of the body and tail is as one to four; the greatest depth of the body, which is beneath the first dorsal, is about one-fourth the whole length, excepting the tail. The head is broad and depressed; snout rounded; the skin of the anterior and posterior margins of the orbit does not advance over the eye. First dorsal fin commences about the middle of the body, its height is equal to twice its length; between the first and second dorsal there is a considerable interval; its proportions, as regards height and length, the same as the first. The upper surface of the body is dusky-gray, tinged with blue; the sides and belly are silvery-white, marked with longitudinal dusky lines; fin-membranes dirty-white; a dark spot on the base of the pectoral fin.

It is found plentifully in Cornwall and Devonshire, and along the south coast. It is also taken on the eastern coasts. This fish never goes to a great distance from land, and delights in shallow water. It is on this account probably that it bears confinement better than other fishes, and is one of those which have been most successfully kept in the Aquavivarium of the Zoological Society in Regent's Park. They seem more intelligent than most fish. Carew, the Cornish historian, had a pond of salt water in which he had naturalised these fish, and he could assemble them together to be fed by knocking on a stick. Fishermen also relate numerous instances of its intelligence, and the devices it has recourse to for the purpose of escaping from the net when once caught. It takes its food from the mud at the bottom of the water in which it lives, and seldom partakes of any living food. It is most readily taken by fat, or cabbage boiled in broth.

This fish frequently goes up rivers, and is thus often caught by the angler. When taken young and placed in fresh water it has been found to thrive.

M. chelo, Cuvier, the Thick-Lipped Gray Mullet, according to Mr. Couch's manuscripts, communicated to Mr. Yarrell, seems to be abundant on the coast of Cornwall, but no other British naturalists appear to have noticed it. It is distinguished from the Common Gray Mullet chiefly by its large and fleshy lips, the margins of which are ciliated; the teeth resemble hairs; the maxillary bone curved, and showing itself behind the commissure.

M. curtus, the Short Gray Mullet of Yarrell, is a third species, found in the British seas. "The length of the head, as compared with that of the body and tail, is as one to three, the proportion in the Common Gray Mullet being as one to four; the body is also deeper in proportion than in *M. capito*, being equal to the length of the head: the head is wider, the form of it more triangular, and also more pointed anteriorly; the eyes larger in proportion; the fin-rays longer, particularly those of the tail; the ventral fins placed nearer the pectoral, and a difference exists in the number of some of the fin-rays: the colours of the two species are nearly alike; and in other respects, except those named, they do not differ materially." (Yarrell, 'British Fishes.') Mr. Yarrell caught this new species at the mouth of Poole harbour.

Tetragonurus, so named from the projecting keels or ridges on each side, near the base of the caudal. There is only one species, an inhabitant of the Mediterranean, about a foot long, and black, and reputed to be poisonous.

MUGWORT, the common name for the *Artemisia vulgaris*. This species of *Artemisia* is known by its leaves being woolly beneath, with lanceolate, acuminate, cut, and serrated segments. It is a very common plant on waste ground in Great Britain. [ARTEMISIA.]

MULBERRY. [MORUS.]

MULE. This word is, in its particular sense, used to denote the offspring of the male ass and the mare [EQUIDÆ]; but, in its general signification, it is applied to the offspring of any two animals of distinct species, and is then synonymous with the term 'Hybrid.' [HYBRID.]

"The true distinction between different species of animals," writes John Hunter, "must ultimately, as appears to me, be gathered from their incapacity of propagating with each other an offspring capable again of continuing itself by subsequent propagations: thus the horse and ass beget a mule capable of copulation, but incapable of begetting or producing offspring. If it be true that the male has been known to breed, which must be allowed to be an extraordinary fact, it will by no means be sufficient to determine the horse and ass to be of the same species; indeed from the copulation of mules being very frequent, and the circumstance of their breeding very rare, I should rather attribute it to a degree of monstrosity in the organs of the mule which conceived, as not being a mixture of two different species, but merely those of either the male or female ass. This is not so far-fetched an idea, when we consider that some true species produce monsters which are a mixture of both sexes, and that many animals of distinct sex are incapable of breeding at all. If then we find nature in its most perfect state deviating from general principles, why may it not happen likewise in the production of mules, so that sometimes a mule shall breed from the circumstance of its being a monster respecting mules?" We think that the views here laid down are clear and satisfactory so far as they go, and that the question with which the paragraph concludes is in no danger of a contradictory answer.

But the student should be on his guard as to an unhesitating admission of everything that is laid down even by an authority so deservedly eminent as that of the great physiologist whose opinion we have just quoted. Professor Owen, for instance, in one of his valuable notes on another part of this very paper, truly observes that John Hunter's assertion that the fertility of a hybrid with an individual of a pure breed proves the fact of identity of two supposed distinct species equally with the production of offspring from the connection of hybrid with hybrid, cannot be admitted. "To prove the identity of two supposed distinct species," continues the Professor, "granting the fertility of the hybrids from the two to be the proof required, it should be shown that such hybrids are fertile inter se, and capable of propagating indefinitely an intermediate variety. Now this is precisely the fact which is wanting in the evidence adduced in the text. All that Hunter proves is that two species very nearly allied to each other will produce a hybrid offspring, and that the hybrid is again productive with an individual of the pure breed; but this only illustrates a general law by which the reversion of the hybrid to the pure breed is provided for; while, on the other hand, the intermixture of the distinct species is guarded against by the aversion of the individuals composing them to a sexual union." And it is no contradiction to this general rule to show that in some instances this aversion is overcome, as in the case of the lion and tigress—to cite an example, among the *Carnivora* [FELIDÆ], and in that of the pheasant and common fowl: and the hen canary-bird with the goldfinch, linnet, &c., among birds. [CANARY-BIRD.] Such cases are the exceptions, and prove the generality of the rule or law.

Doubtless there must be a concurrence of predisposing accidents to bring different species, in their anxious desire to obey the all-powerful impulse of reproduction, together; and the presence of such predisposing causes may be generally traced in most of these erratic alliances. In the great majority of them the species thus mingled are very nearly allied. Thus there are several instances on record of the Hooded Crow (*Corvus Cornix*) pairing and producing offspring with the Carrion Crow (*Corvus Corone*); the male of Montagu's Harrier (*Circus hyemalis*) and a Ringtail (*Circus cyaneus*) having been shot at the nest feeding their young (Yarrell, ex relatione Sweeting). Mr. Berry notices the pairing of a Blackbird and a Thrush in Lancashire: these birds reared their broods, which were strongly-marked hybrids, for two successive years. ('Magazine of Nat. Hist.,' vol vii.)

Mr. Yarrell, who in his 'History of British Birds' mentions the last-named cases in detail, adds that several instances are known in which the female of the Black Grouse, usually called the Gray Hen, has bred in a wild state with the Common Pheasant; such a hybrid is represented in the title-page of Mr. T. C. Eyton's 'History of the Rarer British Birds.' [BLACK GROUSE.] The last-named ornithologist has also recorded the fruitful connection between the Common Goose and the Chinese Gander; and the Hon. Twiselton Fiennes communicated to the Zoological Society of London an instance of the Common Wild Duck breeding with the male Pintail. [DUCKS.]

The author of the 'History of British Birds' above quoted has had so much experience on this intricate subject, so far as it relates to birds that the following observations by him are worthy of all attention:—'

"Several experiments on the productive powers of various hybrid birds are now in progress; but without intending to anticipate the interesting particulars which may be elicited, I may briefly refer to what has fallen under my own observation. Some degree of restriction, either accidental or imposed, and arising from various causes, appears to be necessary to induce the union of birds that are of different species; but the influence of the divine command to 'increase and multiply' is so irresistible, that some birds unite with strange partners rather than have no partner at all. When putting two birds of different species together, with the intention of breeding from them, union is less likely to take place if they are kept within sight or hearing of other birds of their own species. The two sexes of the broods produced by such unions take little or no notice of each other when adult even during the usual breeding season, and are believed to be unproductive among themselves if so restricted; but if allowed an opportunity of uniting with the true species of either parent they are then prolific, and the young birds produced soon lose all intermediate character." ('Hist. Brit. Birds,' part xiii.)

Mr. Darwin, in his highly interesting 'Journal and Remarks,' being the third volume of the 'Narrativo of the Surveying Voyages of H.M. ships Adventure and Beagle,' gives the following graphic account of the social habits of the Mule when describing the passage of the Cordillera:—

"Our manner of travelling was delightfully independent. In the inhabited parts we bought a little firewood, hired pasture for the animals, and bivouacked in the same field with them. Carrying an iron pot, we cooked and ate our supper under the cloudless sky, and knew no trouble. My companions were Mariano Gonzales, who had formerly accompanied me, and an arriero, with his ten mules and a madrina.

"The madrina (or godmother) is a most important personage. She is an old steady mare, with a little bell round her neck; and wheresoever she goes tho mules, like good children, follow her. If several largo troops are turned into one field to graze, in the morning the muleteer has only to lead the madrinas a little apart and tinkle their bells; and although there may be two or three hundred mules together each immediately knows its own bell, and separates itself from the rest. The affection of these animals for their madrinas saves infinite trouble. It is nearly impossible to lose an old mule; for if detained for several hours by force, she will, by the power of smell, like a dog, track ont her companions, or rather the madrina; for, according to the muleteer, she is the chief object of affection. The feeling however is not of an individual nature; for I believe I am right in saying that any animal with a bell will serve as a madrina. In a troop each animal carries, on a level road, a cargo weighing four hundred and sixteen pounds (more than twenty-nine stone); but in a mountainous country a hundred pounds less. Yet with what delicate slim limbs, without any proportional hulk of muscle, these animals support so great a burden! The mule always appears to me a most surprising animal. That a hybrid should possess more reason, memory, obstinacy, social affection, and powers of muscular endurance, than either of its parents, seems to indicate that art has hero out-mastered nature."

MULGE'DIUM, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Liguliflorœ*, the tribe *Cichoraceœ*, and subtribe *Hieraciœ*. It has many-flowered heads, a double involucre, the inner of one row, the outer of short lax imbricated scales; the fruit compressed, constricted above, and terminating in a ciliated disc; the onter rows of the pappus rigid and brittle. There are several species of this genns.

M. alpinum, has glabrous, lyrate at the base, arrow-shaped leaves, the terminal lobe large, triangular-hastate, acute; the stem simple, heads racemose, bracts, peduncles, and involucres, glandular hairy; the fruit oblong, not attenuated, with many ribs. This plant has blue flowers iu small numerous heads, with a stem about 3 feet high. It is a remarkahly handsome plant, and is the only British species of the genus. It is the *Sonchus cœruleus* of Smith in the English botany. The only locality in which it grows in Great Britain is the Clooa Mountains of Scotland.

M. floridanum is a native of America, and on account of its excessive bitterness is called Gall of the Earth.

(Babington, *Manual;* Lindley, *Vegetable Kingdom.*)

MULI'NIA, Dr. Gray's name for a genus of *Conchifera*, allied to *Mactra*, having the ligament, properly so called, internal, and the lateral teeth simple.

MULLET. [MUGILIDÆ; MULLUS.]

MULLUS, a genus of Fishes belonging to the group *Acanthopterygii* and the family *Percidœ*. The species have the body thick oblong; profile of the head approaching to a vertical line; scales large, deciduous; two dorsal fins widely separated, the rays of the first spinous, those of the second flexible; teeth on the lower jaw and palate only; two cirri at the symphysis of the lower jaw; branchiostegous rays 4. There are two species of this genus found in Europe, and both are inhabitants of the seas of Great Britain.

M. surmuletus, the Striped Red Mullet, or Striped Surmullet, has the following fin-ray formula:—D. 7—1+8; P. 17; V. 1+5; A. 2+6; C. 13.

The forehead, nape, cheeks, and operculum are covered with scales; irides pale-yellow; mucous-pores abundant; the colour of the body is from a pink to a bright-red; the membraue of the first dorsal-fiu is tinged with yellow; those of the other fins transparent; the axilla of the ventral fin furnished with a poiuted scale; the vent placed under the commencement of the second dorsal fin.

The Striped Red Mullet is abundant on the southern coasts of Great Britain, but is rarer on the eastern and northern coasts. This fish is good eating, and is sent in large numbers from the coasts to the London market. In the month of August, 1819, 5000 were taken off Weymouth, and in one week during the month of May, 1831, 10,000 were sent to London from Yarmouth. The Striped Red Mullet was a favourite dish amongst the ancient Romans, and large prices were paid for them. "A fish of 3 lbs. weight produced a considerable sum to the fortunate fisherman, while the cost of a fish of 4½ lbs., says Martial, was ruinous. A Mullet of 6 lbs. is recorded to have produced a sum equal to 48*l.*; one still larger 64*l.*; and even 240*l.* were given for them of unusual size, procured on the same day, for a repast of more than usual magnificence." (Yarrell.) On our own coast this fish seldom exceeds 14 inches in length.

The Striped Red Mullet spawns in the spring, aud the young are 5 inches long in October. Their food consists of the softer crustaceous and molluscous creatures. The cirri, which are generally placed near the mouth, seem to act as organs of feeling, whereby these animals are enabled to distinguish their food. Mr. Yarrell says, "Ou dissecting these appendages in the Mullet, the Common Cod, and others, I found them to consist of an elongate and slender flexible cartilage, invested by numerous longitudinal muscular and nervous fibres, and covered by an extension of the common skin. The muscular apparatus is most apparent in the Mullet, the nervous portion most conspicuous in the Cod. These appendages are to them, I have no doubt, delicate organs of touch, by which all the species provided with them are enabled to ascertain, to a certain extent, the qualities of the various substances with which they are brought in contact, and are analogous in function to the beak, with its distribution of nerves, among certain wadiug and swimming birds which probe for food beyond their sight; and may be considered another instance, among the beautiful provisions of nature, by which in the case of fishes feeding at great depths, where light is deficient, compensation is made for imperfect vision." ('British Fishes,' vol. i., p. 34.) This and the next species must not be confounded with the Gray Mullet, which belongs to a very different family of Acanthopterygious Fishes. [MUGILIDÆ.]

M. barbatus, the Plain Red Mullet, the Surmullet, the Red Surmullet. This fish is much rarer on the British coasts than the last. They seem to be equally abundant in the Mediterranean. The fin-rays are as follows:—D. 7—1+8; P. 16; V. 6; A. 1+6; C. 15. The scales are somewhat smaller than in the last and present some structural differences.

(Yarrell, *History of British Fishes.*)

MULTIVALVES, the name formerly used to designate those shells which were mado up of more than two pieces. Thus the Cirrhipeds (*Lepas*) were all multivalve shells of Linnæus, and so were *Chiton* and *Pholas*.

MUNTJAK. [CERVIDÆ.]

MURÆ'NIDÆ, or ANGUI'LLIDÆ, a family of Fishes belonging to the Apodal section of the *Malacopterygii*. These fishes have an elongated and often cylindrical body, covered by a thick and soft skin in which the scales are deeply imbedded and scarcely apparent. They have no cæca, but nearly all are furnished with a natatory bladder. In the first group, which constitutes the great genus *Murœna* of Linnæus, the opercula are small, and enveloped in the skin; the gill-opening is small, and is situated far back, an arrangement which, by more completely protecting the branchiæ, permits these fishes to live a long time out of water. They have no ventral fins.

The species of the genus *Anguilla* are distinguished by the possessiou of pectoral fins; the dorsal, anal, and caudal fins are united. the dorsal commences at a considerable distance behind the pectorals; the upper jaw is shorter than the lower; the gills opening by a small aperture on each side, situated beneath the pectoral fin. Three if not four species of *Anguilla*, or Eel, are found iu this country—the Sharp-Nosed Eel, the Broad-Nosed Eel, aud the Suig.

A. acutirostris (Yarrell), the Sharp-Nosed Eel, may bo distinguished, as its name implies, by its comparatively narrow and sharp muzzle. "The head is compressed, the top convex, depressed as it slopes forwards; the eyes small, placed immediately over the angle of the mouth; irides reddish-yellow; the jaws very narrow, slightly rounded at the end; the lower jaw the longest; nostrils with two openings on each side, one tubular, the other a single orifice; both jaws furnished with a narrow band of small teeth; gape small; various mucous pores about the mouth and other parts of the head; gill-opening a small aperture immediately before and rather below the origin of the pectoral fin. The scales on the body rather small; dorsal fin extending over more than two-thirds of the whole length of the fish; anal fin occupying more thau half the whole length; both united at tho end, forming a tail; the number of rays in the first fins not easily ascertaiued, from the thickness of the skin; the lateral line exhibits a long series of mucous orifices; vetebræ 113. The vent includes four distinct openings, the most anterior of which leads upwards to the intestine, the posterior to the urinary bladder, in a direction backwards, and one elongated lateral opening on each side communicating with the cavity of the abdomen, as in other bony fishes." Colour of the upper surface of the head and body very dark olive-green; under surface silvery; the colouring however varies somewhat according to the nature of the water in which the animal lives, as in other fishes; in those found in clear streams the colours are bright, whilst those found in muddy waters are dusky.

This species is common in streams, lakes, &c., throughout the country. The Eel is said to be averse to cold, and in the autumn migrates down the rivers to reach the warm brackish water, where it passes the winter, and deposits its spawn. In the spring the young fry may be seen making their way up the streams, sometimes in immense numbers. Such a desire do the young eels (about three inches in length) appear to have to go up the stream that their course is not easily stopped. The writer of this has seen a flood-gate, 6 or 7 feet in height, in parts covered with them, and has observed many succeed in passing over this perpendicular barrier by availing themselves of the trickling water which escaped through the crevices of the wood-work.

Those eels which live in ponds, and cannot therefore migrate, bury themselves in the mud during the winter months. In these cases however they will sometimes leave the water, and, availing themselves of the wet grass during the night, travel considerable distances in order to reach a stream; they are known also to leave certain ponds, the water of which does not suit them, and to make their way over land to other and more favourable situations.

The question as to whether the Eel be an oviparous or viviparous fish has been much discussed; many have imagined that it brought forth its young alive, but there appears to be better grounds for the belief that it is oviparous.

"The London market," Mr. Yarrell informs us, "is principally supplied from Holland by Dutch fishermen. There are two companies in Holland, having five vessels each: their vessels are built with a capacious well, in which large quantities of eels are preserved alive till wanted. One or more of these vessels may be constantly seen lying off Billingsgate; the others go to Holland for fresh supplies, each bringing a cargo of 15,000 to 20,000 pounds weight of live eels, for which the Dutch merchant pays a duty of 13*l.* per cargo for his permission to sell."

A. latiorostris, Yarrell, the Broad-Nosed Eel, is not uncommon, and is often found in the same waters as the sharp-nosed species, from which it is readily distinguished by the comparatively greater breadth of its head, and the situation of the eye, which is placed in advance of the angle of the mouth. The body is moreover thicker in proportion to its length, the teeth are more numerous, larger, and stronger; the dorsal fin commences farther back; the dorsal and anal fins are much deeper and thicker. The number of vertebræ is 115. This species is the Anguille Plat-Bec of Cuvier, and is sometimes called in England the Grig-Eel.

A. mediorostris, Yarrell, the Snig, is in some respects intermediate between the common or sharp-nosed species and the broad-nosed eel. The general colour above is olive-green, and beneath yellowish-white. "In the comparative breadth of the nose, the Snig is intermediate in reference to the sharp and broad nosed eels, but rather more resembles that with the sharp nose," says Mr. Yarrell; "it has a slight but elongated depression extending from the anterior edge of the upper jaw to the upper and back part of the head; the tubular openings of the nostrils are longer, and the mucous pores about the lips larger and more conspicuous; both jaws rounded at their extremities, the lower one the longest; teeth longer and stronger than in the common sharp-nosed species; gape large; the angle and the posterior edge of the eye on the same vertical line; the pectoral fins, the commencement of the dorsal fin, and the vent, are each placed nearer the head than in either of our fresh-water eels."

Besides the distinguishing characters above pointed out, there are others, the most important of which perhaps is the difference observable in the form of the vertebræ—see Yarrell's 'History of British Fishes,' where the skulls and adjoining vertebræ of these three species are figured.

A. Conger, Shaw (*Conger vulgaris*, *Muræna Conger*, Linnæus, Le Congre, Cuvier), the Conger Eel, is readily distinguished from the fresh-water species by the upper jaw being the longest, and the dorsal fin commencing much nearer the head—characters which have induced Cuvier to separate it from them as a sub-genus.

This marine species is common on many parts of our coast, and is indeed found in most of the European seas. It attains a very large size, being often five or six feet in length and occasionally as much as ten feet or upwards; the thickness bearing about the same proportion to the length as in the common eel. The upper parts of the body are brownish and the under parts dirty-white; dorsal and anal fins whitish margined with deep bluish-black; the lateral line is spotted with white.

A. myrus, another species of Conger, is found in the Mediterranean. It resembles the common species, but is of a smaller size, and is known by there being spots on the snout, a band across the occiput, and two rows of dots on the nape, all of which are of a whitish colour.

Ophisurus of Lacépède is a genus nearly allied to *Anguilla*, the species of which differ from the true eels by their dorsal and anal fins terminating before they reach the end of the tail, which has no fin. The posterior orifice of the nostrils opens on the edge of the upper lip.

O. serpens, the Snake-Eel, inhabits the Mediterranean; it is about five or six feet in length and about three inches in thickness, of a brown colour above and silvery beneath; the snout is slender and pointed.

In some species of this genus the pectoral fins are very small, and in this respect approach the genus *Muræna*, in which there are no pectorals.

Muræna, as just stated, has no pectoral fins; the orifices of the gills are small and open, one on each side; in each jaw there is a single row of teeth; the dorsal and anal fins are very low, and are united.

M. Helena, the Muræne, the Muræna, is the type of the genus. It is found in the Mediterranean and Portuguese seas, and in one instance has been taken on the coast of Britain. It grows to the length of between four and five feet, and even more. The body is smooth and glossy, beautifully mottled with salmon colour, yellow, and purple. The head is large and swollen, which gives the fish a disagreeable aspect. It is excellent eating, and was highly esteemed by the ancients, who reckoned it among the best of fishes for the table, and kept the *Muræna* alive in vivaria. It is said that Vedius Pollio used to cause his offending slaves to be flung alive into the ponds to feed his *Murænæ*.

Leptocephalus has a small and short head; numerous teeth; pectoral fins and gill-openings very small; body compressed and very thin, tape-like; dorsal and anal fins small, united at the tail, forming a point.

L. Morrisii, the Anglesey Morris, appears to be the only European species. This fish, which is identical with the *L. Spallanzani* of Risso, has been found in Great Britain. [LEPTOCEPHALUS.]

Ophidium, *Echiodon*, and *Ammodytes* are other British genera of this family. [ECHIODON; AMMODYTES; OPHIDIUM.] *Gymnotus* contains the Electric Eel. [GYMNOTUS; ELECTRICITY IN ORGANIC BEINGS.] *Carapus* and *Stenarchus* are genera, the species of which inhabit South America. *Gymnarchus* inhabits the Nile. [GYMNARCHUS.]

MURÆNOIDES (Lacépède), a genus of Fishes belonging to the section *Acanthopterygii* and the family *Gobiadæ*. The species have been included under the genera *Blennius* of Linnæus, and *Gunnellus*. They have the head small, muzzle obtuse; body elongated, smooth; scales minute, covered with a mucous secretion; dorsal fin extending the whole length of the back, the rays simple; ventral fins very small; teeth small, pointed, detached.

M. guttata, the Spotted Gunnel or Butter-Fish, is distinguished from its congeners by the consistence and quantity of mucous secretion by which its sides are covered. It is known from the true Blennies by its dorsal fin being but little elevated above the line of the back, and by its elongated, slender, and compressed body, from which circumstance it has obtained the name of Swordick in Orkney and Svardfisk in Norway, from a supposed resemblance to the blade of a sword. It is a common fish on the coasts of Great Britain, where it is often found in the little pools left by the tide. It feeds on small *Crustacea* and the spawn and fry of other fishes. In Greenland it is eaten, but it is only used for bait in this country, its flesh being hard. The length of the head is equal to the depth of the body, and is, when compared with the whole length of the body and head of the fish, without including the tail-fin, as one to eight. It is said to attain the length of 10 inches, but its more frequent length on the British shores is from 5 to 7 inches.

Mr. Yarrell states that the Spotted Gunnel of America is identical with the British fish.

MUREX. [SIPHONOSTOMATA.]

MU'RIDÆ, the name of an extensive family of Rodents, comprising, when taken in its largest sense, a great number of genera and species, which, though none of them attain to any considerable size, become worthy of serious notice from their prodigious multiplication and the destructive influence which they exert over vegetation and the fruits of the labour of the agriculturist. The type of this family is found in the genus *Mus*, to which our Common Rats and Mice belong.

The Linnean genus *Mus* is thus characterised in the last edition of the 'Systema Naturæ:'—'Dentes primores inferiores subulati;' and, as might be expected from such a definition, it is made the receptacle not only for such Rodents as are vernacularly known as Rats and Mice, but for the Guinea Pig, the Agoutis, the Paca; in short, for all the *Glires* then known, not arranged under the genera *Hystrix*, *Lepus*, *Castor*, and *Sciurus*. The remaining genus (*Noctilio*), placed by Linnæus among his *Glires*, belongs to the Bats. [CHEIROPTERA.] Pallas concurred with Linnæus in uniting under one great genus (*Mus*) all the Rodents provided with clavicles which had no striking external distinction, such as the tail of the Squirrel or the Beaver.

Gmelin separated from this crowd of Rodents the Marmots (*Arctomys*), the Dormice (*Myoxus*), and the Jerboas (*Dipus*).

Cuvier, in the last edition of the 'Règne Animal,' carries this subdivision much farther, adopting the following sub-genera, under the great genus *Mus*, or the Rats:—The Marmots (*Arctomys*, Gm.), the Dormice (*Myoxus*, Gm.), *Echymys*, Geoff. (*Loncheres*, Ill.), *Hydromys*, Geoff., *Capromys*, Desm., the Rats and Mice, properly so called (*Mus*, Cuv.), *Gerbillus*, Desm. (*Meriones*, Ill.), *Meriones*, F. Cuv., the Hamsters (*Cricetus*, Cuv.), the Campagnols, or Field Rats and Mice (*Arvicola*, Lacép.), which he subdivides into—1st, the Ondatras (*Fiber*, Cuv.), and, 2nd, the ordinary Campagnols (*Arvicola*, Cuv.; *Hypudæus*, Ill.) —the Lemmings, Cuv. (*Georychus*, Ill.; *Otomys*, F. Cuv.), and the Jerboas (*Dipus*, Gm.). To these succeed the Jumping Hares (*Helamys*, F. Cuv.; *Pedetes*, Ill.), the Mole-Rats (*Spalax*, Guld.), the Oryctères, F. Cuv. (*Bathyergus*, Ill.), *Geomys*, Raf. (*Pseudostoma*, Say, *Ascomys*, Licht., *Saccomys* (?), F. Cuv.), and *Diplostoma*, Raf.

Dr. J. E. Gray, in his 'Outline' ('Ann. Phil.,' 1825), after observing that the *Glires* are exceedingly difficult to arrange, and that the arrangement given is only "an attempt according to their habits," makes *Muridæ* the first family of the order, with the following character:—"Cutting teeth two in each jaw, lower awl-shaped, grinders simple or compound, upper shelving backwards, lower forwards; limbs proportionate, tail scaly, fur with scattered longer hairs, or flat spines; clavicles distinct."

He then subdivides the family as follows:—

† Grinders rooted, simple.

1. *Murina.*—*Mus*, Linn.; *Otomys*, F. Cuv.; *Capromys*, Desm.
2. *Hydromina.*—*Hydromys*, Geoff.

†† Grinders rootless, compound.

3. *Ondatrina.*—*Ondatra.*
4. *Castorina.*—*Castor*, Linn.; *Osteopora*, Harlan.
5. *Echymina.*—*Echymys*, Geoff.; *Heteromys*, Desm.; *Saccomys*, F. Cuv.

In the 'Catalogue of specimens in the British Museum,' Dr. J. E. Gray has somewhat modified this arrangement. A list of the British Museum specimens of this family is given at the end of this article.

Dr. Fischer, in his 'Conspectus Ordinum et Generum' (1829), divides the *Glires* into two sections: the first consisting of those with complete clavicles; and the second of those which have none. The following genera are thus arranged under the first section:—*Castor*, *Lemmus*, *Spalax*, *Saccophorus*, *Loncheres*, *Myoxus*, *Hydromys*, *Capromys*, *Mus*, *Cricetus*, *Saccomys*, *Pedetes*, *Dipus*, *Aulacodus*, *Arctomys*, *Sciurus*, *Pteromys*, and *Cheiromys*.

Mr. Swainson, in his 'Classification of Quadrupeds' (1835), also separates the *Glires* into two divisions: the first, or *Glires* proper, with clavicles; and the second with rudimentary clavicles, or none. In the first division, after the genera *Castor*, *Fiber*, and *Myopotamus*, and an observation in a note to the first section, that these divisions are purely artificial, and merely formed to facilitate the search among so many unarranged groups, we find the following sections:—

1. Rats and Mice, under which are arranged the following:—*Arvicola*, Lacép. (*Hypudæus*, Ill.). Example, *Mus amphibius*, Linn., Water-Rat, Penn.; *Georychus*, Ill. (Lemmings). Example, *Mus Norvegicus*, Linn., the Lemming.* *Echimys*, Geoff. (Spined Rats). Ex. *Echimys cristatus*, Desm., Gilt-Tailed Dormouse, Penn. *Myoxus*, Gm. (Dormouse). Ex. *Mus avellanarius*, Linn., the Common Dormouse. *Hydromys*, Geoff. (Water-Rat). Ex. *H. leucogaster*, Australia. *Mus*, Auct. Ex. *M. Rattus*, Linn., Common Rat. *Capromys*, Desm. Ex. *C. prehensilis*, South America. *Cricetus*, (Hamster). Ex. *C. vulgaris*, the Hamster.

2. Fore legs very short, hind legs long. Jumping Mice, under which come the following genera and sub-genera:—*Dipus* (Jerboa), Ex. *Mus Jaculus*, Linn. (*D. Sagitta*, Dum.). Sub-genus *Gerbillus*, Desm. Ex. *M. Tamariscinus*, Tamarisk Jerboa, Sh. *Meriones*, F. Cuv. Ex. *Meriones Labradorius*. Sub-genus *Pedetes*, Ill. Ex. *M. Caffer*, Pall., Cape Jerboa, Penn. Then follows *Lagostomus*, Brookes, with its sub-genera *Chinchilla* and *Lagotis*. [CHINCHILLIDÆ.]

3. Tail very short. Mole and Sand-Rats, including *Geomys*, Schmaltz (Sand-Rat). Ex. *Geomys Douglasii*, America. *Diplostoma*, Schmaltz, America; *Aplodontia*, Richardson. Ex., *A. leporina*, America. *Aspalax*, Güld.† Ex. *Mus Typhlus*, Pall., Asia; *Bathyergus*, Ill. Ex. *M. maritimus*, Gm., Africa.

4. Tail long, bushy. Squirrels, under which are arranged *Arctomys*, Gm. Ex. *Mus Marmotta*, Linn., the Marmot. *Spermophilus*, F. Cuv. Ex. *M. citellus*, Pall., chiefly America. *Sciurus*, Auct. Ex. *S. vulgaris*, Linn., the Common Squirrel; together with the sub-genus *Pteromys*, Geoff., and the genus *Cheiromys*.

The numerous forms which press upon the attention in considering this large section of *Mammalia* are enough to convince any one who has bestowed any thought on the subject that authors have not spoken of the difficulties surrounding it without reason. We shall therefore introduce the student to the most remarkable among them; and, adopting Mr. Swainson's names for the first three sections as arbitrary divisions under which we may bring the structure and habits, where they are known, of these animals before the reader, proceed to examine the natural history of this great and destructive group.

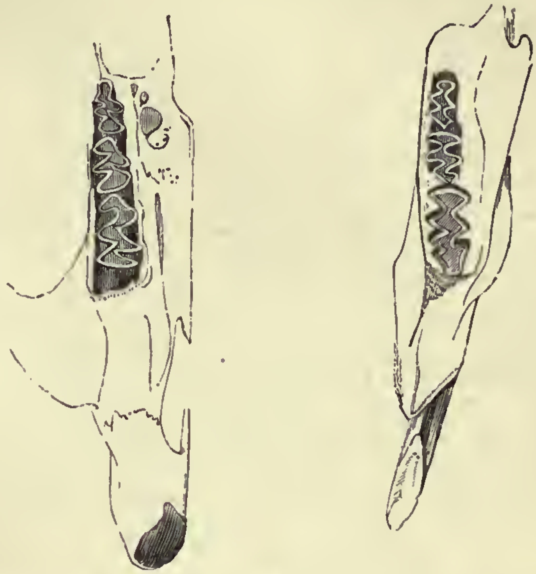
Rats and Mice (popularly so called).

Arvicola.—Ears moderate. Muzzle obtuse. Anterior toes armed with moderate claws. Tail round and hairy, not so long as the body. Number of teats from 8 to 12. Molars composite, with flat crowns, presenting angular enamelled laminæ.

* *Georychus* is generally considered to signify the Mole-Rats. The true Lemmings, such as *Mus Norvegicus*, are closely allied to *Arvicola*.

† *Aspalax* is Olivier's name; *Spalax* is Güldenstädt's.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{3}{3} = 10$.



Teeth of *Arvicola*. F. Cuvier.

Cuvier divides the great genus *Arvicola* of Lacépède (Campagnols) into the Ondatras (*Fiber*, Cuv.) [ONDATRA], and the Campagnols Ordinaires (*Arvicola*, Cuv.; *Hypudæus*, Ill.); and so they stand in Cuvier's last edition of the 'Règne Animal.' M. Lesson, in his 'Manuel,' states that Cuvier has formed two sub-divisions of the *Arvicolæ*, namely, first, the Campagnols Nageurs, of which M. Lesson gives *A. amphibius*, Desm., *Mus amphibius*, Linn., as an example; and second, the Campagnols Terrestres, which may be exemplified by *A. agrestis*.

Adopting this latter sub-division of *Arvicola* in its restricted sense for convenience, there being hardly sufficient difference in the structure, whatever there may be in habits, to justify the breaking the true *Arvicolæ* down into two groups, we shall, before we proceed to the description of the two examples selected, detain the reader very shortly with the views of two modern English naturalists of note with respect to the *Arvicolæ*.

Dr. Gray raises this group to the rank of a family under the name of *Arvicolidæ*, or of a tribe *Arvicolina*, and under it places his genus *Ctenodactylus*, a word, by the way, which comes very near to Dejean's name for a genus of Coleopterous Insects, *Ctenodactyla*. [CTENODACTYLUS; CTENODACTYLA.] Mr. Yarrell is of opinion that *C. Massonii* of Gray, is, as suggested by Mr. Ogilby, identical with the *Mus Gundi* of Rothman, on whose description is founded the *Arctomys Gundi* of Gmelin and others, and the Gundi Marmot of Pennant's 'Zoology.'

Mr. Bell, in his 'British Quadrupeds,' observes that the location of the *Arvicolæ* with the genus *Mus* involves an inconsistency which was early detected, and the correction of which has been universally recognised and followed. The characters of the teeth, he remarks, as well as the general form of the body, and the habits of all the species, remove them not only generically from the *Mures*, but even point out their association with a different family of the *Rodentia*; and their affinity to the beaver, he adds, appears to have forcibly struck Linnæus himself, who, in his 'Fauna Suecica,' applied the name *Castor* to the European Water-Vole, or Water-Rat. Mr. Bell then continues thus: "The generic term *Arvicola*, if not absolutely unobjectionable, must be retained, as having the sanction of priority over the name *Microtus* of Schrank, *Hypudæus* of Brant, or *Lemmus* of F. Cuvier. With regard to the name of the family, I have ventured to change that of Dr. Gray, *Arvicolidæ*, to *Castoridæ*, because the genus *Castor* must be considered as the type of the family, of which the present can only be an aberrant form." [BEAVER.]

Section 1. Water or Swimming Arvicoles or Voles.

A. amphibius, Desm.—*Castor caudâ lineari tereti* (Linn. 'Faun. Suec.'); *Mus amphibius* ('Syst. Nat.,' Mull., 'Zool. Dan. Prod.'); *M. aquaticus* (Briss.); *Lemmus aquaticus* (F. Cuv.); *Arvicola amphibia* (Jenyns); *A. aquatica* (Flem.); Rat d'Eau (Buffon); Water Rat (Pennant).

The head is thick, short, and blunt; eyes small, not very prominent; ears short, scarcely conspicuous beyond the fur; the cutting-teeth of a deep yellow colour in front, very strong, chisel-shaped, considerably resembling those of the beaver; the surface of the grinding-teeth formed of alternate triangles arranged on each side of the longitudinal axis; fore feet with four complete toes, the last phalanx only of the thumb being conspicuous beyond the skin; hinder feet with five toes, not webbed, though connected to a short distance from the base; tail more than half the length of the body, covered with hairs, of which those on the inferior surface are rather long, and probably assist the animal in swimming by forming a sort of rudder of the tail. Fur thick and shining; of a rich reddish-brown mixed with gray above, yellowish-gray beneath. Dimensions by Mr. Bell:—

	Inches.	Lines.
Length of the head and body . . .	8	4
Length of the head	1	10
Length of the ears	0	5
Length of the tail	4	8

This appears to be the Sorgo Morgange of the Italians; Wasser-Mause-Rat of the Germans; Water-Rot of the Dutch; Watn-Ratta of the Swedes; Vand-Rotte of the Danes; Llygoden y Dwfr of the Welsh; and Water-Vole and Water-Rat of the English.

Ray names it *Mus major aquaticus, seu Rattus aquaticus*, and he, as well as Linnæus, states that the Water-Rat is web-footed. This puzzled White of Selborne, who, in one of his letters to Pennant, writes, "Ray says, and Linnæus after him, that the water-rat is web-footed behind. Now I have discovered a rat on the banks of our little stream that is not web-footed, and yet is an excellent swimmer and diver: it answers exactly to the *Mus amphibius* of Linnæus (see 'Syst. Nat.'), which, he says, 'natat in fossis et urinatur.' I should be glad to procure one 'plantis palmatis.'" This letter is dated early in August, 1767, and Pennant in his 'Synopsis' (1771), says of the Water-Rat that it "swims and dives admirably, though it is not web-footed, as Mr. Ray supposed, and Linnæus copied after him."

The Water-Rat inhabits the banks of rivers, streams, ponds, and even ditches, in the banks of which it burrows and breeds. Its retreat is however sometimes at a great distance from the water. White (Selborne), says, "As a neighbour was lately plowing in a dry chalky field, far removed from any water, he turned out a water-rat, that was curiously laid up in an hybernaculum artificially formed of grass and leaves. At one end of the burrow lay above a gallon of potatoes regularly stowed, on which it was to have supported itself for the winter. But the difficulty with me is how this amphibious *Mus* came to fix its winter station at such a distance from the water. Was it determined in its choice of that place by the mere accident of finding the potatoes which were planted there? or is it the constant practice of the aquatic rat to forsake the neighbourhood of the water in the colder months?" We suspect that the potatoes had their charms for the store-keeper. The Water-Rat is indeed entirely, as we believe, a vegetable feeder, roots and subaqueous plants being its staple. It has been said to feed on worms, frogs, small fish, and the fry of fish generally, among other animal food; and has thence laboured under a very bad character as the enemy of the fish-pond and the trout-stream. The best writers are agreed that there is no foundation for this charge, and there can be little doubt, as Mr. Bell observes, that it has arisen from this phytiphagous animal being confounded by inaccurate observers with the common Brown Rat (*Mus decumanus*) which often haunts ditches and mill-tails, feeding freely on all sorts of animal substances, and taking the water boldly. The last-named rats have been seen towards nightfall crossing the canal in the Regent's Park in order to forage in the gardens of the Zoological Society.

The Water-Rat is a very cleanly animal, and generally has but one brood, consisting of five or six: these are ordinarily born in May or June, when the vegetation is well forward; but the young are sometimes produced as early as April, in which latter case there is a second litter towards the end of summer or beginning of autumn. The flesh is said to be eaten by the French peasants on maigre days.

This Rat is an inhabitant of most parts of Europe.

Mr. Bell, who gives a very good figure of the Common Water-Vole, or Water-Rat, remarks that a black variety of this species has long been known, and that it has been described by Pallas and other continental zoologists. Mr. Bell is of opinion that this is probably identical with the quadruped described by Mr. Macgillivray in the sixth volume of the 'Transactions of the Wernerian Society of Edinburgh,' under the name of *Arvicola ater*, as very common in the counties of Banff and Aberdeen. The Water-Vole, it is stated, does not occur where this *Arvicola ater* abounds. The habits of the latter agree with those of the Water-Vole. Mr. Macgillivray however thinks that there are sufficient differences in the organisation and colour of these two animals to warrant specific distinction. *Arvicola ater* is stated to be deep black above, and black with a tinge of gray beneath; in size somewhat smaller than the Common Water-Vole, but the difference of the proportions is scarcely appreciable. Mr. Bell observes that this author believes the number of caudal vertebræ to be different; and he adds that, if this were constantly the case, it would go far to establish their specific distinction; but an examination of a stuffed specimen belonging to Mr. Yarrell, does not, on a comparison with several of the common sort, appear to Mr. Bell to justify this supposition. "Mr. Jenyns," continues Mr. Bell, "states that the black variety is not uncommon in the fens of Cambridgeshire, and differs in no respect from the other but in colour; a testimony which must weigh very heavily against the opinion of its being specifically distinct, when we consider the great accuracy of that gentleman's observations."

Section II. Terrestrial Arvicoles.

A. agrestis (*Mus agrestis brachyurus*, Ray; *M. agrestis*, Linn.; *M. arvalis*, Pall., Gmel.; *Lemmus arvalis*, F. Cuv.; *A. vulgaris*, Desm.; *A. agrestis*, Flem., Jenyns, Yarrell; *A. arvalis*, Selys-Longchamps; Campagnol, Buff.); Short-Tailed Field-Mouse, Penn.; Meadow-Mouse, Shaw.

The head is large; muzzle very obtuse; ears just appearing above the fur; body thick and full; tail not more than one-third the length of the body, sparingly covered with hair; thumb of the fore feet rudimentary, without a claw. Upper parts reddish-brown, mixed with gray; of the under parts ash-colour; feet and tail dusky. Dimensions by Mr. Bell:—

	Inches.	Lines.
Length of head and body	4	1
Length of head	1	2
Length of tail	1	3½

This appears to be Le Petit Rat de Champs and Le Campagnol of the French; Campagnolo of the Italians; Skier Muus of the Danes; Llygoden Gwtta'r Maes of the Welsh; Field-Vole, Short-Tailed Field-Mouse, and Meadow-Mouse, of the English.

Small and insignificant as the animal is in appearance, there is scarcely a species among the Rodents more destructive to the fields, gardens, and woods, which have been rendered fruitful by the industrious hand of man, than the Short-Tailed Field-Mouse. In the cornfield, in the rick-yard, in the granary, in the extensive plantation, its depredations are often severe, and sometimes overwhelming. The following instance will show what damage these mice are capable of doing when they become multitudinous. Lord Glenbervie, in a letter to Sir Joseph Banks, dated June 30th, 1814, observes that the whole both of Dean Forest and New Forest appeared to be numerously stocked with mice; at least wherever the large furze-brakes in the open parts had been burnt their holes and runs covered the surface. Haywood Hill, a new plantation of about 500 acres in the forest of Dean, was particularly infested. This inclosure, after being properly fenced, was planted with acorns in 1810, and in the following spring about one-third came up; the rest of the seed having been probably destroyed by mice principally. The young shoots of the natural hollies of the tract, which had been cut down to favour the plantation, were not attacked by the mice in the winter of 1811, though their runs were numerous. In the autumn of 1812 a large quantity of five-year's-old oaks and chestnuts, with ash, larch, and fir, were planted in the inclosure. In the winter the destruction began, and numbers of the hollies, then two, three, or more feet high, were barked round from the ground to four or five inches upwards, and died. In the spring of 1813 a number of the oaks and chestnuts were found dead, and when they were pulled up it appeared that the roots had been gnawed through two or three inches below the surface of the ground; many were also barked round and killed like the holly-shoots; whilst others, which had been begun upon, were sickly. The evil now extended to the other inclosures; and becoming very serious both in Dean Forest and the New Forest, cats were turned out; the bushes, fern, rough grass, &c., were cleared away to expose the mice to beasts and birds of prey; poisons in great variety were laid; and seven or eight different sorts of traps were set for them, some of which made of tin succeeded very well. These were however superseded by the plan of a professed rat-catcher, who, having been employed to catch the mice, had observed on going to work in the morning that some of them had fallen into wells or pits, accidentally formed, and could not get out again, many of them dying from hunger or fatigue in endeavouring to climb up the sides. Such pits were therefore, on his recommendation, immediately tried: they were at first made 3 feet deep, 3 feet long, and 2 feet wide; but these were found to be unnecessarily large, and after various experiments it appeared that they answered best when from 18 to 20 inches deep at the bottom, about 2 feet in length, and one foot and a half in width, and at top only 18 inches long and 9 inches wide, or indeed as small as the earth could be got out of a hole of that depth; for the wider they are below and the narrower above the better they answer their purpose. They were made about 20 yards asunder, or about 12 on an acre; or, where the mice were less numerous, 30 yards apart. Nearly 30,000 mice had been caught principally by this last method, in Dean Forest, up to the 22nd of December; and Mr. Davies (the deputy-surveyor) was convinced that a far greater number had been taken out of the holes, either alive or dead, by stoats, weasels, kites, owls, &c., and even by crows, magpies, jays, &c.

The success of these holes in Dean Forest was so great, that the use of a bait in them was soon discontinued; but from an inaccuracy in the digging of them, or some other cause, they were far less efficacious in the New Forest, where the mice continued still, though less numerous, to infest the plantations. It was hoped that the severe weather would have either totally destroyed or greatly diminished the numbers of these animals, for they did not venture out during the hard frosts. In a letter from Mr. Davies, dated the 8th of March, 1814, he gives only 1216 as the number taken from the 7th of January to the 5th of March; and he says the whole of these had been caught in a few days of open weather which intervened about that time. The total number taken in Dean Forest to the 8th of March, 1814, did not much exceed 30,000; and in the New Forest only about 11,500 had heen taken up to the same period. In both forests two sorts of mice had heen observed—one the Short-Tailed, the other the Long-Tailed Field-Mouse; but the former was hy far the most numerous, particularly in Dean Forest, where it was in the proportion of upwards of fifty to one Long-Tailed.

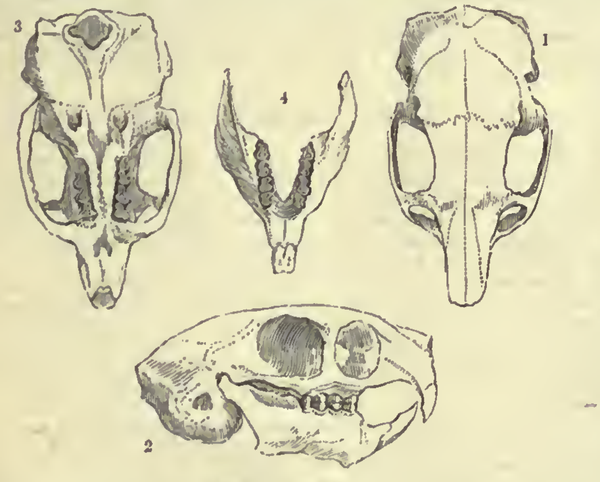
Buffon speaks of similar depredations to plantations by the species under consideration; but though he seems to have tried the same sort of trap which was used in the English forests above-mentioned, he does not appear to have resorted to the plan of making holes, which is stated to have been successfully employed hy the farmers in the neighbourhood of Liège; but though they make the holes round, and not more than four inches in diameter, and a foot deep, the success seems to be complete.

This destructive Arvicole is a burrower, though it not unfrequently takes up with the subterranean retreat of another animal, that of the mole, for instance. The wheat-rick and the harn are not unfrequently infested hy them, but their favourite situations are low and damp. Dry seasons are fatal to them. The nest is formed in some hank or meadow, generally of dried grass, and from five to seven young ones are produced at a birth. To this species, or to the Long-Tailed Field-Mouse, the latter most probably, White appears to allude in the letter containing anecdotes of the maternal affections of animals, when he speaks of a remarkable mixture of instinct and sagacity which occurred to him one day, when his people were pulling off the lining of a hot-bed, in order to add some fresh dung:—"From out of the side of this bed leaped an animal with great agility that made a most grotesque figure; nor was it without great difficulty that it could be taken, when it proved to be a large white-bellied Field-Mouse, with three or four young clinging to her teats hy their mouths and feet. It was amazing that the desultory and rapid motions of this dam should not oblige her litter to quit their hold, especially when it appeared that they were so young as to be both naked and blind."

This mouse is a native of Europe.

Mr. Bell is of opinion that the *Arvicola riparia* of Yarrell ('Zool. Proc.,' 1832) is no other than the *A. pratensis* of Baillon and the *A. rufescens* of Selys-Longchamps. For the other species of Arvicole see the list at the end of this article.

Octodon.—Mr. Bennett observes that "In the structure of its molar teeth, *Octodon* may be regarded as occupying an intermediate station between *Poephagomys* and *Ctenomys.* In *Octodon* the molars of the upper jaw differ remarkably in form from those of the lower. The upper molars have on their inner side a slight fold of enamel, indicating a groove tending in some measure to separate on this aspect the mass of the tooth into two cylinders: on their outer side a similar fold penetrates more deeply, and behind it the crown of the tooth does not project outwardly to so great an extent as it does in front. If each molar tooth of the upper jaw be regarded as composed of two partially united cylinders, slightly compressed from before hackwards, and somewhat oblique in their direction, the anterior of these cylinders might be described as entire, and the posterior as heing truncated hy the removal of its outer half. Of such teeth there are, in the upper jaw of *Octodon*, on each side, four; the hindermost heing the smallest, and that in which the peculiar form is least strongly marked. In *Ctenomys*, all the molar teeth, hoth of the upper and the lower jaw, correspond with the structure that exists in the upper jaw of *Octodon*, excepting that their crowns are more slender and more obliquely placed, whence the external emargination hecomes less sharply defined; and also excepting that the hinder molar in each jaw is so small as to be almost evanescent: as is generally the case, however, the relative position of the teeth is counterchanged, and the deficiency in the outline of the crown of tho tooth, which in the upper jaw is external, is, in the lower jaw, internal. In the lower jaw of *Octodon* the crowns of the molars assume a figure very different from those of the upper, dependent chiefly on the prolongation of the hinder portion of the tooth to the same lateral extent as its anterior part: each of them consists of two cylinders, not disjoined in the middle where the houy portion of the crown is continuous, hut partially separated hy a fold of euamel on either side producing a corresponding notch; placed obliquely with respect to the jaw they resemble, in some measure, a figure of 8 with its elements flattened obliquely, pressed towards each other, and not connected by the transverse middle bars. With the lowers molars of *Octodon* those of *Poephagomys*, as figured hy F. Cuvier, correspond in structure in both jaws. *Octodon* thus exhibits, in its dissimilar molars, the types of two genera: the molars of its upper jaw represent those of both jaws of *Ctenomys*; those of its lower jaw correspond with the molars of both jaws of *Poephagomys.*"



Skull of *Octodon*.

1, seen from above; 2, profile; 3, seen from below; 4, lower jaw seen from above.

O. Cumingii, Benn. (*Dendrobius degus*, Meyeu). In size and shape generally resembling the Water-Rat, with which Mr. Bennett thinks that it is nearly connected systematically. All the feet with five toes, but the innermost hoth before and behind very short, and separated by a wide interval from the rest. Upper surface and sides brownish gray, intermixed with frequent indistiuct and undefined spots and patches of dusky-hlack; colour slightly darker towards the rump, and upper surface of the entire tail, together with its under surface for one-third of its length from the tip, approaching closely to hlack; under surface of the hody dusky-gray, mingled with a shade of brown, lighter and nearly white heneath the base of the tail, aud deeper on the hreast and the neck, where it becomes almost of the same general hue as the upper surface.

Octodon Cumingii. Bennett.

Mr. Cuming thus describes the habits of *O. Cumingii* in its natural state:—"These animals hurrow in the ground, but always under brushwood fences or in low thickets. They are so ahundant in the neighbourhood of Valparaiso that in the high-road between that place and St. Jago more than a hundred may frequently he seen at one time in search of food. Sometimes, but not often, they are ohserved on the lower branches of the shruhs, and on those which form the fences. They fly at the least alarm, and iu running carry their tufted tails like a bent how. A species of horned owl feeds principally on these pretty little creatures." Mr. Benuett adds, that two living specimens hrought by Mr. Cuming from Chili, were placed hy him, in 1831, in the Society's Menagerie: one of them escaped, hut the other was alive when Mr. Bennett wrote (December, 1835), and was as active and lively as it was on its first arrival. They were rather shy, and had hut little playfulness. They leaped readily aud without any appearance of exertion from the floor of their cage to a narrow perch placed at the height of nearly a foot, and there remained seated at their ease. Their food was vegetable.

It is found in Chili, near Valparaiso, where Captain King informed Mr. Bennett that he had seen thousands of them. ('Zool. Proc.,' aud 'Zool. Trans.')

The genus *Octodon* is referred to the family *Hystricidæ* by Mr. Waterhouse. [HYSTRICIDÆ.]

Ctenomys.—Mr. Waterhouse refers this genus to the tribe *Octodontina* in his family *Hystricidæ*. [HYSTRICIDÆ.]

C. Magellanicus may he taken as an example. In general form it seems nearly to resemhle *Octodon Cumingii.* Toes 5, the innermost, hoth before and behind, much shorter than the others. Tail sparingly haired, but comparatively shorter than in *O. Cumingii*, and destitute of any marked tuft of longer hairs at its extremity. Upper surface and sides brownish-gray tinged with yellow, and hardly varied by thumb being conspicuous beyond the skin; hinder feet with five toes, not webbed, though connected to a short distance from the base; tail more than half the length of the body, covered with hairs, of which those on the inferior surface are rather long, and probably assist the animal in swimming by forming a sort of rudder of the tail. Fur thick and shining; of a rich reddish-brown mixed with gray above, yellowish-gray beneath. Dimensions by Mr. Bell:—

	Inches.	Lines.
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This appears to be the Sorgo Morgange of the Italians; Wasser-Mause-Rat of the Germans; Water-Rot of the Dutch; Watn-Ratta of the Swedes; Vand-Rotte of the Danes; Llygoden y Dwfr of the Welsh; and Water-Vole and Water-Rat of the English.

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The Water-Rat is a very cleanly animal, and generally has but one brood, consisting of five or six: these are ordinarily born in May or June, when the vegetation is well forward; but the young are sometimes produced as early as April, in which latter case there is a second litter towards the end of summer or beginning of autumn. The flesh is said to be eaten by the French peasants on maigre days.

This Rat is an inhabitant of most parts of Europe.

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Length of tail	1	3½

This appears to be Le Petit Rat de Champs and Le Campagnol of the French; Campagnolo of the Italians; Skier Muus of the Danes; Llygoden Gwtta'r Maes of the Welsh; Field-Vole, Short-Tailed Field-Mouse, and Meadow-Mouse, of the English.

Small and insignificant as the animal is in appearance, there is scarcely a species among the Rodents more destructive to the fields, gardens, and woods, which have been rendered fruitful by the industrious hand of man, than the Short-Tailed Field-Mouse. In the cornfield, in the rick-yard, in the granary, in the extensive plantation, its depredations are often severe, and sometimes overwhelming. The following instance will show what damage these mice are capable of doing when they become multitudinous. Lord Glenbervie, in a letter to Sir Joseph Banks, dated June 30th, 1814, observes that the whole both of Dean Forest and New Forest appeared to be numerously stocked with mice; at least wherever the large furze-brakes in the open parts had been burnt their holes and runs covered the surface. Haywood Hill, a new plantation of about 500 acres in the forest of Dean, was particularly infested. This inclosure, after being properly fenced, was planted with acorns in 1810, and in the following spring about one-third came up; the rest of the seed having been probably destroyed by mice principally. The young shoots of the natural hollies of the tract, which had been cut down to favour the plantation, were not attacked by the mice in the winter of 1811, though their runs were numerous. In the autumn of 1812 a large quantity of five-year's-old oaks and chestnuts, with ash, larch, and fir, were planted in the inclosure. In the winter the destruction began, and numbers of the hollies, then two, three, or more feet high, were barked round from the ground to four or five inches upwards, and died. In the spring of 1813 a number of the oaks and chestnuts were found dead, and when they were pulled up it appeared that the roots had been gnawed through two or three inches below the surface of the ground; many were also barked round and killed like the holly-shoots; whilst others, which had been begun upon, were sickly. The evil now extended to the other inclosures; and becoming very serious both in Dean Forest and the New Forest, cats were turned out; the bushes, fern, rough grass, &c., were cleared away to expose the mice to beasts and birds of prey; poisons in great variety were laid; and seven or eight different sorts of traps were set for them, some of which made of tin succeeded very well. These were however superseded by the plan of a professed rat-catcher, who, having been employed to catch the mice, had observed on going to work in the morning that some of them had fallen into wells or pits, accidentally formed, and could not get out again, many of them dying from hunger or fatigue in endeavouring to climb up the sides. Such pits were therefore, on his recommendation, immediately tried: they were at first made 3 feet deep, 3 feet long, and 2 feet wide; but these were found to be unnecessarily large, and after various experiments it appeared that they answered best when from 18 to 20 inches deep at the bottom, about 2 feet in length, and one foot and a half in width, and at top only 18 inches long and 9 inches wide, or indeed as small as the earth could be got out of a hole of that depth; for the wider they are below and the narrower above the better they answer their purpose. They were made about 20 yards asunder, or about 12 on an acre; or, where the mice were less numerous, 30 yards apart. Nearly 30,000 mice had been caught principally by this last method, in Dean Forest, up to the 22nd of December; and Mr. Davies (the deputy-surveyor) was convinced that a far greater number had been taken out of the holes, either alive or dead, by stoats, weasels, kites, owls, &c., and even by crows, magpies, jays, &c.

The success of these holes in Dean Forest was so great, that the use of a bait in them was soon discontinued; but from an inaccuracy in the digging of them, or some other cause, they were far less efficacious in the New Forest, where the mice continued still, though less numerous, to infest the plantations. It was hoped that the severe weather would have either totally destroyed or greatly diminished the numbers of these animals, for they did not venture out during the hard frosts. In a letter from Mr. Davies, dated the 8th of March, 1814, he gives only 1216 as the number taken from the 7th of January to the 5th of March; and he says the whole of these had been caught in a few days of open weather which intervened about that time. The total number taken in Dean Forest to the 8th of March, 1814, did not much exceed 30,000; and in the New Forest only about 11,500 had been taken up to the same period. In both forests two sorts of mice had been observed—one the Short-Tailed, the other the Long-Tailed Field-Mouse; but the former was by far the most numerous, particularly in Dean Forest, where it was in the proportion of upwards of fifty to one Long-Tailed.

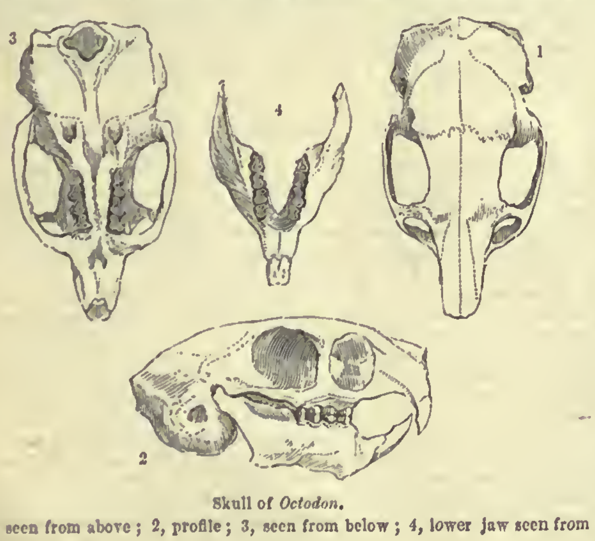
Buffon speaks of similar depredations to plantations by the species under consideration; but though he seems to have tried the same sort of trap which was used in the English forests above-mentioned, he does not appear to have resorted to the plan of making holes, which is stated to have been successfully employed by the farmers in the neighbourhood of Liège; but though they make the holes round, and not more than four inches in diameter, and a foot deep, the success seems to be complete.

This destructive Arvicole is a burrower, though it not unfrequently takes up with the subterranean retreat of another animal, that of the mole, for instance. The wheat-rick and the barn are not unfrequently infested by them, but their favourite situations are low and damp. Dry seasons are fatal to them. The nest is formed in some bank or meadow, generally of dried grass, and from five to seven young ones are produced at a birth. To this species, or to the Long-Tailed Field-Mouse, the latter most probably, White appears to allude in the letter containing anecdotes of the maternal affections of animals, when he speaks of a remarkable mixture of instinct and sagacity which occurred to him one day, when his people were pulling off the lining of a hot-bed, in order to add some fresh dung:—"From out of the side of this bed leaped an animal with great agility that made a most grotesque figure; nor was it without great difficulty that it could be taken, when it proved to be a large white-bellied Field-Mouse, with three or four young clinging to her teats by their mouths and feet. It was amazing that the desultory and rapid motions of this dam should not oblige her litter to quit their hold, especially when it appeared that they were so young as to be both naked and blind."

This mouse is a native of Europe.

Mr. Bell is of opinion that the *Arvicola riparia* of Yarrell ('Zool. Proc.,' 1832) is no other than the *A. pratensis* of Baillon and the *A. rufescens* of Selys-Longchamps. For the other species of Arvicole see the list at the end of this article.

Octodon.—Mr. Bennett observes that "In the structure of its molar teeth, *Octodon* may be regarded as occupying an intermediate station between *Poephagomys* and *Ctenomys.* In *Octodon* the molars of the upper jaw differ remarkably in form from those of the lower. The upper molars have on their inner side a slight fold of enamel, indicating a groove tending in some measure to separate on this aspect the mass of the tooth into two cylinders: on their outer side a similar fold penetrates more deeply, and behind it the crown of the tooth does not project outwardly to so great an extent as it does in front. If each molar tooth of the upper jaw be regarded as composed of two partially united cylinders, slightly compressed from before backwards, and somewhat oblique in their direction, the anterior of these cylinders might be described as entire, and the posterior as being truncated by the removal of its outer half. Of such teeth there are, in the upper jaw of *Octodon*, on each side, four; the hindermost being the smallest, and that in which the peculiar form is least strongly marked. In *Ctenomys*, all the molar teeth, both of the upper and the lower jaw, correspond with the structure that exists in the upper jaw of *Octodon*, excepting that their crowns are more slender and more obliquely placed, whence the external emargination becomes less sharply defined; and also excepting that the hinder molar in each jaw is so small as to be almost evanescent: as is generally the case, however, the relative position of the teeth is counterchanged, and the deficiency in the outline of the crown of the tooth, which in the upper jaw is external,



Skull of *Octodon*.

1, seen from above; 2, profile; 3, seen from below; 4, lower jaw seen from above.

is, in the lower jaw, internal. In the lower jaw of *Octodon* the crowns of the molars assume a figure very different from those of the upper, dependent chiefly on the prolongation of the hinder portion of the tooth to the same lateral extent as its anterior part: each of them consists of two cylinders, not disjoined in the middle where the bony portion of the crown is continuous, but partially separated by a fold of enamel on either side producing a corresponding notch; placed obliquely with respect to the jaw they resemble, in some measure, a figure of 8 with its elements flattened obliquely, pressed towards each other, and not connected by the transverse middle bars. With the lowers molars of *Octodon* those of *Poephagomys*, as figured by F. Cuvier, correspond in structure in both jaws. *Octodon* thus exhibits, in its dissimilar molars, the types of two genera: the molars of its upper jaw represent those of both jaws of *Ctenomys;* those of its lower jaw correspond with the molars of both jaws of *Poephagomys*."

O. Cumingii, Benn. (*Dendrobius degus*, Meyen). In size and shape generally resembling the Water-Rat, with which Mr. Bennett thinks that it is nearly connected systematically. All the feet with five toes, but the innermost both before and behind very short, and separated by a wide interval from the rest. Upper surface and sides brownish gray, intermixed with frequent indistinct and undefined spots and patches of dusky-black; colour slightly darker towards the rump, and upper surface of the entire tail, together with its under surface for one-third of its length from the tip, approaching closely to black; under surface of the body dusky-gray, mingled with a shade of brown, lighter and nearly white beneath the base of the tail, and deeper on the breast and the neck, where it becomes almost of the same general hue as the upper surface.

Octodon Cumingii. Bennett.

Mr. Cuming thus describes the habits of *O. Cumingii* in its natural state:—"These animals burrow in the ground, but always under brushwood fences or in low thickets. They are so abundant in the neighbourhood of Valparaiso that in the high-road between that place and St. Jago more than a hundred may frequently be seen at one time in search of food. Sometimes, but not often, they are observed on the lower branches of the shrubs, and on those which form the fences. They fly at the least alarm, and in running carry their tufted tails like a bent bow. A species of horned owl feeds principally on these pretty little creatures." Mr. Bennett adds, that two living specimens brought by Mr. Cuming from Chili, were placed by him, in 1831, in the Society's Menagerie: one of them escaped, but the other was alive when Mr. Bennett wrote (December, 1835), and was as active and lively as it was on its first arrival. They were rather shy, and had but little playfulness. They leaped readily and without any appearance of exertion from the floor of their cage to a narrow perch placed at the height of nearly a foot, and there remained seated at their ease. Their food was vegetable.

It is found in Chili, near Valparaiso, where Captain King informed Mr. Bennett that he had seen thousands of them. ('Zool. Proc.,' and 'Zool. Trans.')

The genus *Octodon* is referred to the family *Hystricidæ* by Mr. Waterhouse. [HYSTRICIDÆ.]

Ctenomys.—Mr. Waterhouse refers this genus to the tribe *Octodontina* in his family *Hystricidæ*. [HYSTRICIDÆ.]

C. Magellanicus may be taken as an example. In general form it seems nearly to resemble *Octodon Cumingii.* Toes 5, the innermost, both before and behind, much shorter than the others. Tail sparingly haired, but comparatively shorter than in *O. Cumingii*, and destitute of any marked tuft of longer hairs at its extremity. Upper surface and sides brownish-gray tinged with yellow, and hardly varied by blackish—in short the same as that of *Octodon*, but of a lighter tint; colour of the belly lighter than the upper surface; chin and throat pale-fawn; short hairs of feet and tail almost white. Length of head and body, 7·5 inches; of the tail, 2·75 inches.

Skull of *Ctenomys.*

1, seen from above; 2, profile; 3, seen from below; 4, lower jaw seen from above.

Captain King's memoranda on the subject of this animal are:—"From the size of the jaw, as compared with the abundant remains of this little animal which are scattered over the surface of the ground, I think that the present specimen is rather a young one. On examining the teeth I find that it cannot be referred to any of the genera of M. F. Cuvier's arrangement in his 'Dents des Mammifères': that to which it approaches most nearly is *Helamys;* but it is sufficiently distinct to constitute a new genus. The red colour of the incisive teeth is very remarkable in all the specimens which I have seen. The little animal is very timid, feeds upon grass, and is eaten by the Patagonian Indians. It dwells in holes which it burrows in the ground; and, from the number of the holes, it would appear to be very abundant." Mr. Darwin ('Journal and Remarks') gives a circumstantial account of this curious animal, which he well describes as a rodent with the habits of a mole. "The Tucutuco," says that author, "is extremely abundant in some parts of the country, but is difficult to be procured, and still more difficult to be seen when at liberty. It lives almost entirely under ground, and prefers a sandy soil with a gentle inclination. The burrows are said not to be deep, but of great length. They are seldom open, the earth being thrown up at the mouth into hillocks, not quite so large as those made by the mole. Considerable tracts of country are so completely undermined by these animals that horses, in passing over, sink above their fetlocks. The Tucutucos appear, to a certain degree, to be gregarious. The man who procured specimens for me had caught six together, and he said this was a common occurrence. They are nocturnal in their habits; and their principal food is afforded by the roots of plants, which is the object of their extensive and superficial burrows. Azara says they are so difficult to be obtained that he never saw more than one. He states that they lay up magazines of food within their burrows. This animal is universally known by a very peculiar noise which it makes when beneath the ground. A person, the first time he hears it, is much surprised; for it is not easy to tell whence it comes, nor is it possible to guess what kind of creature utters it. The noise consists in a short but not rough nasal grunt, which is repeated about four times in quick succession; the first grunt is not so loud, but a little longer, and more distinct than the three following: the musical time of the whole is constant, as often as it is uttered. The name Tucutuco is given in imitation of the sound. In all times of the day, where this animal is abundant, the noise may be heard, and sometimes directly beneath one's feet. When kept in a room the Tucutucos move both slowly and clumsily, which appears owing to the outward action of their hind legs; and they are likewise quite incapable of jumping even the smallest vertical height. Mr. Reid, who dissected a specimen which I brought home in spirits, informs me that the socket of the thigh bone is not attached by a ligamentum teres; and this explains in a satisfactory manner, the awkward movements of their hinder extremities. When eating they rest on their hind legs and hold the piece in their fore paws; they appeared also to wish to drag it into some corner. They are very stupid in making any attempt to escape; when angry or frightened they uttered the tucutuco. Of those I kept alive several, even the first day, became quite tame, not attempting to bite or to run away; others were a little wilder. The man who caught them asserted that very many are invariably found blind. A specimen which I preserved in spirits was in this state; Mr. Reid considers it to be the effect of inflammation in the nictitating membrane. When the animal was alive I placed my finger within half an inch of its head, and not the slightest notice was taken: it made its way however about the room nearly as well as the others."

Tucutuco (*Ctenomys Magellanicus*). Bennett.

This creature is found at the east entrance of the Strait of Magalhaens, at Cape Gregory, and the vicinity. (King.) Mr. Darwin says that the wide plains north of the Rio Colorado are undermined by these animals; and that near the Strait of Magalhaens, where Patagonia blends with Tierra del Fuego, the whole sandy country forms a great warren for them.

Mr. Darwin further states that at the Rio Negro, in northern Patagonia, there is an animal of the same habits, and probably a closely allied species, but which he never saw. Its noise was different from that of the Maldonado kind, and was repeated only twice instead of three or four times, and was more distinct and sonorous; when heard from a distance it so closely resembled the sound made in cutting down a small tree with an axe, that Mr. Darwin sometimes remained in doubt concerning it.

The *Sigmodon* of Say and Ord occupies, in their opinion, a station between the genera *Arvicola* and *Mus*, having the habits and some of the external characters of the former, with teeth remotely allied to the latter. The genus *Neotoma* of the same zoologists, must, in their opinion, be also placed near *Arvicola.* (See 'Journal of Nat. Acad. Sc. Phil.,' vol., iv.; and 'Zool. Journ.,' vol. ii.)

Hypudæus (Ill.).—Closely allied to the *Arvicola*, from which they differ but little except in the number of the anterior toes, and in the shortness of the tail, are the true Lemmings. They have the following generic character:—Molars composite, with an even crown presenting enamelled angular laminæ; ears very short; anterior feet generally pentadactyle and formed for digging; tail very short and thickly haired.

$$\text{Dental Formula:—Incisors, } \frac{2}{2}; \text{ Molars, } \frac{3-3}{3-3} = 16.$$

H. Norvegicus, the Lemming. It is the Lemmar, or Lemmus, of Olaus Magnus; the Leem, or Lemmer, of Gesner; *Mus Norvegicus vulgò Leming* of Wormius; *Mus Lemmus* of Linnæus; Fial-Mus and Sabell-Mus of the Laplanders; Lummick of the Swedes; Le Leming of Buffon; Lemming of the British; *Lemmus Norvegicus* of Desmarest; and *Mus Lemmus* of Pallas and Linnæus.

Head not quite so blunt as in the *Arvicolæ;* whiskers long; eyes small but black and piercing; mouth small; ears small. Fore legs short, pentadactyle, but the thumb hardly perceptible though the claw is very sharp; hind legs pentadactyle. Skin thin. Head and body black and tawny, irregularly disposed; belly white with a yellowish tinge. Length from nose to tail 5 inches or thereabout, the tail half an inch.

The ordinary food of the Lemming consists of grass, the rein-deer lichen, and the catkins, &c., of the dwarf birch; but at intervals of time, generally once or twice in a quarter of a century, a great army of them appears: pouring onwards in vast hosts, they devour every green thing in their path of desolation. Great bands descending from the Kolen, traverse Nordland and Finmark, ending their journey and their lives in the Western Ocean, which they enter and there perish. Others, taking a direction through Swedish Lapland, are drowned in the Gulf of Bothnia. Their march is stated to be in parallel lines about 3 feet apart, without stop or stay, unless the obstacle is insurmountable: rivers and lakes they cross without deviation, and they are said to gnaw through corn and haystacks. ('Phil. Trans.,' ii.) Pennant, who states that they appear in numberless troops in Norway and Lapland, where they are the pest and wonder of the country, thus graphically describes one of these irruptions. "They march like the army of locusts so emphatically described by the prophet Joel; destroy every root of grass before them, and spread universal desolation: they infect the very ground, and cattle are said to perish which taste of the grass which they have touched; they march by myriads in regular lines; nothing stops their progress, neither fire, torrents, lake, nor morass. They bend their course straight forward, with most amazing obstinacy; they swim over the lakes; the greatest rock gives them but a slight check, they go round it, and then resume their march directly on, without the least division: if they meet a peasant, they persist in their course, and jump as high as his knees in defence of their progress; are so fierce as to lay hold of a stick, and suffer themselves to be swung about before they quit their hold: if struck, they turn about and bite, and will make a noise like a dog."

The *Carnivora* are close attendants upon these wandering multitudes, which Olaus and others believed to have been generated in the clouds and to have fallen from thence in storm and tempest. They are, says Pennant, "the prey of foxes, lynxes, and ermines, who follow them in great numbers: at length they perish, either through want of food or by destroying one another, or in some great water, or in the sea. They are the dread of the country: in former times spiritual weapons were exerted against them; the priest exorcised and had a long form of prayer to arrest the evil: happily it does not occur frequently; once or twice in 20 years: it seems like a vast colony of emigrants from a nation overstocked; a discharge of animals from the great northern hive, that once poured out its myriads of human creatures upon Southern Europe. Where the head-quarters of these quadrupeds are is not very certainly known; Linnæus says the Norwegian and Lapland Alps; Pontopiddan seems to think that Kolens Rock, which divides Nordland from Sweden, is their native place; but wherever they come from, none return: their course is predestinated, and they pursue their fate."

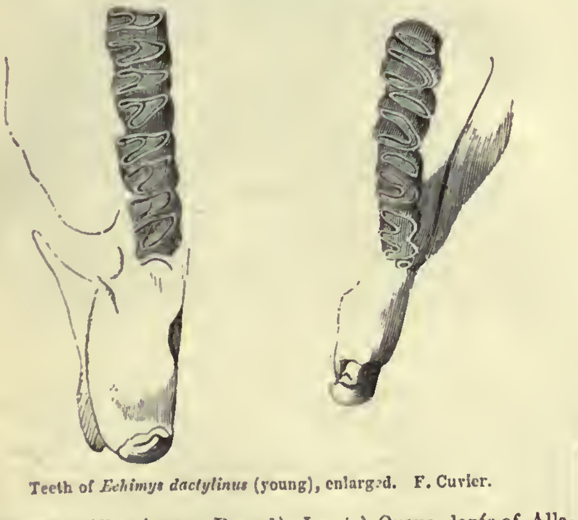
When seeking the reindeer lichen in the winter, the Lemmings get under the snow, making lodgments, and opening spiracles to the surface to secure air. The Arctic Fox pursues them in these retreats. It does not appear that they lay up any magazines of food, and to this improvidence perhaps, as Pennant observes, may be traced the great migrations that they are compelled to make in certain years; hunger urging them to quit their usual residences.

They breed often in the course of a year, producing five or six young at a birth, and they bring forth sometimes on their migrations. They are said to carry some of their young in their mouths and some on their backs.

The Laplanders, who compare their flesh to that of squirrels, eat them.

Echimys (Geoff.; *Loncheres*, Ill. part).—Four unguiculate toes and a vestige of a fifth on the anterior feet. Tail very long, scaly, and nearly naked. Hairs, especially those on the upper parts, flat and aciculated. Molars with transverse laminæ, united to each other by twos at one end, or isolated.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$.



Teeth of *Echimys dactylinus* (young), enlarged. F. Cuvier.

E. chrysurus (*E. cristatus*, Desm.?), Lerot à Queue dorée of Allamand; the Gilt-Tail Dormouse of Pennant.

The ears are short and broad, whiskers strongly developed, a gold-coloured line extending longitudinally from the nose to the space between the ears; head, body, and upper part of tail, marone or shining purplish chestnut, ruddy marginate bristles being scattered between the hairs, which give the splendour to the animal; lower part of tail, which is thick at the base and longer than the body, golden. Length from nose to tail 5 inches. This species is said to climb trees, and live principally on fruits.

It is a native of Surinam.

Cercomys (F. Cuvier).—In shape resembling the Black Rat, but with the chanfrein more arched and the ears larger. Anterior limbs considerably shorter than the posterior, which are terminated with five toes, the three middle ones longest; the anterior with four toes only, and the rudiment of a thumb with a small flat nail; all the other toes with compressed nails curved and pointed, and seeming more proper for climbing than burrowing. Tail very long, and like that of the Brown Rat. Fur composed of long straight firm hairs of a uniform texture, and of hairs which are finer, softer, and much thicker; no bristle as in *Echimys*. Molars with distinct roots of equal size, and their slightly elevated crown nearly circular, presenting at the surface a notch and three ellipses surrounded with enamel, as is the tooth itself. The notch is on the internal side in the upper molars, and on the external side in the lower molars. Great sub-orbital hole considerably extensive.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$.

C. cunicularius. It is deep brown above, paler on the sides and the sides of the cheeks; jaws and neck beneath, as well as the under parts generally, whitish. Eyes and ears large.

It is a native of Brazil.

Cercomys cunicularius.

The genera *Echimys* and *Cercomys* are included in the tribe *Echymyina* of Mr. Waterhouse's family *Hystricidæ*. [HYSTRICIDÆ.]

Myoxus (Schreber; Gmelin).—Four toes and the vestige of a fifth on the anterior feet; five toes behind. Fur very soft and fine. Tail

Teeth of *Myoxus*, enlarged. F. Cuvier.

very long, sometimes well clothed with hair and round, sometimes depressed, and sometimes tufted at the extremity only. Molars with transverse ridges of enamel projecting and hollowed.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$.

M. avellanarius, the Dormouse.—The head is proportionally large; eyes large, black, and prominent; muzzle not blunt; ears broad, about one-third the length of the head; body plump and round; tail flattened, the hairs rather long and bushy; head, back, sides, belly, and tail, tawny-red; length that of a common mouse.

Young of a mouse-gray, head and flanks only tinged with red.

This is the Muscardin, Croque-Noix, and Rat-d'Or of the French; Moscardino of the Italians; Liron of the Spanish; Rothe Wald-Maus Hasel-Maus, and Hasel-Schläfer, of the Germans; Skogsmus of the Swedes; Kassel-Muus of the Danes; Pathew of the Welsh; and Sleeper of the English.

There is little if any doubt that this species is the *Glis* of the Roman authors. Thus Pliny, in his chapter, 'De Faginâ Glande,' &c. (xvi. 6), says, "Fagi glans muribus gratissima est . . . glires quoque saginat;" and Martial (xiii. 59, 'Glires') writes—

"Tota mihi dormitur hyems, et pinguier illo
Tempore sum, quo me nil nisi somnus alit."

Nor does the occasional short awakening caused by a warm sunny day, to which the animal is subject, militate against the application of Martial's lines; for the occasional disturbance is the exception to the rule.

Mr. Bell places the Dormouse among the *Sciuridæ* (Squirrels); and indeed zoologists have assigned it to both the genus *Sciurus* and *Mus*. In its habits it comes near to the Squirrel, but in its dentition it is nearer to the Mice. It is in truth one of those forms by which nature glides from one race of animals to another. Mr. Bell gives the following synonyms:—*Mus avellanarius minor* (Ray), *M. avellanarius* (Linn.), *Sciurus avellanarius* (Desm.), *Myoxus Muscordinus* (Schreb.), *Myoxus avellanarius* (Desm.), Le Muscardin (Buff.), Dormouse (Penn.) He considers the specific name *avellanarius* is not well chosen, inasmuch as the hazel-nut is not the principal food of the Dormouse; "indeed," he continues, "I have never seen any that could gnaw through the shell of that nut when fully ripe and dry."

Dormouse (*Myoxus avellanarius*).

Dense thickets, bushy dells, and tangled hedgerows are the favourite retreats of the Dormouse. There it constructs its easy dormitory, and there providently lays up its winter store, consisting of acorns, beech-mast, corn, young hazel-nuts, haws, &c. It seems inclined to be gregarious; and indeed Mr. Yarrell told Mr. Bell that he had seen not less than ten or a dozen, or even more, of their nests built in the shrubs of a thicket. The latter zoologist well describes its habits.

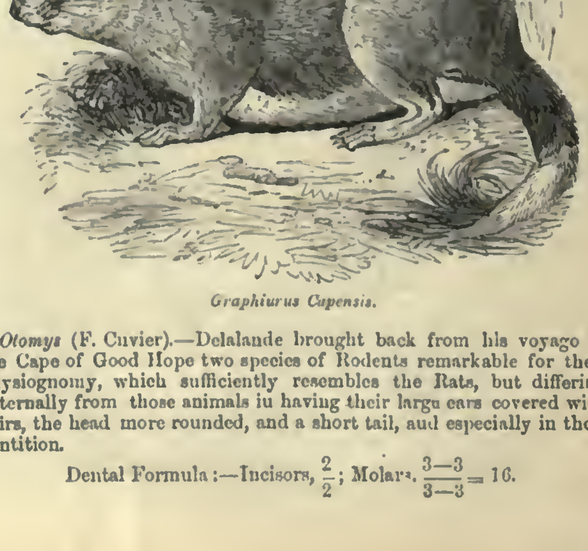
"It takes its food holding it in its hands, and sitting on its haunches like a squirrel (so do the rats), and often suspending itself by its hind-feet, in which position it feeds as easily and comfortably as in the more ordinary position. Towards the winter it becomes exceedingly fat; and having laid up a store of food, retires to its little nest, and coiling itself up into a ball, with the tail over the head and back, becomes completely torpid. A mild day calls it into transient life; it then takes a fresh supply of food and relapses into its former slumber; and finally awakening in the spring, at which time it has lost much of its fat, it enters upon its usual habits, and the enjoyment of the conjugal and paternal affections. The young, which are generally about four in number, are born blind; but in a few days the eyes are opened, and in a short time they are enabled to seek their food independently of the parent's care. I have reason to believe that, in some cases at least, the Dormouse has a second brood early in the autumn, as I have received from one locality in the month of September an adult, one about half-grown, evidently of the spring brood, and three very young ones apparently not more than a fortnight or three weeks old." ('British Quadrupeds.')

This pretty little animal is nocturnal in its habits. In 'The Naturalist' (vol. iii.) will be found a well related instance of its behaviour on being aroused from its nap during the winter. One of them having been taken in its nest in the middle of December, the heat of its captor's hand and the warmth of the room completely revived it, and it nimbly scaled the furniture, finding no difficulty in ascending and descending the polished backs of the chairs, and leaping from chair to chair with great agility. On being set at liberty it sprang at least two yards to a table. It did not seem alarmed at being taken into the hand. In the evening it was placed with its nest in a box, and the next morning had relapsed into torpidity. Another account in the same volume informs us that a Dormouse, which had been sent a distance of 140 miles, was apparently but little disturbed by its ride. "From that time till the 1st of April, 1838," says Mr. Piggott, "it slept in its snug dormitory, a deal box lined with wool, when it awoke, and readily ate of apples and nuts. It is easily alarmed, being more timid than tame, but shows no signs of anger on being taken in the hand. As it sleeps the greater part of the day, I cannot then closely watch its habits; but towards evening it wakes up, and is very lively and frolicsome, running, on being let out of its cage, up the bell-rope, where it will sit for hours in the folds of the knot, timidly watching our movements."

It is found all over Europe.

Graphiurus (F. Cuvier).—Limbs short, delicate, and not differing much from each other in length; anterior feet terminated by four nearly equal toes, and with a flat nail on the internal tubercle of the palm, which indicates the thumb; posterior feet with five toes, the two external, but the thumb principally, the shortest; all the toes armed with pointed, compressed, arched, and strong claws. Tail short, very fleshy, and seemingly thicker at its extremity than at its root. Molars eight in each jaw, remarkable for the comparative smallness of their size; the first in each jaw only a linear rudiment; the three following are a little smaller in the lower jaw than they are in the upper, equal in size to each other, with the surface of the crown united, and in this respect resembling those of the Aye-Aye; no figure was traceable, but this may have been from detrition.

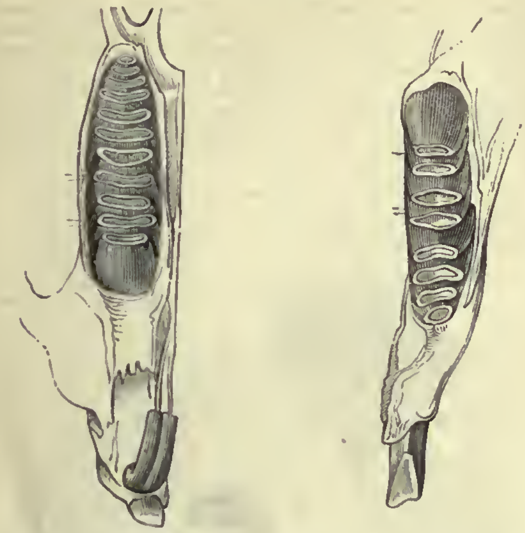
G. Capensis. The eyes are not so large as in *Myoxus*, with which the animal has much relationship; ears round; fur thick; upper parts of the head, neck, shoulders, back, sides, rump, and upper part of the limbs, deep brownish-gray; tip of the muzzle, sides, and lower part of the head and limbs reddish-white; a large band of blackish-brown from the eyes to below the ears; lower parts of the body grayish-white with a reddish tinge; tail brown-gray, and whitish above, with its extremity entirely reddish-white; there is a tuft of white hairs at the upper and anterior part of the base of the ear. Size of the Lerot, Buffon, *Mus quercinus*, Linnæus. This species is a native of the Cape of Good Hope. Its habits are unknown.



Graphiurus Capensis.

Otomys (F. Cuvier).—Delalande brought back from his voyage to the Cape of Good Hope two species of Rodents remarkable for their physiognomy, which sufficiently resembles the Rats, but differing externally from those animals in having their large ears covered with hairs, the head more rounded, and a short tail, and especially in their dentition.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{3-3}{3-3} = 16$.



Teeth of *Otomys*. F. Cuvier.

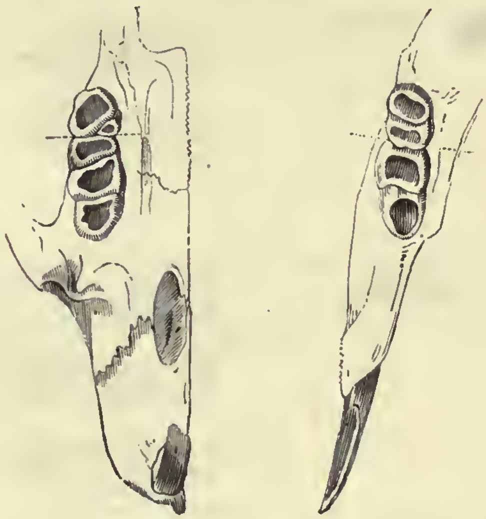
O. unisulcatus, Caffre Otomys. The anterior limbs have four complete toes, armed with delicate nails, which are compressed and sharp, and a rudiment of an unguiculated thumb; the posterior feet have five toes, armed with the same nails, but the two external ones are very short. The tail is but scantily covered with hairs, and is scaly and short. The muzzle is very thick and obtuse, entirely covered with hair, with the exception of a slight ridge round the nostrils, which are small, and approximated to each other below; the eyes are large, as well as the ears, which have an internal projecting membrane, which, when its edges (parois) are approximated, entirely shut the entrance of the auditory passage. The mouth is very small, the upper lip cleft, and the tongue thick, short, and covered with soft papillæ. There are whiskers on the sides of the muzzle and above the eyes. The fur is thick, very soft, and consists of two sorts of hairs; the shortest and most numerous, which determine the colour of the animal, are woolly, and, when viewed through a microscope, appear to be formed of very small rings, alternately bright and obscure; the others, rare and longer than the first, are also stouter and more stiff; these, when viewed through a microscope, present only a uniform texture, and so it is with the whiskers. The woolly hairs are of a slaty-gray for two-thirds of their length, and then of a yellowish-white, with the point black, whence results the dirty yellow tint with which the animal is coloured above; below, yellowish-white predominates. The very short hairs of the tail are of the colour of those of the back; the extremities have the tint of the under parts. Length about 6 inches (French), from the tip of the muzzle to the origin of the tail, which last measures 3½ inches. Mean height, 2½ inches. (F. Cuvier.)

Caffre Otomys (*Otomys unisulcatus*).

The habits of this species do not appear to be known, nothing respecting them having been found in the notes of M. Delalande. F. Cuvier thinks that it is doubtless omnivorous, like the rats; but from the size of its eyes, it may be conjectured that its life is not passed in such obscurity as theirs; and from the delicacy of its sharp claws, and the softness of its fur, that it does not burrow.

Hydromys (Geoffroy).—Muzzle rather pointed; ears small and rounded. Body covered with long hairs. Tail long, cylindrical, rather scaly, with scattered hairs. Four toes and the vestige of a thumb on the fore feet. The hinder feet 5-toed, and palmated for two-thirds of the length of the toes. Molars with the crowns divided into obliquely quadrangular lobes, the summits of which are hollowed into a spoon-shape.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{2-2}{2-2} = 12$.



Teeth of *Hydromys*. F. Cuvier.

H. leucogaster. It has the fur short, soft, marone-brown above, white below; tail black at the base and white at the other extremity. Size sometimes twice that of the Common Brown Rat.

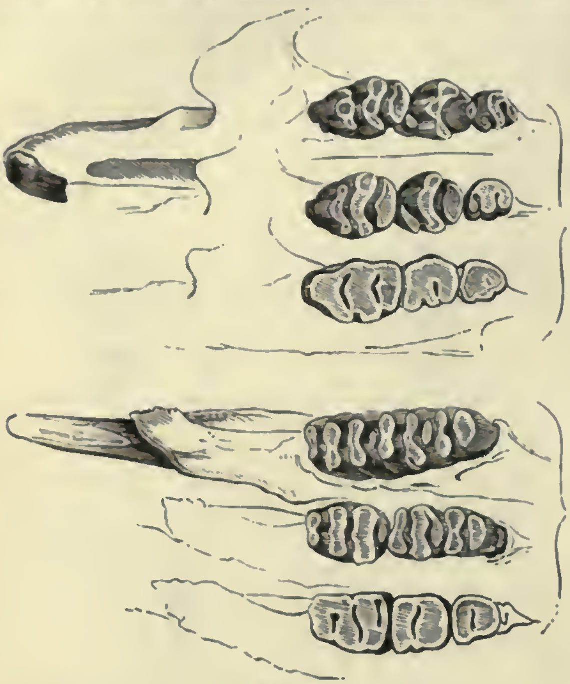
Hydromys leucogaster.

M. Geoffroy has recorded two species, that described above, and another with a yellow belly, *H. chrysogaster*; the last he states to be nearly one-half less than the *Coypou*, but they are generally considered to be only varieties of the same species. M. Geoffroy speaks highly of the quality of the fur of the yellow-bellied variety, and says that it is more valuable than that of the *Coypou*.

These animals are aquatic, and were found in the islands of D'Entrecasteaux Channel. That named *H. chrysogaster* was killed by a sailor at the moment when it was taking refuge under a heap of stones; *H. leucogaster* was taken in the island Maria, in the same channel.

True Rats and Mice.

F. Cuvier ('Dents des Mammifères') observes that up to the time of his writing, animals provided with the same teeth as the Rat (*Mus Rattus*), the Brown Rat (Surmulot of the French—*Mus decumanus*), or the Mouse (*M. Musculus*), formed a single and very natural genus. He then goes on to state that the possession of a cranium, the origin of which he knows not, in presenting the type of a new genus provided with the same teeth as the rat, confers on those teeth a more elevated rank than they had previously held, and begins to form the character of a family. The following is a copy of F. Cuvier's plate, and he informs us that the species which gave him this dentition are *M. Rattus*, *M. decumanus*, *M. Musculus*, *M. Pumilio*, &c.



Teeth of *Mus*.

In endeavouring to give a sketch of the swarms of this group, we shall treat of them according to their geographical distribution.

European Rats and Mice.

The Long-Tailed Field-Mouse, Wood-Mouse, or *Mus sylvaticus*, and the Harvest-Mouse, *M. minimus* of White, and *M. messorius* of Shaw, may be considered as indigenous in Europe. Whether the old English or Black Rat (*M. Rattus*) and Domestic Mouse are aborigines, or imported, is not so clear. The latter is only found in inhabited countries; and, like the Black Rat and Brown Rat, is a cosmopolite, following civilised man wherever he is to be found.

Mus sylvaticus, the Long-Tailed Field-Mouse. It is the Llygoden Ganolig and Llygoden y Maes of the Welsh; Le Mulot of the French; and Voed of the Danes; *M. sylvaticus* (Linn.), *M. agrestis major* (Briss.), and *M. domesticus medius* of Ray. The length of the head and body, as given by Mr. Bell, is 3 inches 8 lines, and that of the tail 3 inches and 6 lines. Pennant makes its measurement from the nose to the setting on of the tail 4½ inches, and the tail 4 inches. If the last-mentioned dimensions are correct, they must have been taken from a very large individual. Mr. Macgillivray gives the dimensions of three individuals; the length (to the end of the tail) of the largest was 6 inches 8 lines, that of the next 6 inches 6 lines, and that of the least 6 inches only.

The animal is well described by Mr. Bell as larger than the Common Field-Vole, but varying considerably in size; the head long and raised, the muzzle tapering; the whiskers very long; the eyes remarkably large and prominent; the ears large, oblong, oval, with the anterior margin turned in at the base, and a projecting lobe arising within the ear, near the base of the posterior margin; the tail nearly as long as the body, slender and tapering; the legs long. The upper part and sides of the head, neck, and body, and the outer surface of the legs, of a yellowish-brown, darker on the back, each hair being gray or ash-coloured at the base, then yellow, and the tips of some of them black; under parts whitish, with a very slight grayish tint in some parts, and a yellowish gray patch on the breast. Tail brown above, white beneath. ('British Quadrupeds.')

This is a most destructive species, and a bitter enemy to the horticulturist, the agriculturist, and the planter. It is very prolific, bringing forth from seven to ten at a birth, and is not always stinted to one brood in a year. The hoards that it collects in its subterranean retreats (which are sometimes the results of its own labour, but more frequently excavations which it finds ready made, but which it enlarges, such as those under roots of trees, old mole-runs, &c.) are enormous for the size of the animal, and Pennant is of opinion that the great damage done by hogs in rooting up the ground, or mooting,' as it is called in some counties, is caused chiefly by the search of the swine for the concealed treasure of this Field-Mouse.

It is an inhabitant of the whole of temperate Europe.

Mus messorius, the Harvest-Mouse. White of Selborne, who suggests the name of *Mus minimus*, appears to be the first who drew the attention of naturalists to this the smallest of British quadrupeds. He wrote an account of it to Pennant, who called it the Less Long-Tailed Field-Mouse and the Harvest-Mouse. It is the *Mus messorius* of Shaw, and Mr. Bell adds the following synonyms:—*Mus minutus* (Pallas); Mulot Nain (?) and Rat des Moissons (F. Cuvier, 'Mamm.'); Minute Mouse of Shaw.

Harvest-Mouse (*Mus messorius*). Nest in background.

White thus introduces his discovery to Pennant:—"I have procured some of the mice mentioned in my former letter, a young one and a female with young, both of which I have preserved in brandy. From the colour, size, shape, and manner of nesting, I make no doubt but that the species is nondescript. They are much smaller and more slender than the *Mus domesticus medius* of Ray, and have more of the squirrel or dormouse colour; their belly is white; a straight line along their sides divides the shades of their back and belly. They never enter into houses; are carried into ricks and barns with the sheaves; abound in harvest; and build their nests amidst the straws of the corn above the ground, and sometimes in thistles. They breed as many as eight at a litter, in a little round nest composed of the blades of grass or wheat. One of these I procured this autumn, most artificially platted, and composed of the blades of wheat, perfectly round, and about the size of a cricket-ball, with the aperture so ingeniously closed that there was no discovering to what part it belonged. It was so compact and well fitted that it would roll across the table without being decomposed, though it contained eight little mice that were naked and blind. As this nest was perfectly full, how could the dam come at her litter respectively so as to administer a teat to each? Perhaps she opens different places for that purpose, adjusting them again when the business is over; but she could not possibly be contained herself in the ball with her young, which moreover would be daily increasing in bulk. This wonderful procreant cradle, an elegant instance of the efforts of instinct, was found in a wheat-field suspended in the head of a thistle." And again:—"As to the small mice, I have further to remark that, though they hang their nests for breeding up amidst the straws of the standing corn above the ground, yet I find that in the winter they burrow deep in the earth, and make warm beds of grass; but the grand rendezvous seems to be in corn-ricks, into which they are carried at harvest. A neighbour housed an oat-rick lately, under the thatch of which were assembled near an hundred, most of which were taken, and some I saw. I measured them, and found that from nose to tail they were just two inches and a quarter, and their tails just two inches long. Two of them in a scale weighed down just one copper halfpenny, which is about the third of an ounce avoirdupois; so that I suppose they are the smallest quadrupeds in this island. A full-grown *Mus medius domesticus* weighs, I find, one ounce lumping weight, which is more than six times as much as the mouse above; and measures from nose to rump four inches and a quarter, and the same in its tail. . . . As my neighbour was housing a rick he observed that his dogs devoured all the little red mice they could catch, but rejected the common mice; and that his cats ate the common mice, refusing the red." Thus far White. Dr. Gloger describes one of these nests as beautifully constructed of the panicles and leaves of three stems of the common reed interwoven together, and forming a roundish ball, suspended on the living plants about five inches from the ground. On the side opposite the stems, rather below the middle, was a small aperture, which appeared to be closed during the absence of the parent, and was scarcely observable even after one of the young had made its escape through it. The inside, when examined with the little finger, was found to be soft and warm, smooth, and neatly rounded, but very confined; it contained only five young; but another less elaborately formed sheltered no less than nine. The panicles and leaves were slit into minute stripe or strings by the teeth of the animal in order to assist the neatness of its weaving. Mr. Macgillivray found one of these nests in Fifeshire composed of dry blades of coarse grass arranged in a globular form, and placed in the midst of a tuft of *Aira cæspitosa*, nine inches from the ground: it contained six or seven young, naked and blind. The food of this little mouse consists of corn and grass seeds, insects, and earth-worms: one to which a bit of the tail of a dead blind worm, *Anguis fragilis*, was presented, devoured it greedily. Of insects it is very fond. Mr. Bingley says:—"One evening, as I was sitting at my writing-desk, and the animal was playing about in the open part of its cage, a large blue fly happened to buzz against the wires. The little creature, although at twice or thrice the distance of her own length from it, sprang along the wires with the greatest agility, and would certainly have seized it had the space between the wires been sufficiently wide to have admitted her teeth or paws to reach it. I was surprised at this occurrence, as I had been led to believe that the Harvest-Mouse was merely a granivorous animal. I caught the fly, and made it buzz in my fingers against the wires. The mouse, though usually shy and timid, immediately came out of her hiding-place, and, running to the spot, seized and devoured it. From this time I fed her with insects whenever I could get them, and she always preferred them to every other kind of food that I offered her." Mr. Macgillivray figures one in the coils of an earth-worm, which it devoured, though the worm at first upset it by twisting round its body. ('Naturalist's Library, Mammalia,' vol. vii.; 'British Quadrupeds,' pl. 27.)

Colonel Montagu failed to keep it in confinement, but it has been so kept. The Rev. W. Bingley and Mr. Broderip observed that the tail is in a degree prehensile. The latter had a pair in a dormouse's cage for some time, and frequently saw them coil the ends of their tails round the bars, especially when they were clambering along the sides or on the top of it. They became very familiar, soon recognised their friends, and would lie down or rear themselves up to be tickled with a straw or a pen; an operation which they evidently enjoyed much. We know of no instance when the female has brought forth in confinement where she has not eaten her young. One just born that was saved from the teeth of the mother is in the Museum of the Royal College of Surgeons, and is perhaps one of the smallest placental quadrupeds that ever breathed.

It is probably generally spread throughout Europe. It has been found in Siberia, Russia, and Germany. In Britain it is recorded as having occurred in Hampshire, Gloucestershire, Wiltshire, and Devonshire; in the three last counties by Colonel Montagu, and noted as not uncommon. It has been found also in Cambridgeshire. Mr. Macgillivray had one sent to him from Aberdeenshire, and another from the neighbourhood of Edinburgh: he found, as we have seen, the nest in Fifeshire.

There are, it appears, in Trebizond, mice (*M. Alleni* and *M. Abbottii*) smaller than *M. messorius*. ('Zool. Proc.,' 1837.)

We shall here notice those cosmopolites, the Black Rat, the Brown Rat, and the Common Mouse, the pests of civilised man.

M. Rattus, the Black Rat. This is Le Rat of the French; Ratto and Sorico of the Italians; Raton and Rata of the Spaniards; Rato of the Portuguese; Ratze of the Germans; Rot of the Dutch; Rotta of the Swedes; Rotte of the Danes; Llygoden Ffrengig of the Welsh; Black Rat of the English; and Ratton of the Scotch. It is the *M. domesticus major* of Ray.

That this animal is indigenous may be doubted. Mr. Macgillivray observes that the 'Old English or Black Rat,' as it has been called, is as much French or Irish as English. That it was in Britain long before the introduction of the Brown Rat, before whose superior strength it is rapidly disappearing, can be doubted as little. Pennant, who gives the British name above stated for the Black Rat, has no British name for the brown species; and we suspect that the king's rat-catcher, noticed by Pennant, with his scarlet dress embroidered with yellow worsted, on which are figures of mice or rats destroying wheat-sheaves, owed his office in this kingdom to the Black Rat. "It is believed," says Mr. Macgillivray, "to have been originally imported from the continent, where it first made its appearance in the beginning of the 16th century, and is supposed to have come from the East. Vessels in port were formerly liable to be infested by it, so that it soon became as common in America as in Europe; although in the maritime parts of that country it has now become nearly as scarce as with us, and from the same cause, the predominance of the more enterprising and stronger Brown Rat." Mr. Bell had previously fixed the middle of the same century for its appearance in this country. "At least," says he, "no author more antient than that period has described or even alluded to it, Gesner being the first who described and figured it." The figure of Gesner leaves no doubt that the animal represented is the Black Rat, and it is spoken of in such terms that it may well have been a long resident in England:—"Mus domesticus major, quem Rattum appellârim cum Alberto, quoniam hoc nomine non Germani tantum, sed Itali etiam, Galli, et Angli, utuntur;" and again, among the names given to the animal by various nations, "Anglicè, Rat, Ratte." Shakspere's lines—

"But in a sieve I'll thither sail,
And, like a rat without a tail,
I'll do—I'll do—and I'll do!"

show that the animal must have been familiarly known to his audience; and it must have been very common early in the 17th century, when the white variety was probably well known; for we read in the 'Dysart Kirk Session Minutes' (May, 1626), that a suspected witch, one Janet, came to John White's house, "and span on his wife's wheel in her absence, and thereafter there came a White Ratton at sundrie times and sat on his cow's back, so that thereafter the cow dwined away." Mr. Bell notices the usurpation of the haunts of this species by the Brown Rat. The Black Rat, he says, "is now rarely found, excepting in old houses of large cities, as in London, in Edinburgh, and some other places, where it still exists in considerable numbers, especially in the cellars and stables of the city of London, in many of which it is more common than the other." Mr. Macgillivray remarks that in Edinburgh it appears to be completely extirpated. "I have not," he continues, "seen a specimen obtained there within these fifteen years." The last-mentioned author also tells us that the Rev. Mr. Gordon, minister of Birnie, some years ago sent him several individuals alive, which were caught in Elgin, where however the species is much less frequently met with than the Brown Rat. In Leith he says it is not very uncommon; and in other towns and villages in Scotland which are farther inland, it is still to be procured. "Whether," adds Mr. Macgillivray, "the destruction of this animal has been effected by the larger and more ferocious Brown Rat, or, like that of many tribes of the human species, has resulted from the diminution of food, caused by the overwhelming increase of an unfriendly race, it is impossible to determine."

The Black Rat is grayish-black above and ash-coloured beneath. The ears are half the length of the head, and the tail is rather longer than the body.

Mr. Bell gives the following dimensions:—

	Inches.	Lines.
Length of the head and body	7	4
Length of the head	1	10
Length of the ears	0	11
Length of the tail	7	11

It breeds often in the year, and the female ordinarily produces from seven to nine at a birth. Like the brown species it is omnivorous. Mr. Bell thinks it probable, from the proximity of the two countries, that it was introduced into this kingdom from France, and observes that the Welsh name for it, which signifies 'French Mouse,' appears to favour this opinion. From Europe, he adds, it has been sent with the Brown Rat to America, the islands of the Pacific, and to many other places.

Mr. Thompson ('Zool Proc.,' 1837) notices an Irish Rat with a white breast, which he is inclined to consider distinct from *Mus Rattus*, and which he names *Mus Hibernicus*.

Sir John Richardson did not observe the Black Rat in the Fur Countries of North America; and he says that he may venture to affirm that it had not, when he wrote, advanced farther north than the plains of the Saskatchewan.

Mus decumanus (Pallas), the Brown Rat. This is Le Surmulot of the French, Norway Rat of the English, and *M. Norvegicus* of Brisson. Why this overwhelming pest has obtained the name of Norway Rat does not appear: so far from its being aboriginal in that country, it was not known to exist there when the name was first applied to it. "It is," says Pennant, "an animal quite unknown in Scandinavia, as we have been assured by several natives of the countries which form that tract, and Linnæus takes no notice of it in his last 'System.' It is fit here to remark an error of that able naturalist in speaking of the Common Rat, which he says was first brought from America into Europe by means of a ship bound to Antwerp. The fact is that both Rat and Mouse were unknown to the New World before it was discovered by the Europeans, and the first rats it ever knew were introduced there by a ship from Antwerp. This animal never made its appearance in England till about forty years ago. . . . I suspect that this rat came in ships originally from the East Indies. They are found there, and also in vast numbers in Persia, from whence they have made their way westerly even to Petersburg." It made its appearance in the neighbourhood of Paris about 1750. Mr. Bell states that the original country of this rat can no longer be ascertained, although there is reason to believe that it comes from a warmer climate than our own. Mr. Macgillivray says that it is supposed to have been introduced from Persia and the East Indies about 1730, and gradually to have spread over the greater part of the continent of Europe, as well as America, by means of the frequent commercial intercourse established among the nations of these regions. It is not, he observes, confined to cities and villages, but establishes colonies in farmsteadings, on the banks of canals and rivers, and even in islands at a considerable distance from the mainland, or from larger islands, to which it has been introduced by shipping. Thus, he states, it is found on many of the islets of the Hebrides in considerable numbers, feeding on grass, shell-fish, and *Crustacea*, and burrowing in the banks; "for although not essentially amphibious, like the Water-Rat, it does not hesitate on occasion to betake itself to the water, and flocks have been seen swimming from one island to another."

According to Dr. Harlan the Brown Rat did not make its appearance in North America until the year 1775. When Sir John Richardson wrote ('Fauna Boreali-Americana') it was very common in Lower Canada; but he was informed that in 1825 it had not advanced much beyond Kingston in Upper Canada. He did not observe it in the Fur Countries; and if it does exist there, he thinks that it is only at the mouth of the Columbia River, or at the commercial stations on the shores of Hudson's Bay.

This species is eminently carnivorous, bold, ferocious, and most destructive in the game-preserve and poultry-yard, where the eggs and young birds are preyed upon by them without mercy. In towns carrion and offal form their chief subsistence. An official report to the French government on the proposition for removing the establishment for slaughtering horses at Montfaucon gives an account of their numbers and voracity almost appalling; indeed one of the chief arguments against the removal was the danger to the neighbourhood of suddenly depriving these voracious animals of their usual food. The carcasses of the slaughtered horses, sometimes to the amount of thirty-five per diem, are found next morning picked to the bare bone by the rats. A part of this establishment is inclosed by solid walls, at the bottom of which several holes are made for the entrance and exit of these vermin. Into this place Dusuassois, the proprietor, put the dead bodies of two or three horses; and having stopped up all the holes towards midnight, with as little noise as possible, he, with several workmen, each bearing a torch in one hand and a stick in the other, suddenly entered the inclosure, shut the door, and began a general massacre. Wherever a blow was directed, even without aim, a rat was killed; and those which attempted to escape by running up the walls were quickly knocked down. The dead of one night amounted to 2650; the result of four hunts was 9101; and by repeating the experiment at intervals of a few days, Dusuassois destroyed 16,050 rats in the space of a month. Now when it is recollected that the yard in which these numbers were killed does not contain more than a twentieth of the area over which the dead horses are spread, some idea may be formed of the multitudes that infest this place; indeed the adjoining fields and eminences are riddled with their burrows, and their paths thereto may be traced from the inclosures where the horses are slaughtered.

This rat is grayish-brown above and grayish-white beneath, and the tail is shorter than the head and body. Mr. Bell gives the following dimensions, from which its superiority in size to the Black Rat will be evident:—

	Inches.	Lines.
Length of the head and body . . .	10	8
Length of the head	2	4
Length of the ears	0	8
Length of the tail	8	2

White or yellowish-white varieties, being albinoes with red eyes, and variegated individuals, sometimes occur.

Mus Musculus, the Common or Domestic Mouse, needs no description. It seems to be entirely dependent on civilised man, and has never been found at a distance from his dwelling. White varieties with pink eyes are kept and propagated as pets by those who admire such albinoes; they are pretty little animals, and soon become familiar. This well-known species is La Souris of the French; Topo, Sorcio, and Sorgio di Casa, of the Italians; Rat of the Spanish; Ratinho of the Portuguese; Maus and Hausmaus of the Germans; Muys of the Dutch; Mus of the Swedes; Muus of the Danes; Llygoden of the Welsh; *Mus domesticus communis vel minor* of Gesner; and *Mus domesticus vulgaris seu minor* of Ray.

Sir John Richardson saw a dead mouse in a storehouse at York Factory filled with packages from England, and he thinks it probable that the species may have been introduced into all the ports on the shores of Hudson's Bay; but he never heard of its being taken in the Fur Countries at a distance from the sea-coast. Mr. Say informed him that it was introduced at Engineer Cantonment, on the Missouri, by Major Long's expedition.

Asiatic Rats and Mice.

It seems to be certain that the Brown Rat is an Asiatic species, and the Black Rat is not without claims to a similar geographical origin; but among the most formidable of the Oriental Rats is the *Mus giganteus* of Hardwicke, *Mus Malabaricus* of Shaw. Of this rat General Hardwicke gives a faithful figure, of the size of life, in the seventh volume of the 'Transactions of the Linnæan Society.' It has the appearance of a Brown Rat dilated to gigantic proportions, and it is impossible to look at it without thinking what the consequences might be if it were ever to be imported and naturalised in Europe. Above it is most hairy and black; beneath inclining to gray. The animal figured was a female, and weighed 2 lbs. 11½ oz. Its total length was 26¼ inches, of which the tail measured 13 inches. The male grows larger, and weighs 3 lbs. and upwards. "This rat," writes the General, "is found in many places on the coast of Coromandel, in Mysore, and in several parts of Bengal between Calcutta and Hurdwar. It is partial to dry situations, and hardly ever found distant from habitations. The lowest caste of Hindoos eat the flesh of this rat in preference to that of any other species. It is a most mischievous animal, burrows to a great depth, and will pass under the foundations of granaries and storehouses, if not deeply laid. Mud or unburnt brick walls prove no security against its attacks, and it commonly perforates such buildings in all directions. It is destructive in gardens, and roots up the seeds of all leguminous plants sown within its haunts. Cucurbitaceous plants and fruits also suffer by its depredations. When grain and vegetables are not within its reach, or scarce, it will attack poultry; but the former is its choicest food." Dr. Gray remarks that the geographical range of *Mus giganteus* appears to be very extensive, Mr. Charles Hardwicke having transmitted to the British Museum a specimen from Van Diemen's Land.

M. setifer (Horsf.). The Tikus-Wirok of the Javanese was considered by M. Temminck and others to be the young of this species; but this opinion is corrected by Dr. Gray ('Zool. Proc.,' 1832), who points out the differences. Dr. Horsfield states that it is found in Java at the confines of woods and forests, and, according to his observations, rarely approaches the villages and dwellings of the natives, who describe it however as a bold and mischievous animal, and the Doctor says that the robustness of its form and the remarkable size and strength of its front teeth agree with this character: its nose, he adds, is evidently employed in burrowing the ground in search of its food; and its tail has the character of those species which are in the habit of frequenting the water. Mr. Hodgson states that *M. decumanus* and *M. Rattus* are both very numerous and troublesome in Nepaul; that *M. Musculus* is very uncommon; and that Field-Mice are frequently met with.

African Rats and Mice.

M. Barbarus, the Barbary Mouse, will serve as an example of the African species. It is of a darkish-brown colour, with five or six yellowish longitudinal stripes on each side, about half as wide as the intervening spaces, and becoming confused towards the under parts, which are nearly white. Mr. Bennett observes, that on the fore feet only three of the toes are at first visible; and that this circumstance, mentioned in the specific character given by Linnæus, has led many subsequent naturalists to doubt whether the Barbary Mouse really belonged to the genus with which it was associated. Linnæus himself, continues Mr. Bennett, had however stated, in his description of the species, that rudiments of a thumb, and also of a fifth toe, were observable on a closer inspection; and this statement, he adds, was fully confirmed by the examination of the specimens in the Menagerie of the Zoological Society of London, which were intermediate in size between the Common Rat and Common Mouse.

Barbary Mouse (*Mus Barbarus*).

It is a native of Barbary, where they are not rare, and where the name given to them by the natives is Phār-Azēff, the Palmetto Mouse.

American Rats and Mice.

Some of the best examples of the forms of American Mice will be found in the 'Zoology of H.M.S. Beagle,' where many species are figured. They were collected by Charles Darwin, Esq., at various parts of the southern coast of South America, namely, Coquimbo, Valparaiso, Port Desire, Maldonado, Bahia Blanca, &c. Mr. Waterhouse first described these in the 'Proceedings of the Zoological Society of

London' (1837), dividing them into several subordinate groups, to which he assigns the sub-generic titles of *Scapteromys*, *Oxymycterus*, *Abrothrix*, *Calomys*, and *Phyllotis*, which last, in Mr. Waterhouse's opinion, indicates an aberrant form of the *Muridæ*.

Mus (*Phyllotis*) *Darwinii* may be taken as an example. The fur above is cinnamon and blackish intermixed; in front of the eyes ash-colour; cheeks, sides, and tail, near the base, yellow-cinnamon; under parts and feet white; ears very large and leaf-like, nearly naked; the tail, which is nearly equal to the head and body, blackish-brown above, white beneath. Length from the tip of the nose to the end of the tail 10 inches 9 lines, of which the tail measures 4 inches 9 lines. It is a native of Coquimbo.

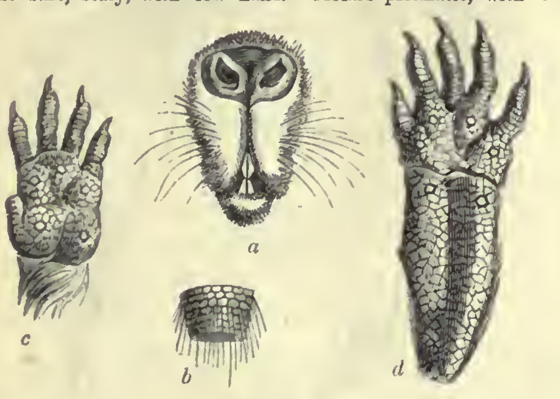
Mus (*Phyllotis*) *Darwinii.*

Mr. Waterhouse also characterises from the same collection two new genera of small Rodents, *Reithrodon* and *Habrocoma*. The affinity of the first is stated to be with the *Muridæ*, and the second Mr. Waterhouse considers to be evidently allied on the one hand to *Octodon*, *Ctenomys*, and *Poephagomys*, and on the other to the *Chinchillidæ*. [CHINCHILLIDÆ; HYSTRICIDÆ.]

Before we take leave of this part of the subject we must refer to an observation of Dr. Gray, who remarks ('Zool. Proc.,' 1832) that the comparative length of the hinder feet, and the relative distance of the tubercles of the sole from the end of the toes and from the heel, appear to furnish very good distinctive characters for the species of this difficult genus. Thus, in the Wood-Mouse (*M. sylvaticus*), the hinder tubercle of the sole is about a line nearer to the heel than to the end of the toes; while in the Common Mouse (*M. Musculus*), which has a shorter hind foot, the hinder tubercle is nearly equidistant between the heel and the tip of the toes.

Mr. Darwin ('Journal and Remarks') observes that mice, and other small rodents, subsist in considerable numbers in very desert places as long as there is the least vegetation. In Patagonia, even on the borders of the Salinas, where a drop of fresh water can never be found, they swarm. Next to lizards, he adds, mice appear to be able to support existence on the smallest and driest portions of the earth, even on the islets in the midst of great oceans. He believes it will be found that several islands, which possess no other warm-blooded quadruped, have small rodents peculiar to themselves. Sir Woodbine Parish ('Buenos Ayres,' &c.) states, that after the great drought of 1830, 1831, and 1832, there was a prodigious increase of all kinds of vermin, especially field mice, myriads of which overran the country, and entirely destroyed the maize harvest of 1833.

Capromys, Desmarest (*Isodon*, Say).—Fore feet 4-toed; thumb rudimentary: hind feet strong, thick, 5-toed. Tail moderate, thick at the base, scaly, with few hairs. Molars prismatic, with their



Capromys.

a, muzzle; *b*, portion of tail enlarged to show its scales and hairs; *c*, under part of fore foot; *d*, under part of hind foot.

crown traversed by folds of enamel, which penetrate rather deeply, and resemble those in the crown of the teeth of the Beavers.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$.

C. Fournieri, Desm. (*Isodon pilorides*, Say). It is the size of a rather small rabbit. Fur coarse, greenish, or blackish-brown, tinged with specks of obscure yellow above, except on the rump, where the hairs are stiffer, and which is reddish-brown; belly and chest dirty brownish-gray; muzzle and feet blackish.

Capromys Fournieri.

M. Desmarest was presented with two males from Cuba by M. Fournier. Of the habits of these animals in the wild state, the latter knows only that they are found in woods, that they climb trees with great facility, and that they live on vegetables. In the domesticated state, M. Desmarest remarked that their intelligence appeared to be developed as much as that of rats and squirrels, being much beyond that of rabbits and Guinea pigs. They showed great curiosity, and were very wakeful at night; but their sense of hearing did not seem so fine as that of rabbits and hares. Their nostrils were incessantly in motion, especially when they smelt any new object, and their taste was sufficiently delicate to enable them to distinguish and reject vegetables which had been touched by animal substances, which last appeared to be odious to them. They agreed well, sleeping close together; and when they were apart they called to each other with a sharp cry, differing little from that of a rat. They expressed pleasure by a low soft kind of grunting. They hardly ever quarrelled, except for food, as when one piece of fruit only was given between both; one would then seize it and run away till the other was able to take it from him. They sometimes played for a long time together, holding themselves up in the manner of kangaroos, firmly supported upon the broad soles of their feet and the base of the tail, and striking each other with the hands, until, one of them finding a wall or some other body against which to support himself, acquired additional power and gained advantage; but they never bit each other. They manifested the greatest indifference to other animals, paying no attention even to cats. They were fond of being caressed, and particularly of being scratched under the chin. They did not bite, but slightly pressed with the incisive teeth the skin of those who caressed them. They did not ordinarily drink, but M. Desmarest saw them occasionally suck up water as squirrels do. Their food was solely vegetable, such as cabbage, succory, grapes, nuts, bread, apples, &c.; and they were not very difficult in their choice of it, though they were very fond of highly flavoured herbs and aromatic plants—wormwood, rosemary, pimpernel, geraniums, celery, &c., for instance. Grapes too pleased them mightily, and to obtain the fruit they climbed up a long pole on which it was placed. They were fond of bread steeped in anisseed or wine. Their excrements were long black lumps, similar in consistence to that of rabbits. Their urine reddened, in drying, white linen wetted with it.

They were almost absolutely plantigrade, and their movements were slow, the hinder parts appearing to be embarrassed, as it were, when they walked, as may be observed in the bear. They took occasional leaps, suddenly turning round from head to tail, like the field mouse, and gallopped, when at play, making a considerable noise with the soles of their feet. They climbed with ease, assisting themselves with their tails as a support, and using the same in descending. In certain positions, on a stick for example, the tail served as a balance to preserve equilibrium. They often raised themselves to a listening posture, sitting erect, with the hands hanging down, like rabbits and hares; and in eating they employed sometimes both of their hands, at other times one only. The latter happens when the substance they are holding is small enough to be held between their fingers and the tubercle at the base of the thumb.

This species appears to be known in Cuba by the name of Utia, and M. Desmarest thinks that it is the animal described by Bomare, Oviedo, and others, more than 300 years since. According to Bomare, the Utias is a species of rabbit of the size of a rat, which inhabits the West Indies, and is hunted at night by the light of a luminous insect, named *Acadia* (propably *Elater noctilucus*), of which M. Fournier brought large quantities from Cuba.

Another species, also from Cuba, *Capromys prehensilis* (Pöppig), is also recorded, but Dr. Fischer places the mark of doubt before it. [HYSTRICIDÆ.]

Professor Owen has made some observations on the comparative anatomy of *Capromys* in the 'Zool. Proc.' for 1832 and 1835.

Cricetus is a genus of the family *Muridæ*, including the Common Hamster. [CRICETUS.]

Jumping Mice.

The race of Jerboas, or *Dipodidæ*, appears to be ordained by nature for living upon desert and sandy plains.

Schreber, and he was followed by Gmelin and others, appears to have been the first who characterised the genus *Dipus*.

Dr. Gray ('Annals of Philosophy,' 1825) makes the *Jerboïdæ* the fourth family of the *Glires*, and thus characterises it: Cutting-teeth two in each jaw; grinders simple or compound, rooted; ears moderate; eyes large, prominent; clavicles distinct; fore feet short (used as hands); hind feet very long; tail long, hairy, used in leaping or walking; fur soft. And he thus divides the family:—

† Grinders compound or rootless.

1. *Pedestina; Pedestes*, Illig. 2. *Dipina; Dipus*, Schreb.; *Meriones*, F. Cuv., not Illig.

†† Grinders simple, roots divided; legs nearly equal.

3. *Gerbillus*, Desm. 4. *Myoxina; Myoxus*, Gm. 5. *Sciurina; Sciuropterus*, F. Cuv.; *Pteromys*, Cuv.; *Macroxus*, F. Cuv.; *Sciurus*, Linn.; *Tamai*, Illig. The latter genus very closely allied to *Arctomina*.

Mr. Swainson ('Classification of Quadrupeds') observes that the Jerboas (*Dipus*) are remarkable for possessing the longest hind legs of any quadrupeds yet discovered, while the fore legs are disproportionally short; this structure he remarks is seen also in the Kangaroos, which seem to be represented in miniature by these little animals, which, "like their pouched prototypes, use the fore feet only as organs of rest upon the ground; for if they are frightened or wish to proceed at a quick pace, they stand upon the hind legs only, and take prodigious leaps." That the tail is necessary for the efficient performance of these feats, is proved by the fact that individuals deprived of their tails were unable to assume the erect position or to leap at all. The fore feet are employed in conveying food to the mouth, and seem to be of little or no use as organs of progression. Those that we have seen alive seemed to use their posterior extremities only as organs of locomotion, and appeared to walk on the toes of those extremities. They are very bird-like in some of their movements, and there is something in their general appearance that would lead an imaginative mind to the fancy that they were birds suddenly transformed to quadrupeds and were hardly reconciled to the change. Parts of their internal structure, in the skeleton particularly, are bird-like.

Mr. Swainson says, "The best-known species is the Gerbo, or Egyptian Jerboa (*Dipus Sagitta*), in which country it is very common. It lives in large societies, and constructs burrows under ground: it is shy and timid, nor can it be kept in confinement any considerable time. Of four typical species already known, three inhabit the sandy deserts in the heart of Asia, and the shores of the Caspian; the rest have been separated as a sub-genus, under the name of Gerbil (*Gerbillus*); but their distinctions are so very slight that we have not adopted the name. The genus *Pedetes*, represented by the Cape Jerboa, clearly belongs to the same group. America, which has no Jerboas, nevertheless presents us with their prototypes in the Jumping Mice of Canada (*Meriones*, Illig.)."

The Jerboas have, in truth, presented considerable difficulties to zoologists, and the distinction of the species is often not clearly made out. Sonnini was one of the first who endeavoured to dissipate the confusion which prevailed on the subject. He comes to the conclusion that there exists but one variety of them in Egypt, where they are multiplied without end. "In fact," says M. Sonnini, "among all those which I have observed at different times and in different places, I never remarked the least dissimilitude of either form or colour." His paper, M. Berthout van Berchem's letter on the true nomenclature of the Gerboise, and M. Sonnini's reply to the same, will be found in the 'Travels' of the latter in Upper and Lower Egypt. That these Jerboas were known to the ancients is evident. Herodotus (iv. 192) alludes to them as inhabiting Africa. Aristotle ('Hist. Anim.,' vi. 37) speaks of them as those Egyptian Rats which walk on two feet, because the hind feet are great and the fore feet small. They are noticed by Ælian (xv. 26), who quotes Theophrastus. The description of Theophrastus (Fr. xiv.) cannot be mistaken. He says that these rats have indeed fore feet, but do not walk upon them, and use them as hands. When they flee, he adds, they leap. They are clearly the *Ægyptii mures* of Pliny, who says '*bipedes* ambulant' (x. 65), and Pennant gives an engraving of a gold coin with the plant *Silphium* and one of these animals represented on it, and says that these symbols were used to denote the country of Cyrene, where both were found.

One of the best monographs of the genus *Dipus* is that of M. Lichtenstein: the species he gives are numerous, and it may be doubted whether some of them are not varieties. A very elaborate memoir on the Jerboas and Gerbillas, by F. Cuvier, was read before the Zoological Society of London in 1836, and is published, with beautiful illustrations, in the 'Transactions' of that Society (vol. ii.).

Skull and Teeth of *Dipus hirtipes*. F. Cuvier.

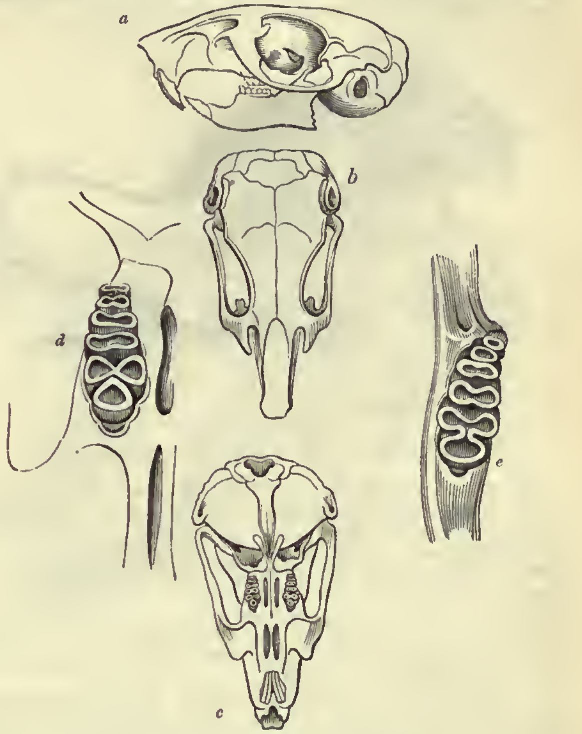
a, skull, profile; *b*, same, seen from above; *c*, same, seen from below; *d*, *e*, teeth of same.

Skull and Teeth of *Alactaga*.

a, *b*, cranium, one-third larger than natural size; *c*, *d*, teeth of the same, five times larger than nature.

F. Cuvier commences this 'Memoir' with observing that his attention had been particularly directed to the *Rodentia*, with a view of arriving at a natural classification of the numerous species composing that order, among which considerable confusion had hitherto prevailed, particularly in the genera *Dipus* and *Gerbillus*, the relations of which to other allied groups had been but very imperfectly understood by previous writers. The species included in the genus *Dipus* had been formed by M. Lichtenstein into three divisions, which are distinguished by the absence and number of rudimentary toes upon the hind feet. In the first section are placed those with three toes, all perfectly formed; in the second, those with four, one of which is rudimentary; and in the third, those with five, two of these being rudimentary. F. Cuvier states that he is unacquainted with the second division of M. Lichtenstein; but in the examination of the species belonging to the first, in addition to the absence of rudimentary toes, he finds that they are also distinguished from those of the third by the form of the teeth and the osteological characters of the head. These points of difference he considers of sufficient importance to justify a distinct genus for the Jerboas with five toes, adopting the name *Alactaga*, given by Pallas to a species, as the common generic appellation. F. Cuvier remarks that the three principal toes of the Alactagas, as well as the three only toes of the Jerboas, are articulated to a single metatarsal bone, and that the two rudimentary toes of the first genus have each their metatarsal bone; whence it results that the penultimate segment of the foot is composed of three bones in the Alactagas, and of one only in the Jerboas. The incisors of the Alactagas are simple, whilst those in the upper jaw of the Jerboas are divided longitudinally by a furrow. The molars of the latter genus are complicated in form, and but little resemble those of the former. They are four in number in the upper jaw, and three in the lower; but the first in the upper is a small rudimentary tooth, which probably disappears in aged individuals. After a detailed account of the structure of the grinding teeth, F. Cuvier observes that the general structure of the head of the Alactagas and Jerboas is evidently the same, and is characterised by the large size of the cranium, the shortness of the muzzle, and, above all, by the magnitude of the suborbital foramina. The cranium of the Jerboa is distinguished by its great breadth posteriorly, resulting from the enormous development of the tympanic bone, which extends beyond the occipital posteriorly and laterally, as far as the zygomatic arch, which is by no means the case in the Alactagas, where all the osseous parts of the ear are of moderate dimensions. Another differential character between the two genera is presented by the maxillary arch, which circumscribes externally the suborbital foramina, and which, in the Alactagas, may be said to be linear, presenting a very limited surface for the attachment of muscles. He then notes a difference in the relative development of the jaws, the lower being comparatively much shorter in the Alactagas than in the Jerboas. Having described a new species of Alactaga, a native of Barbary, under the name of *Alactaga arundinis*, F. Cuvier proceeds to consider the characters and affinities of the genera *Gerbillus* and *Meriones*, and enters into a critical examination of all the species referred to that group. To these he adds another species, the habits of which he describes, and to which he gives the name of *Gerbillus Burtoni*. The species he includes are :—1, *Gerbillus Ægyptiacus*, Syn.; *Dipus Gerbillus*, *Meriones quadrimaculatus*, Ehrenberg. 2, *Gerbillus Pyramidum*, Syn.; *Dipus Pyramidum*, Geoff.; *Meriones robustus*, Rüpp. 3. *Gerbillus pygargus*, Syn.; *Meriones Gerbillus*, Rüpp. 4. *Gerbillus Indicus*, Syn.; *Dipus Indicus*, Hardwicke. 5. *Gerbillus Africanus*, Syn.; *Meriones Schlegelii*, Smutz; *Gerbillus Afra*, Gray. 6. *Gerbillus brevicaudatus*. 7. *Gerbillus Otaria*. 8, *Gerbillus Burtoni*. The detailed descriptions of these are given in the 'Transactions of the Zoological Society,' in which will also be found F. Cuvier's views with ragard to the affinities of the Gerbillas and Alactagas to the Jerboas, and which lead him to the conclusion that the Gerbillas have a much nearer affinity to the *Muridæ*.

Gerbillus Burtoni.



Cranium and Teeth of *Gerbillus Burtoni.*

a, skull, profile; *b*, same, seen from above; *c*, same, seen from below; *d*, *e*, teeth of same.

General Hardwicke gives the following interesting account of his *Dipus Indicus*:—"These animals are very numerous about cultivated lands, and particularly destructive to wheat and barley crops, of which they lay up considerable hoards in spacious burrows near the scenes of their plunder. They cut the culms of the ripening corn just beneath the ears, and convey them thus entire to one common subterraneous repository, which when filled they carefully close, and do not open for use till supplies abroad become distant and scarce.

Dark-Banded Jerboa.

Grain of all kinds is their favourite food; but in default of this they have recourse to the roots of grass and other vegetables. About the close of day they issue from their burrows, and traverse the plains in all directions to a considerable distance; they run fast, but oftener leap, making bounds of four or five yards at a time, carrying the tail extended in a horizontal direction. When eating they sit on their hind legs like a squirrel, holding the food between their fore feet

They never appear by day, neither do they commit depredations within doors. I have observed their manners by night, in moonlight nights, taking my station on a plain, and remaining for some time with as little motion as possible. I was soon surrounded by hundreds at the distance of a few yards; but on rising from my seat the whole disappeared in an instant, nor did they venture forth again for ten minutes after, and then with much caution and circumspection.

Egyptian Jerboa (*Dipus Ægyptius*, Hempr. and Ehren.).

"A tribe of low Hindus, called Kunjers, whose occupation is hunting, go in quest of these animals at proper seasons, to plunder their hoards of grain; and often, within the space of twenty yards square, find as much corn in the ear as could be crammed into a common bushel. They inhabit dry situations, and are often found at the distance of some miles out of the reach of water to drink. In confinement this animal soon becomes reconciled to its situation, and docile; sleeps much in the day, but when awake feeds as freely as by night. The Hindus above mentioned esteem them good and nutritious food." ('Linn. Trans.,' vol. viii.)

A Jerboa has been discovered in Australia by Sir Thomas Mitchell. "The arid deserts of Asia and Africa, the solitary steppes of Southern Siberia, and the boundless prairies of America, have been long known to be inhabited by numerous species belonging to this or the closely allied genus of Gerbilles; in short, wherever extensive and open plains were found to exist, whether in the Old World or in the New, there likewise were found these little two-legged rats, hopping along or running with great velocity upon their hind legs, and appearing as if nature had expressly intended them to occupy such a situation. Australia alone was believed to form an exception to the general rule in this instance, as in so many others. Who will undertake to say that the progress of discovery may not destroy its anomalous character in many other instances, as it has done in this?" ('Linn. Trans.,' vol. xviii.) Mr. Ogilby has named this species *Dipus Mitchellii*, after its meritorious discoverer, and given a detailed description of the

Dipus Mitchellii.

species in the 'Linnean Transactions' last above quoted. The animal was found on the reedy plains near the junction of the Murray and the Murrumbidgee, on the northern boundaries of Australia Felix. The cut is taken from the figure in Sir T. Mitchell's account of 'Three Expeditions into the Interior of Eastern Australia.' Sir T. Mitchell states that its fore and hind legs resembled in proportion those of the Kangaroo; and it used the latter by leaping on its hind quarters in the same manner. It was not much larger than a common field-mouse, but the tail was longer in proportion even than that of a Kangaroo, and terminated in a hairy brush about two inches long.

Mr. Ogilby has characterised another new genus of Australian Rodents, which he thinks most probably belongs to the extensive and complicated family of the *Muridæ*. In some of the characters the genus very much resembles the Campagnols (*Arvicola*) and Gerbilles (*Meriones*), to the latter of which genera Mr. Ogilby says that *Conilurus* is more particularly related by the length and development of the posterior members.

Meriones (Illiger and F. Cuvier).—Differing from the other Rats with long feet in the form of its molars, which are composite.

$$\text{Dental Formula:—Incisors, } \frac{2}{2}\text{; Molars, } \frac{4-4}{3-3} = 18.$$

Teeth of *Meriones*. F. Cuvier.

M. Labradorius, the Labrador Jumping Mouse. It has the back and upper parts of the head dark liver-brown mixed with brownish-yellow; sides brownish-yellow slightly sprinkled with black; margin of the mouth, chin, throat, and all the lower parts of the body white; yellowish-brown of the sides joining the white of the belly by a straight line extending between the fore and hind extremities. Fur not so long or so fine as that of the common or meadow mice. Total length 9 inches 9 lines, of which the tail measures 5 inches 3 lines; this last tapers slightly, is scaly, and thinly set with short hairs.

Labrador Jumping Mouse (*Meriones Labradorius*).

Sir John Richardson, from whose 'Fauna Boreali-Americana' the above description is abridged, states that in some specimens the yellowish-brown colour occupiss as much space as the darker colour of the back; in others the latter encroaches so much on the sides as to leave merely a narrow yellowish line next the white; whilst in autumn specimens, where the animal has just acquired a new coat of fur, the dark colour of the back adjoins the white of the belly.

This appears to be the Labrador Rat of Pennant; *Gerbillus Hudsonius* of Rafinesque-Smaltz; *Mus Labradorius* of Sabine; *Gerbillus Labradorius* of Harlan; Labrador Jumping Mouse of Godman; and Katse (the leaper) of the Chepewyan Indians.

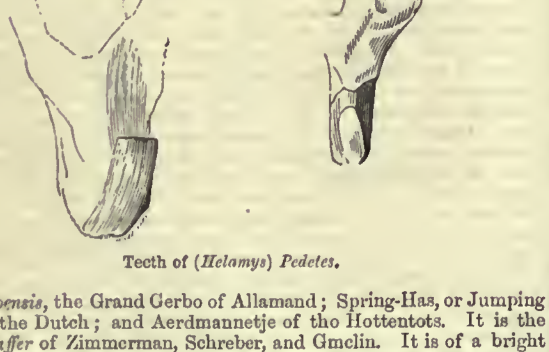
Sir John Richardson remarks that Pennant, in his 'Arctic Zoology,' first described a specimen of this animal, sent from Hudson's Bay by Mr. Graham, to the museum of the Royal Society. Afterwards, in the third edition of his 'History of Quadrupeds,' he is inclined to consider it as identical with the *Mus longipes* of Pallas (the *Dipus meridianus* of Gmelin), an inhabitant of the warm sandy deserts bordering on the Caspian Sea. This opinion, which, in the opinion of Sir John, can scarcely be correct, was, he says, formed from an imperfect inspection of the Hudson's Bay specimen whilst it was suspended in spirits, and is opposed by differences in colour and other characters which he himself points out. From Pennant's time until Mr. Sabine described an individual brought from Cumberland House, on Captain Franklin's first journey, the Labrador Jumping Mouse does not, continues Sir John Richardson, appear to have attracted the notice of naturalists. Pennant, he observes, mentions a yellow lateral line in his specimen, which did not exist in the one Mr. Sabine described, but this difference Sir John Richardson attributes solely to the season in which they were procured. Mr. Sabine's specimen, he remarks, was mutilated in the tail, an accident very common to the whole family of Rats; and Pennant, under the name of Canada Jerboid Rat, and Colonel Davies, under that of *Dipus Canadensis*, describe another Jumping Mouse, which seems to differ from this in having ears shorter than the fur, but in other respects to be very similar to it.

After further observing that the *Gerbillus Canadensis* of Dr. Godman agrees in description with Rafinesque-Smaltz's *G. soricinus* (Desm.), but has larger ears than the Canada Rat of Pennant, and that a specimen in the Philadelphia Museum, described by Dr. Harlan under the name of *G. Canadensis*, appears to be entirely similar to the Labrador species, Sir John Richardson concludes by remarking that it is evident that the Jumping Mice inhabiting different districts of America require to be compared with each other before the true number of species and their geographical distribution can be ascertained.

It is common in the Fur Countries as far north as Great Slave Lake, and perhaps farther; but Sir John Richardson was not able to gain any precise information respecting its habits.

Pedetes (Illiger; *Helamys*, F. Cuvier).—Head large, flattish; muzzle thick; ears long. Anterior extremities with five toes armed with very long claws; posterior extremities very long, 4-toed. Tail long and very bushy. Four pectoral mammæ. Molars simple, with two laminæ.

Dental Formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$.



Teeth of (*Helamys*) *Pedetes*.

P. Capensis, the Grand Gerbo of Allamand; Spring-Has, or Jumping Hare of the Dutch; and Aerdmannetje of the Hottentots. It is the *Dipus Caffer* of Zimmerman, Schreber, and Gmelin. It is of a bright yellowish-tawny colour above, varied with blackish; white below, with a line of the same colour in the fold of the groins. Legs brown. Tail reddish above at its origin, gray below, and black at the tip. Length from nose to tail about 1 foot 2 inches; of the tail, near 15 inches; of the ears, 3 inches.

Jumping Hare (*Pedetes Capensis*).

It is a native of the Cape of Good Hope, where it sleeps during the day, going forth by night, and leaping twenty or thirty feet at a bound. It eats sitting nearly upright, with the hind legs extended horizontally, and using the small fore feet to bring the food to its mouth. It is a very strong animal, and with these same fore feet, which are admirably formed for digging, burrows so expeditiously as quickly to hide itself. It sleeps in a sitting position, placing the head between the legs, and holding its ears over its eyes with its fore legs.

Tail moderate or short. Sand and Mole Rats. Pouched.

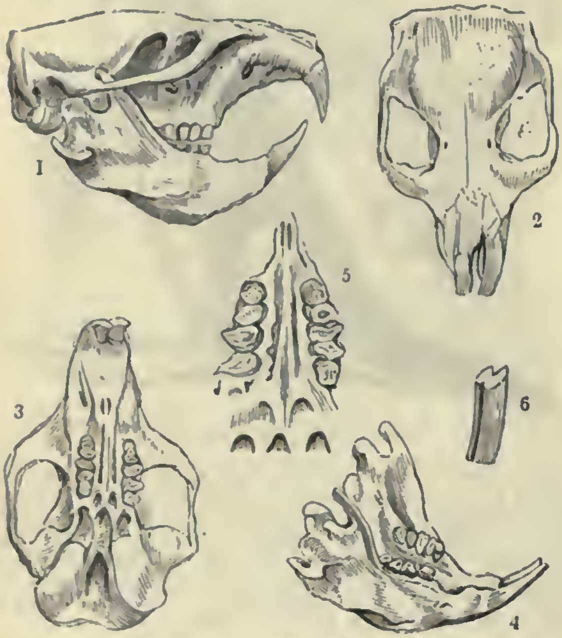
The genera *Saccophorus*, Kuhl; *Pseudostoma*, Say; *Geomys* and *Diplostoma*, Rafinesque; *Ascomys*, Lichtenstein; and *Saccomys*, F. Cuvier, are given by Dr. Fischer as synonymous; and indeed the distinctions, except perhaps in the case of *Geomys* and *Diplostoma*, do not appear to be sufficiently marked to warrant their separation.

Sir John Richardson remarks that M. Rafinesque-Smaltz, in 1817, founded his genus *Geomys* on the Hamster of Georgia (*Geomys pinetis*), described by Mitchell, Anderson, Meares, and others; and referred to it, as a second species, the Canada Pouched Rat (*Mus bursarius* of Shaw). Under another genus, *Diplostoma*, he arranged some Louisiana or Missouri animals, known to the Canadian voyagers by the appellation of Gauffres, and remarkable for their large cheek-pouches, which open forwards exterior to the mouth and incisors, to which they form a kind of hood. These two genera, he observes, have been adopted by few naturalists; and the American systematic writers have either overlooked M. Rafinesque's species entirely, or referred them all to *M. bursarius*. In the latter case, Sir John says, they are undoubtedly wrong; for there are at least six or seven distinct species belonging to one or other of these genera which inhabit America, and he thinks that both *Geomys* and *Diplostoma* will eventually prove to be good genera; the Sand-Rats belonging to the former having cheek-pouches which are filled from within the mouth, and the Gauffres, or Camas-Rats, of the latter genus, having their cheek-pouches exterior to the mouth, and entirely unconnected with its cavity. Sir John Richardson had no opportunity of examining *Geomys pinetis*, the type of the genus, but he had inspected an undescribed species from Cadadaguios, and another (*Geomys Douglasii*) from the banks of the Columbia; from these two Sir John Richardson's characters of the genus were drawn up. With regard to the Canada Pouched-Rat, great doubt, he observes, still exists as to whether it belongs properly to *Geomys* or to *Diplostoma*. Judging from the description of Dr. Shaw and the figure in 'Linn. Trans.' (vol. v. pl. 8), Sir John Richardson has little doubt of the cheek-pouches opening into the mouth, and of their being precisely similar in form and functions to the cheek-pouches of the Sand-Rats; but he states that he was told, on good authority, that the identical specimen described by Shaw (which at the sale of Bullock's museum passed into the hands of M. Temminck), is in fact similar to the Gauffres in having cheek-pouches that open exteriorly, and that consequently Major Davies's drawing represented them in an unnatural and inverted position. Mr. Say gives the characters of a Missouri Gauffre with cheek-pouches opening exteriorly, and he identifies his specimen with *M. bursarius*. The same zoologist alludes to the Georgia Hamster as belonging to the same genus, without giving any further account of its characters than merely quoting Dr. Barton's remark of its being only half the size of the Missouri one. His account of the dentition of the Missouri Gauffre, observes Sir John Richardson in conclusion, corresponds, as far as it goes, pretty closely with that of the Columbia *Geomys*. Dr. Harlan and Dr. Godman refer the Georgia, Canada, and Missouri animals to one species. ('Fauna Boreali-Americana.')

The following is the dental formula of *Geomys* given by Sir John Richardson:—

$$\text{Incisors, } \frac{2}{2}; \text{ Canines, } \frac{0-0}{0-0}; \text{ Grinders, } \frac{4-4}{4-4} = 20,$$

and below is given the skull and teeth of the genus from the same authority.



Skull and Teeth of *Geomys*. Richardson.

1, 2, 3, skull, natural size; 4, lower jaw, natural size; 5, palate and upper teeth, magnified; 6, first upper grinder, magnified.

The dental formula of M. F. Cuvier's genus *Saccomys* is:—

$$\text{Incisors, } \frac{2}{2}; \text{ Molars, } \frac{4-4}{4-4} = 20;$$

and the following cut is taken from his figure of the dentition.

Teeth of *Saccomys*, enlarged. F. Cuvier.

The following is Dr. Shaw's description of *Mus bursarius*:—"Ash-coloured rat, with short nearly naked tail, pouched cheeks, and the claws of the fore feet very large and formed for burrowing." (*Mus bursarius*, 'Linn. Trans.,' vol. v. p. 227, pl. 8.)

"This, which is a species but lately discovered, seems to be the most remarkable of all the pouched rats for the proportional size of the receptacles. It is a native of Canada, and the individual here figured was taken by some Indians in the year 1798, and afterwards presented to the lady of Governor Prescot. It is about the size of a brown or Norway rat, and is of a pale grayish-brown colour, rather lighter beneath: the length to the tail is about nine inches, and that of the tail, which is but slightly covered with hairs, about two inches: the legs are short; the fore feet strong, and well adapted for burrowing in the ground, having five claws, of which the three middle ones are very large and long; the interior much smaller, and the exterior very small, with a large tubercle or elbow beneath it. The claws on the hind feet are comparatively very small, but the two middle are larger than the rest, and the interior one is scarcely visible; the teeth are extremely strong, particularly the lower pair, which are much longer than the upper; the ears are very small. This species is described in the 5th vol. of the 'Trans. of Linn. Soc.,' but I must observe, that, by some oversight in the conduct of the figure there given, the claws on the fore feet are represented as only three in number, and are somewhat too long, weak, and curved; the engraving in the present plate is a more faithful representation, and is accompanied by an outline of the head, in its natural size, as viewed in front, in order to show the teeth and cheek-pouches. The manners of this species are at present unknown, but it may be concluded that it lays in a stock of provisions, either for autumnal or winter food. The pouches of the individual specimen above described, when first brought to Governor Prescot, were filled with a kind of earthy substance; it is therefore not improbable that the Indians who caught the animal might have stuffed them thus, in order to preserve them in their utmost extent."

Mus bursarius.

In Sir John Richardson's *Geomys Douglasii* the length of the head and body was 6 inches 6 lines; and that of the tail (vertebræ) 2 inches 10 lines. Cheek-pouches large, much resembling the thumb of a lady's glove in form and size, and hanging down by the sides of the head. The specimen was a female, and was taken in her nest with three young ones, near the mouth of the Columbia, by Mr. Douglas. When it came into the hands of Sir John Richardson the fur had mostly fallen off, but the specimen was in other respects perfect, and what was wanting to the description was supplied from Douglas's notes. The state of ossification of the skull showed the animal to be an old one. Douglas informed Sir John Richardson that the outside of the pouches was cold to the touch, even when the animal was alive, and that on the inside they were lined with small orbicular indurated glands, more numerous near the opening into the mouth. When full the pouches had an oblong form, and when empty they were corrugated or retracted to one-third of their length; but, it is added, they are never inverted so as to produce the hood-like form of the pouch of a *Diplostoma*. When in the act of emptying its pouches the animal sits on its hams like a marmot or squirrel, and squeezes his sacks against the breast with his chin and fore paws. ('Fauna Boreali-Americana.')

Sir John Richardson states that these little sand-rats are numerous in the neighbourhood of Fort Vancouver, where they inhabit the declivities of low hills, and burrow in the sandy soil. They feed on acorns, nuts (*Corylus rostrata*), and grass, and commit great havoc in the potato-fields adjoining the fort, not only by devouring the potatoes on the spot, but by carrying off large quantities of them in their pouches.

The following figure is copied from Sir John Richardson's *Diplostoma* (?) *bulbivorum*.

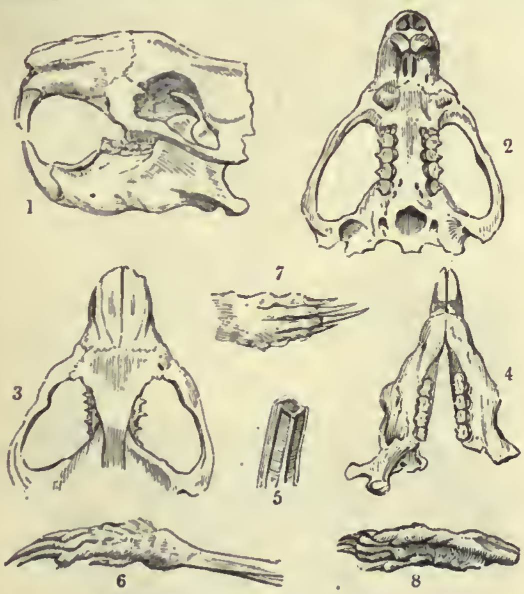
Diplostoma bulbivorum.

Not Pouched.

Aplodontia (Richardson).—Head large, depressed; ears short and round; no cheek-pouches. Feet 5-toed, with large, strong, and compressed claws. Tail very small, and concealed by the fur. First molar in upper jaw small, cylindrical, and pointed, placed within the anterior corner of the second one, and existing in the adult.

$$\text{Dental Formula :—Incisors, } \frac{2}{2}\text{; Molars, } \frac{5-5}{4-4} = 22.$$

A. leporina. Head large; nose thick and obtuse, covered with a dense coat of short fur; eye very small; ear resembling the human in form. Body short, thick, and rabbit-like. Legs very short, and covered down to the wrists and heels with fur similar to that on the body; a little above the wrist-joint, on the inner side, is a small tuft of stiff white hairs. Fur like that of a rabbit out of season, amber and chestnut-brown above; grayish or clove-brown beneath; lips whitish; a rather large spot of pure white on the throat; some white hairs dispersed through the fur. Tail slender, cylindrical, hardly half an inch long.



Skull, Teeth, and Paws of *Aplodontia*.

1, anterior half of the skull, with lower jaw, profile; 2, anterior half of skull, seen from below; 3, the same seen from above; 4, lower jaw, with right condyle broken, seen from above; 5, upper molar tooth; 6, 7, fore feet, upper surface; 8, sole of hind foot.

Sir John Richardson gives the following as the synonyms of this animal:—Sewellel, Lewis and Clark; *Anisonyx* (?) *rufa*, Rafinesque-Smaltz, Desm.; *Arctomys rufa*, Harlan; Marmot, No. 17, Hudson's Bay Museum; and he says that amongst Mr. Douglas's specimens there was a young one, with more white hairs interspersed through its fur, and some differences in the form of its skull, which seem to point it out as a second species, but the specimen was not sufficiently perfect to enable Sir John Richardson to give its characters as a distinct species, though he has little doubt of its being so. Sir John adds, that since the account of the genus was published in the 'Zoological Journal' (vol. iv.), Mr. Douglas had placed in his hands an Indian blanket, or robe, formed by sewing the skins of the Sewellel together. The robe contained 27 skins, which had been selected when the fur was in prime order. In all of them the long hairs were so numerous as to hide the wool or down at their roots, and their points had a very high lustre. The general colour of the surface of the fur was between chestnut and umber-brown, lighter, and with more lustre on the sides. Some of the skins which were in the best order had the long hairs on the back of the head and between the shoulders almost black. Sir John observes further, that it is probable that there were the skins of two species of Sewellels in the robe, and that one of them wants the white mark on the throat. The down of all the skins of the robe had a shining blackish-gray colour.

These animals live in small societies, in burrows, and feed on vegetable substances. They inhabit the neighbourhood of the Columbia River, and are most abundant near the great falls and rapids.

Dr. Gray makes the *Aspalacidæ* the fifth family of the *Glires*, with the following character:—

Cutting teeth two in each jaw, lower chisel- or awl-shaped, often very much exposed; grinders compound or simple; rarely rootless; ears and eyes often very small, sometimes hid; clavicles strong; limbs proportionate; tail none, or hairy, cylindrical; fur very soft. He thus subdivides it into five sub-families.

† 1. Aspalacina.—*Orycterus*, F. Cuv.; *Bathyergus*, Ill.; *Aspalax*, Oliv.

2. Lemnina (*Lemmina* ?).—*Arvicola*, Lacep.; *Sigmodon*, Say.; *Neotoma*, Say.; *Lemnus* (*Lemmus* ?), Linn.

†† 3. Cricetina.—*Cricetus*, Lacep.

4. Pseudostomina.—*Pseudostoma*, Say.; *Diplostoma* and *Geomys*, Rafin.

5. Arctomina.—*Arctomys*, Gmel.; *Spermophilus*, F. Cuv.

Dr. Fischer thinks that Cretzchmar's genus *Psammomys* should be placed before *Aspalax*. (See Rüppel, 'Zool. Atl.') *Psammomys obesus*, on which the genus is founded, lives gregariously in the sandy deserts of Alexandria, forming multifarious burrows, and is a nocturnal and root-eating animal, without cheek-pouches.

Aspalax (Oliv. and others; *Spalax*, Güld., Ill., and others).—Muzzle obtuse. Eyes rudimentary, and hidden under the skin. Ears null, or mere obsolete margins of the auditory passage. Body thick and cylindrical. Feet short, pentadactyle, with falcular claws, proper for digging. Tail null or very short. Molars simple.

$$\text{Dental Formula :—Incisors, } \frac{2}{2}\text{; Molars, } \frac{3-3}{3-3} = 16.$$

A. typhlus.—This species appears to be the *Spalax typhlus* of Illiger; *Aspalax typhlus* of Desmarest; *Mus typhlus* of Pallas and others; *Marmota typhlus* of Blumenbach; *Georychus typhlus* of Lesson; the Zemui of Rzaczynski; the Slepez of Gmelin; the Podolian Marmot of Pennant; and the Blind Rat of Shaw.

Podolian Marmot (*Aspalax typhlus*).

Description.—The head is broader than the body, no aperture for the rudimentary eyes, which, no bigger than poppy-seeds, are hid beneath the skin; no external ears; end of the nose covered with a thick skin, nostrils very remote, and placed below; limbs very short; toes separated, except a thin membrane at the base, claws short; hair or fur short, thick, and very soft, dusky at the bottom and cinereous gray at the tip, space about the nose and above the mouth white. Length between 7 and 8 inches.

This is supposed by some to be the 'Ασπάλαξ of Aristotle ('Hist. Anim.,' l. 9 and iv. 8). It is evident, from both the passages quoted, that he had accurately examined that part of the animal where the eye should be, and the result of his examination clearly agrees with the condition of those parts in the *Aspalax* of the moderns; but it must not be forgotten that those and other passages will equally apply to a second species of Mole (*Talpa*), now named *Talpa cæca*, which inhabits Europe, and in which the eyelids are closed, whilst in the common species they are open.

This species, which the Russians name Slepez, or the Blind, and the Cossacks Sfochor Nomon, signifying the same defect, burrows extensively beneath the turf, driving at intervals lateral passages in its search for roots, particularly that of the bulbous *Chærophyllum.* Openings to the surface occur at distances of some yards from each other, and there the earth is raised into hillocks, sometimes of two yards in circumference, and of considerable height. It works stoutly and rapidly, and on the approach of an enemy instantly digs a perpendicular burrow. Though it cannot see, it lifts its head in a menacing attitude towards its assailant, and when irritated snorts and gnashes its teeth, but emits no cry: its bite is very severe. In the morning it often quits its hole, and during the season of love basks in the sun with the female. It is worthy of notice that there runs a superstition in the Ukraine that the hand which has suffocated one of these animals is gifted with the virtue of curing scrofula, or the King's Evil (as it is still called), in the same way that it was supposed to vanish before the royal touch of the Stuarts in this country.

It is found in the southern parts of Russia, from Poland to the Volga, but not to the east of that river; it is common from the Sysran to the Sarpa, and frequent along the Don, even to its origin, and about the town of Rœsk, but not in the sandy parts.

Bathyergus, Brants (*Orycterus*, F. Cuv.).—M. F. Cuvier assigns to *Bathyergus* only three molars in each jaw; whilst to *Orycterus* he assigns four.

The Dental Formula of the first, according to this statement, would be :—Incisors, $\frac{2}{2}$; Molars, $\frac{3-3}{3-3} = 16$; and of the second, Incisors, $\frac{2}{2}$; Molars, $\frac{4-4}{4-4} = 20$.

Teeth of *Orycterus*. F. Cuvier.

Dr. Fischer quotes Professor Kaup for the opinion that the *Bathyergus Capensis* of Brants (Cape Rat of Shaw and Pennant) and *Bathyergus maritimus* of Brants (Coast Rat of Shaw, *Orycterus maritimus* of F. Cuvier) are identical, the former being the animal in a comparatively early stage of life. The latter is the Zand Moll of the Dutch and Kauw-Howba of the Hottentots: it is of a reddish-gray or ash-colour, above, and hoary beneath. Length from tip of muzzle to origin of tail, 1 foot 1½ inch; of tail without the hair, 1 inch 1 line; of the pencil of hairs, 10 lines. There is a variety all white.

It is found among the sand-flats of the Cape of Good Hope, wherein it burrows in great numbers. In every part of those flats Burchell observed innumerable mole-hills, and his foot often sunk into their galleries: for this reason, he remarks, it is very unpleasant, if not dangerous, to ride on horseback in such places, as persons are liable to be thrown by the feet of their horses unexpectedly sinking into these holes.

Coast Rat (*Orycterus maritimus*).

The following genera are placed by Mr. Swainson among the Squirrels, and, indeed, there is much about them to indicate a near approach to that family of Rodents.

Not Pouched.

Arctomys (Gmelin).—Head and eyes large; ears short; body stout; fore feet with four toes and an obsolete thumb, hind feet five-toed. Tail short. Upper surface of molars ridged and tuberculous.

Dental Formula :—Incisors, $\frac{2}{2}$; Molars, $\frac{5-5}{4-4} = 22$.

A. Marmota, Schreb., and *A. Empetra*, Schreb. may be given as examples: the latter of the American Marmots.

A. Marmota. This is the *Mus Alpinus* of Gesner and others; *Mus Marmota* of Linnæus and others; *Glis Marmota* of Klein; *Marmota Alpina* of Blumenbach; Marmotte of Buffon; Murmelthier of Kramer and of Meyer; and Alpenmurmelthier of Schrank.

The cheeks are large; ears round and short, hid in the fur; body stout; head and upper parts brownish-ash mingled with tawny; legs and under parts reddish; tail rather full; length from nose to tail, about 16 inches; of the tail, 6 inches.

This well-known species is found in the Alps and Pyrenees, even, it is said, on the summits of those mountain chains. They live in little societies, feeding on roots and vegetables, and occasionally on insects. Their holes are formed in the ground, generally with three chambers in the shape of a Y, with two entrances. These apartments are comfortably lined with moss and hay, and to them the Marmots retire about Michaelmas, having stopped up the entrances with earth, there to doze away the inclement months, till the warm suns and showers of April arouse them from their torpidity to partake of the renewed vegetation. From five to a dozen are said to be lodged in a chamber. They lift their food to their mouths with their fore feet, eat it sitting, and will walk on their hind feet. When on their feed a sentinel is placed to watch, and on the approach of danger his whistle drives them instantly to their subterranean retreats. They are playful creatures, but when angry or before a storm pierce the ear with their shrill whistle. Though they soon become tame, and will eat almost anything, they bite very hard when offended. Milk pleases them greatly, and they lap it with satisfactory murmurs. They become fat, and are sometimes eaten; but they are taken by the Savoyards and others principally that they may be exhibited by those itinerants. The number of young at a birth is generally three or four.

Alpine Marmot (*Arctomys Marmota*).

A. Empetra is the Quebec Marmot of Pennant and Godman; the Common Marmot of Langsdorff; the Thick-Wood Badger of the Hudson's Bay residents; the Siffleur of the French Canadians, who apply the same name to the other species of Marmot and to the Badger; Tarbagan of the Russian residents on Kodiak (?); Weenusk of the Crees; Kath-hillœ-Kooay of the Chepewyans; *Mus Empetra* of Pallas; *Arctomys Empetra* of Sabine and others. It is hoary above, mixed with black, and bright brown shining through; reddish-orange beneath; head and feet blackish-brown; cheeks whitish; ears flat, round, moderate; tail about half the length of the body, black at the tip. Length of the head and body, from 17 to 20 inches; of tail vertebræ), 5½ inches.

Quebec Marmot (*Arctomys Empetra*).

Sir John Richardson, who gives the above synonyms, states that the Quebec Marmot inhabits the woody districts from Canada to 61° N. lat., and perhaps still farther north. He says that it appears to be a solitary animal, inhabits burrows in the earth, but ascends bushes and trees, probably in search of buds and other vegetable productions, on which it feeds. Mr. Drummond killed two, one on some low bushes, and the other on the branch of a tree. According to Mr. Graham it burrows perpendicularly, selecting dry spots at some distance from the coast, and feeding on the coarse grass which it gathers on the river-sides. The Indians capture it by pouring water into its holes. The flesh is considered delicate when the animal is fat. The fur is valueless. It much resembles the Bobac of Poland in form and general appearance. ('Fauna Boreali-Americana.') Pennant says, "Mr. Brooks had one alive a few years ago; it was very tame, and made a hissing noise."

This species has a slight folding of the lining of the mouth, forming the rudiment of a cheek-pouch. (Richardson.)

Pouched.

Spermophilus (F. Cuvier).—Dental formula as in *Arctomys;* the molars are narrow. Cheeks with large pouches; toes narrow and free; heel covered with hair; hind toes naked.

A. (*Spermophilus*) *Parryi.* This, according to Sir John Richardson, who first named the species, is the Ground Squirrel of Hearne; the Quebec Marmot of Forster; the Seek-Seek of the Esquimaux; the Thœ-Thiay (Rock-Badger) of the Chepewyans; and the *Arctomys Alpina* of Parry's 'Second Voyage.'

Ears very short; body thickly spotted above with white on a gray or black ground, pale rust-coloured beneath; face chestnut-coloured; the tail one-third longer than the hind feet, stretched out flat, black at the extremity, with a narrow white margin, rust-coloured beneath. Length of head and body, 8 inches 6 lines; of tail (vertebræ), 1 inch 6 lines.

Sir John Richardson tells us that this Spermophile inhabits the Barren Grounds skirting the sea-coast from Fort Churchill in Hudson's Bay round by Melville Peninsula, and the whole northern extremity of the continent to Behring's Straits, where specimens precisely similar were procured by Captain Beechey. It is abundant in the neighbourhood of Fort Enterprise, near the southern verge of the Barren Grounds, in 65° N. lat., and is also plentiful on Cape Parry, one of the most northern parts of the continent. It is found generally in stony districts, but seems to delight chiefly in sandy hillocks amongst rocks, where burrows, inhabited by different individuals, may be often observed crowded together. One of the society is generally observed sitting erect on the summit of a hillock, whilst the others are feeding in the neighbourhood. Upon the approach of danger he gives the alarm, and they instantly hurry to their holes, remaining however chattering at the entrance until the advance of the enemy obliges them to retire to the bottom. When their retreat is cut off they become much terrified, and, seeking shelter in the first crevice, they not unfrequently succeed only in hiding the head and fore part of the body, whilst the projecting tail is, as is usual with them under the influence of terror, spread out flat on the rock. Their cry in this season of distress strongly resembles the loud alarm of the Hudson's Bay Squirrel, and is not very unlike the sound of a watchman's rattle. The Esquimaux name is an attempt to express this sound. Hearne states that they are easily tamed, and very cleanly and playful when domesticated. They never come abroad during the winter. Their food appears to be entirely vegetable; their pouches being generally filled, according to the season, with tender shoots of herbaceous plants, berries of the alpine arbutus, and of other trailing shrubs, or the seeds of grasses and leguminous plants. They produce about seven young at a time. ('Fauna Boreali-Americana.') Sir John Richardson's figure, from which the cut is taken, was drawn from a specimen procured from the banks of the Mackenzie River.

Ground Squirrel (*Arctomys* (*Spermophilus*) *Parryi*).

The genus *Aulacodus* of Temminck is placed by Dr. Fischer between *Dipus* and *Arctomys.*

Mr. Waterhouse, in his interesting 'Observations on the Rodentia, with a view to point out the Groups, as indicated by the Structure of the Crania, in this order of Mammals' ('Mag. Nat. Hist.,' 1839), states the following as the principal genera of his section *Murina:—Sciurus, Arctomys, Myoxus, Dipus, Mus, Arvicola, Geomys,* and *Castor.* The principal genera in the section *Hystricina* are, according to the same author,—*Bathyergus, Poephagomys, Octodon, Habrocoma, Myopotamus, Capromys, Echimys, Aulacodus, Hystrix, Dasyprocta, Chinchilla,* and *Hydrochœrus.*

In the 'Zoology of H.M.S. Beagle' (Sept., 1839), Mr. Waterhouse says that he has been induced, by the differences there pointed out in the molar teeth of the two groups, to separate the South American Mice from those of the Old World, or rather from that group of which *Mus decumanus* may be regarded as the type; and to place them, together with such North American species as agree with them in dentition, in a new genus bearing the name of *Hesperomys.* Mr. Waterhouse will not venture to say whether this group be confined to the western hemisphere or not; but he thinks that he may safely affirm that that portion of the globe is their chief metropolis. In the species of *Hesperomys,* he observes, the molar teeth are always rooted; and in the form of the skull and lower jaw they agree with the *Muridæ,* and do not present the characters pointed out by him as distinguishing the *Arvicolidæ;* and, as regards the cranium and lower jaw, it is only in the genus *Neotoma* that any approach is evinced, in his opinion. Under the family *Octodontidæ* he places the genera *Ctenomys, Poephagomys, Octodon,* and *Abrocoma,* which last he states to be allied on the one hand to the genera *Octodon, Poephagomys,* and *Ctenomys,* and on the other to the family *Chinchillidæ.* The *Octodontidæ* appear to him to bear the same relation to *Echimys* as the *Arvicolæ* do to the *Muridæ.* [RODENTIA; HYSTRICIDÆ; SCIURIDÆ.]

In the collection of the British Museum the student will find specimens of nearly all the *Muridæ* at present known. The following is a list of the species found in that collection, with the countries in which the specimens were found:—

Family *Muridæ.*

a. Murina.

1. *Acanthomys Cahirinus,* the Cairo Rat. Egypt.
2. *A. affinis,* the Allied Acanthomys. Egypt.
3. *Mus Bandicota* (Bechstein), the Bandicoot, or Pig-Rat. Nepaul.
4. *M. nitidus* (Hodgson), the Shining Rat. Nepaul.
5. *M. setiger* (Horsfield), the Wirok. Van Diemen's Land.
6. *M. gigas,* the Egyptian Bandicoot. Egypt.
7. *M. decumanus* (Pallas), the Norway Rat. Great Britain and India.
8. *M. Rattus* (Linnæus), the Black Rat. Great Britain.
9. *M. penicillatus* (Gould), the Pencilled Rat. Van Diemen's Land.
10. *M. Decumanoides* (Hodgson), the Indian Rat. Nepaul.

11. *M. Asiaticus* (Gray), the Asiatic Rat. Mexico and India.
12. *M. niviventer* (Hodgson), the White-Bellied Rat. Nepaul.
13. *M. Kok* (Gray), the Kok. India.
14. *M. dolichurus* (Temminck), the Hairy-Eared Rat. South Africa.
15. *M. Abyssinicus* (Rüppell), the Abyssinian Rat. Abyssinia.
16. *M. Ellioti*, Elliot's Rat. Madras.
17. *M. rufescens* (Gray), the Red House-Rat. India.
18. *M. albipes* (Rüppell), the White-Footed Rat. Abyssinia.
19. *M. leucosternum* (Rüppell), the White-Chested Rat. Abyssinia.
20. *M. variegatus* (Brants), the Variegated Rat. Egypt.
21. *M. Musculus* (Linnæus), the Common Mouse. Great Britain and Australia.
22. *M. sylvaticus* (Linnæus), the Wood-Mouse. Great Britain.
23. *M. Mauci*, the Mauci. Madras.
24. *M. fuscipes* (Waterhouse), the Brown-Footed Rat. Australia, Van Diemen's Land, &c.
25. *M. Gouldii* (Waterhouse), the South Australian Rat. South Australia.
26. *M. fuscus*, the Brownish Rat. South Australia.
27. *M. Australasicus*, the Australasian Rat. South Australia.
28. *M. Novæ Hollandiæ* (Waterhouse), Waterhouse's Mouse. Australia.
29. *M. delicatulus* (Gould), the Delicate Mouse. Port Essington.
30. *M. pumilio* (Sparmann), the Lineated Mouse. Cape of Good Hope.
31. *Micromys minutus* (Selys de Longchamp), the Harvest-Mouse. Great Britain.
32. *Callomys leucopus* (Waterhouse), the American Field-Mouse. America.
33. *Vandeleuria oleracea* (Gray), the Meinalka. Madras.
34. *V. dumeticola*, Hodgson's Free Mouse. Nepaul.
35. *Nesokia Hardwickii* (Gray), the Nesoki. India.
36. *Pseudomys Grayii*, Gray's Pseudomys. Australia.
37. *P. Australis* (Gray), the Pseudomys. Australia.
38. *Golunda Ellioti* (Gray), the Galandi. Madras.
39. *G. Meltada* (Gray), the Meltada. Madras.
40. *G. Barbara*, the Barbary Mouse. North Africa.
41. *Leggada Booduga* (Gray), the Buduga. Madras.
42. *L. platythrix* (Gray), the Leggade. Madras.
43. *Holochilus aviculoides*, the Bogota Rat. Santa Fé de Bogota.
44. *H. Brasiliensis*, the Brazilian Rat. Bahia.
45. *H. nasutus*, the Sharp-Nosed Rat. Brazil (?).
46. *H. Angouya* (Brandt), the Angouya. Brazil.
47. *Abrothrix obscurus* (Waterhouse), the Dusky American Rat. South America.
48. *Cricetus frumentarius* (Pallas), the Hamster. Europe.
49. *Dendromys typicus* (A. Smith), the Free Mouse. Cape of Good Hope.
50. *D. melanotus* (A. Smith), the Black-Backed Free Mouse. Cape of Good Hope.
51. *Phlæomys Cumingii* (Waterhouse), the Phlæomys. Manilla.
52. *Hapalotis albipes* (Lichtensteiu), the Rabbit-Rat. Australia.
53. *H. melanura* (Gould), the Black-Tailed Rabbit-Rat.
54. *H. Gouldii* (Gray), Gould's Rabbit-Rat. Port Essington.

b. Arvicolina.

55. *Meriones Labradorius* (Richardson), the Katsè. North America.
56. *Euryotis irroratus* (Brants), the Vley Muis. South Africa.
57. *E. Brantsii* (A. Smith), the Vlakte Muis. Cape of Good Hope.
58. *E. unisulcata* (A. Smith), the One-Grooved Euryotis.
59. *Otomys typicus* (A. Smith), the Otomys. Cape of Good Hope.
60. *O. albicaudatus* (A. Smith), the White-Tailed Otomys. Cape of Good Hope.
61. *Sigmodon hispidum* (Say), the Sigmodon. Florida.
62. *Neotoma Floridana* (Say), the Neotoma. Florida.
63. *Teonoma Drummondii*, the Teonoma. North America.
64. *Ctenodactylus Massoni* (Gray), the Gundi. Cape of Good Hope (?).
65. *Mynomes riparius*, the Bank Meadow-Mouse. North America.
66. *Arvicola amphibius* (Desmoulins), the Water-Rat. Great Britain.
67. *A. Americanus* (Gray), the American Water-Rat. South America.
68. *A. Pennsylvanicus* (Richardson), Wilson's Meadow-Mouse. Hudson's Bay.
69. *A. xanthognathus* (Leach), the Yellow-Cheeked Vole. North America.
70. *A. arvalis*, the Campagnol. Great Britain and Belgium.
71. *A. subterraneus* (Selys de Longchamp), the Subterranean Vole. Belgium.
72. *A. glareolus*, the Bank Campagnol. Great Britain.
73. *A. Roylei* (Gray), the Indian Vole. India.
74. *A.* (?) *hydrophilus* (Hodgson), the Nepaul Vole. Nepaul.
75. *A.* —— (?), the Russian Vole. Russian Soongoro.
76. *A. noveboracensis* (Richardson), the Sharp-Nosed Meadow-Mouse. North America.
77. *A. borealis* (Richardson), the Awinnak, or Northern Meadow-Mouse. North America.
78. *Myodes helvolus*, the Tawny Lemming. Alpine swamps.
79. *M. trimucronatus*, Back's Lemming. North America.
80. *M. Lemmus*, the Lemming. Norway.
81. *M. Hudsonius* (E. Sabine), the Hudson's Bay Lemming. North America.
82. *Lemmus Greenlandicus*, the Owinyak, or Greenland Lemming. Hudson's Bay.

c. Saccomyna.

83. *Dipodomys Phillipsii* (Gray), the Pouched Jerboa Mouse. Mexico.
84. *Heteromys anomalus* (Gray), the Spiny Pouched Rat. Trinidad.

d. Castorina.

85. *Castor Fiber* (Linnæus), the Beaver. North America.
86. *Myopotamus Coypus* (T. Geoffroy), the Coypu, or Racoonda. Central America and Chili.
87. *Fiber zibethicus* (Desmoulins), the Ondatra. North America.
88. *Hydromys chrysogaster* (Geoffroy), the Hydromys. Van Diemen's Land.

e. Echimyna.

89. *Octodon Degus*, the Cucurrito, or the Degus. Chili.
90. *Aulacodus Swinderianus* (Temminck), the Ground Pig. South Africa.
91. *Echimys myosuros* (T. Geoffroy), the Red-Tailed Echimys. Tropical America.
92. *Petromys typicus* (A. Smith), the Rock-Mouse. South Africa.

Fossil Muridæ.—Arvicola (Lacép., *Lemmus*, Link.).—1, Campagnol des Schistes de Bohême (Cuv.); Bohemia. 2, Campagnol des Cavernes (Cuv.); bone-caves, Kirkdale. (Buckland, 'Reliq. Diluv.') 3, Petit Campagnol des Cavernes (Cuv.); bone-caves, Kirkdale. (Buckland, 'Reliq. Diluv.'), where it would seem that there may be other species. *Arvicolæ* also occur in the bone breccias of Cette, Nice, Corsica, and Sardinia; in the tertiary of Puy-de-Dome; and in the bone-caves of Gailenreuth, Sundwick, &c.

Dr. Buckland notices the extreme abundance of the teeth of Water-Rats in the Kirkdale Cave. The same author remarks that the teeth and bones of Water-Rats had been found by Cuvier to occur abundantly in many of the osseous breccias from the shores of the Mediterranean and Adriatic, and that the Baron had also in his collection a large mass from Sardinia, composed exclusively of the bones and teeth of these animals, nearly as white as ivory, and slightly adhering together by delicate stalagmite. ('Reliquiæ Diluvianæ.')

Myoxus.—1, Loir des Platrières (Cuv.), Gypsum of Montmartre. 2, Second Loir des Platrières (Cuv.), Gypsum of Montmartre. 3, *Myoxus primigenius* (Meyer, *Arctomys primigenia*, Kaup). Another *Myoxus* is recorded from the Œningen beds. Dr. Buckland, in his 'List of Vertebral Animals found in the Gypsum of the Paris Basin,' records two small species of Dormouse, those above noticed in all probability, as extinct species.

Mus.—1, *M. Musculus fossilis* (Karg), Œningen beds. Remains of Mice have also been found in the bone-caves and Osseous Breccias. Thus Dr. Buckland describes and figures ('Reliq. Diluv.,' p. 15, pl. 11) the jaw and teeth of a mouse from the Kirkdale Cave. In the Eocene formation (lacustrine) of Cournon, in Auvergne, a Rat is recorded as one of the animals found with the fossil eggs of aquatic birds.

Dipus (*Gerbillus*, Desm.; *Meriones*, Ill.).—Remains of this form are recorded in the Tertiary beds. Bean iron-ore of the Rauh Alp. (Jæger). Russia. (Fischer.)

Ctenomys.—Mr. Darwin found at Bahia Blanca, in a cliff of red earth, part of the head of a *Ctenomys*; the species being different from the Tucutuco, but with a close general resemblance.

Spermophilus.—*S. superciliosus* (Kaup). Tertiary: Eppelsheim Sand.

MUS. [MURIDÆ.]

MUSA, a genus of Endogenous Plants, the type of the natural order *Musaceæ*. The species consist of herbaceous plants, having a gigantic simple stem, thickly clothed with the sheathing petioles of long, broad, horizontal leaves, which form a tuft, like that of some palm, on the apex of the stem. These leaves are of a firm but thin texture, and are undivided; but having simple veins running directly from the margin towards the midrib, and presenting a broad surface to the wind, they are always torn into broad strap-like divisions, which give them a compound appearance. From the midst of these leaves proceeds the inflorescence, consisting of a compound spike of great size, each of whose divisions is inclosed in a large bract or spathe, loaded with male flowers at its base, but bearing females or hermaphrodites at the upper end. The perianth consists of 6 superior divisions, five of which are grown together into a tube, slit at the back, while the sixth is small and concave. There are 6 stamens, one or more of which are imperfect. The ovary is inferior, 3-celled, with a double row of numerous ovules in each cell; the style is short; the stigma is funnel-shaped, and obscurely 6-lobed. The fruit is an oblong fleshy body, obscurely 3-5-cornered, containing numerous seeds buried in pulp. The latter are roundish, the size of a pea, flattened, with a hard brittle shell, which is indented at the hilum.

This genus is one of the most important of those found in tropical countries, to which the species are confined in a wild state. The *M. Sapientum*, or Plantain, of which the Banana, or *M. paradisiaca*, is a slight variety, has a fruit used to a prodigious extent by the inhabit-

Plantain (*Musa Sapientum*).

ants of the torrid zone; and, from its nutritious qualities and general use, it may, whether used in a raw or dressed form, be regarded rather as a necessary article of food than as an occasional luxury. In equinoctial Asia and America, in tropical Africa, in the islands of the Atlantic and Pacific oceans, wherever the mean heat of the year exceeds 24 centigrade degrees (75° Fahrenheit), the plantain is one of the most interesting objects of cultivation for the subsistence of man. Three dozen fruits will maintain a person, instead of bread, for a week, and even appears a better diet in warm countries. Indeed the plantain is often the whole support of an Indian family. The fruit is produced from among the immense leaves, in bunches weighing from 30 to 80 lbs., of various colours, and of great diversity of form. It usually is long and narrow, of a pale-yellow or dark-red colour, with a yellow farinaceous flesh. But in form it varies to oblong and nearly spherical; and in colour it offers all the shades and variations of tints that the combination of yellow and red, in different proportions, can produce. Some sorts are said always to be of a bright-green colour. In general, the character of the fruit to an European palate is that of mild insipidity; some sorts are even so coarse as not to be edible without preparation. The greater number however are eaten in their raw state, and some varieties acquire by cultivation a very exquisite flavour, even surpassing the finest pear. In the better sorts the flesh has a fine butter-yellow colour, is of a delicate taste, and melts in the mouth like marmalade. To point out all the kinds that are cultivated in the East Indies alone would be as difficult as to describe the varieties of apples and pears in Europe, for the names vary according to the form, size, taste, and colour of the fruits. Sixteen principal kinds are described at length by Rumphius, from which all the others seem to have diverged. Of these the worst are, Pisang Swangi, Pisang Tando, and Pisang Gabba-Gabb; and the best are the round, soft, yellowish sorts, called Pisang Medji and Pisang Radja. Some cultivators at Batavia boast of having 80 sorts. Rheede distinguishes 14 varieties by name, as natives of Malabar. In Sumatra alone 20 varieties are cultivated, among which the Pisang Amas, or Small Yellow Plantain, is esteemed the most delicate, and next to that the Pisang Raja, Pisang Dingen, and Pisang Kallé. In the West Indies, plantains appear to be even more extensively employed than in the eastern world. The modes of eating them are various. The best sorts are served up raw at table, as in the East Indies, and have been compared for flavour to an excellent reinette apple after its sweetness has been condensed by keeping through the winter. Sometimes they are baked in their skins, and then they taste like the best stewed pears of Europe. They are also the principal ingredient in a variety of dishes, particularly in one called mantágue, which is made of slices of them fried in butter and powdered over with fine sugar. Of the many cultivated sorts, that called by the French La Banane Musquée is considered the best; it is less than the others, but has a more delicate flavour. There are uncoloured figures of the plantain fruit in Rheede's 'Hortus Malabaricus,' vol. i., plates 12, 13, and 14; and coloured ones in Tussac's 'Flore des Antilles,' plates 1, 2. All hot climates seem equally congenial to the growth of this plant; in Cuba it is even cultivated in situations where the thermometer descends to 7 centesimal degrees (45° Fahrenheit), and sometimes nearly to freezing point. There is a hardy variety called Camburi, which is grown with success at Malaga.

The Plantain prefers a rich fat soil; for in sandy places, where it flowers abundantly, it produces no fruit.

In the climates that suit it, there is no plant more extensively useful, independently of its being an indispensable article of food. A tough fibre, capable of being made into thread of great fineness, is obtained from its stem; and the leaves, from their breadth and hardness, form an excellent material for the thatch of cottages. An intoxicating liquor is also made from the fruits when fermented, and the young shoots are eaten as a delicate vegetable.

The Banana of hot countries is a mere variety of the Plantain, distinguished by being dwarf, with a spotted stem and a more delicate fruit. Botanists call it *Musa paradisiaca*, in allusion to an old notion that it was the Forbidden Fruit of Scripture: it has also been supposed to be what was intended by the grapes, one bunch of which was borne upon a pole between two men, that the spies of Moses brought out of the Promised Land. The only argument of any importance in support of the latter opinion is, that there is no other fruit to which the weight of the fruit of Scripture will apply.

All the genus is Asiatic; the wild plantain is found in the forests of Chittagong, where it blossoms during the rains; *M. coccinea*, a dwarf sort, with a stem not more than 3 or 4 feet high, is found in China; *M. ornata* and *M. superba* inhabit the forests of Bengal; *M. glauca* is from Pegu; *M. textilis* is from the Philippines, where it furnishes the valuable thread called Manilla Hemp. There is also in the gardens of England a plant called *M. Cavendishii*, not above 3 feet high, and fruiting abundantly at that size, the origin of which is said to be Mauritius.

MUSA'CEÆ, *Musads*, a natural order of Endogens, of which the genus *Musa* is the representative. They are stemless or nearly stemless plants, with leaves sheathing at the base and forming a kind of spurious stem, often very large; their limb separated from the taper petiole by a round tumour, and having five parallel veins diverging regularly from the midrib towards the margin. Flowers spathaceous; periauth 6-parted, adherent, petaloid, in two distinct rows, more or less irregular; stamens 6, inserted upon the middle of the divisions, some always becoming abortive; anthers linear, turned inwards,

Musaceæ.

1, a Musaceous flower, with its inferior ovary; 2, the sexual apparatus of a male flower; 3, ditto of a female flower; 4, a section of an ovary; 5, a ripe fruit; 6, the same cut through transversely.

2-celled, often having a membranous petaloid crest; ovary inferior, 3-celled, many-seeded, rarely 3-seeded; ovules anatropal; style simple; stigma usually 3-lobed. Fruit either a 3-celled capsule, with a coculicidal dehiscence, or succulent and indehiscent. Seeds continuous, surrounded by hairs, with an integument which is usually crustaceous; embryo orthotropal, oblong-linear, or mushroom-shaped, with the radicular end touching the hilum, having pierced through the mealy albumen.

The species are stately and always beautiful herbaceous plants with the aspect of a plantain, and with large bracts and spathes, which are usually coloured of some gay tint. The characteristic marks of the order are to have an inferior ovary, with very irregular and unsymmetrical flowers, whose sexual apparatus is not consolidated. It is chiefly by these distinctions that it is known from *Amaryllidaceæ*. In some the fruit is fleshy, as in the Plantain; in others it is dry and capsular. Only 4 genera are known of this order, consisting of about 20 species, all of striking beauty. *Heliconia* is the principal American form, nearly all the others being found in the Old World; of these the species are conspicuous for their brilliantly-coloured rigid boat-shaped bracts, sometimes yellow, sometimes scarlet, and even a mixture of both. The species of *Strelitzia* are Cape plants with rigid glaucous leaves, and singularly irregular flowers of considerable size, coloured yellow and blue or pure white. Finally, the Ravenula of Madagascar (*Urania speciosa*), a noble palm-like plant, is remarkable for the brilliant blue colour of the lacerated pulpy aril which envelopes the seeds; the latter are used for dyeing in Madagascar, but none of the order are of any important use to man, with the exception of the Musas themselves. [MUSA.]

MUSANGA, the name of the seeds of species of *Cecropia* and *Artocarpus*, used by the Africans of the Gold Coast.

MUSCA. [MUSCIDÆ.]

MUSCALES, an alliance of Acrogenous Plants in Lindley's arrangement of the Vegetable Kingdom. It includes two divisions:—1. *Hepaticæ*; 2. *Musci*. The *Hepaticæ* include the orders *Ricciaceæ*, *Marchantiaceæ*, *Jungermanniaceæ*, and *Equisetaceæ*. [ACROGENS; RICCIACEÆ; JUNGERMANNIACEÆ; MARCHANTIACEÆ; EQUISETACEÆ.] The *Musci* include the orders *Andræaceæ* and *Bryaceæ*. [MUSCI.]

MUSCARDINE, the name given to a disease to which silk-worms are subject, and which often causes great injury to those who cultivate these animals for the sake of their silk. This disease is attended with the development of a fungus belonging to the genus *Botrytis*, and has been named by Balsamo and Montagne *B. Bassiana*. This plant, which is characteristic of the disease, can be propagated by the introduction of spores into a healthy caterpillar. The result of the changes produced upon the blood and tissues of the animal is its death. This disease is much more common some years than others. It frequently spreads to other insects; and the caterpillars of other *Lepidoptera* can be inoculated by the spores of the *Botrytis*. When once the disease has appeared there seems to be no means of checking it. The best mode of prevention is to take care that the caterpillars are not over-crowded, and that they have a sufficient supply of fresh food. The predisposition to this disease amongst silk-worms seems to be brought on by the same causes as those which act upon the human system, and render it favourable to the attacks of epidemic diseases. [ENTOPHYTA; FUNGI; BOTRYTIS; MOULDINESS.] (Robin, *Hist. des Végétaux Parasites.*)

MUSCA'RI, a genus of Plants belonging to the natural order *Liliaceæ*. It has a globose and subcylindrical perianth, narrowed at the mouth, and 6-toothed; the stamens are inserted at about the middle of the tube, the filaments not decurrent.

M. racemosum, Grape-Hyacinth, is the only British species of this genus. It abounds in Suffolk, near Pakenham, and is found in some other parts of Great Britain. It has ovate nodding crowded flowers, the upper ones nearly sessile, abortive; the leaves linear, flaccid, and recurved. The flowers are of a dark-blue colour. It grows most abundantly in sandy fields.

The bulbs of *M. moschatum* are, according to Lindley, emetic.

(Babington, *Manual of Brit. Botany*; Lindley, *Veget. Kingdom.*)

MUSCHELKALK. A Calcareous Rock, interposed in the midst of the New Red-Sandstone System, receives this name in Germany, and though it is not more carboniferous than some other limestones, yet it is much richer in organic remains than the average of the strata with which it is associated. This rock occupies a considerable space in the vicinity of the Harz, Schwarzwald, and Vosges Mountains, but is unknown in the British Isles, though several small bands of calcareous rock interlaminate the variegated clays of the Red-Sandstone System. Brown ('Lithæa Geognostica') presents the following synopsis of the strata in this formation, as it appears on the flanks of the Black Forest:—

Keuper Formation.

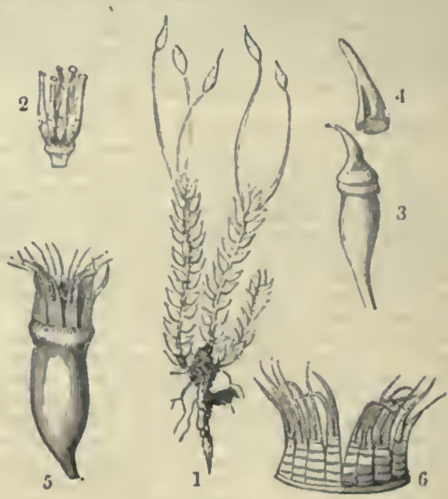
Muschelkalk.	Dolomite . .	Dolomite (Nagelfels, Malbstein).
	Limestone of Friedrichshall .	Pectinite Limestone.
		Rogenstein (Oolitic).
		Encrinitic Limestone.
		Palinurenkalk,
		Encrinitic Limestone.
	Anhydrite . .	Dark Clay and Anhydrite, with Dolomite, Swinestone, and Rock-Salt.
	Wellenkalk . .	Limestone and Dolomite Marls, with Gypsum and Rock-Salt.

Bunter Sandstein.

The fossil remains of the Muschelkalk participate in the more common species of the Bunter Sandstein below and the Keuper above; but among the peculiar species may be reckoned *Encrinus moniliformis* and *Ammonites (ceratites) nodosus*. Saurian reptiles occur in this rock.

MUSCI, or MOSSES, constitute a group of Cryptogamic or Flowerless Plants, of considerable extent and of great interest on account of their very singular structure. They are in all cases of small size, never exceeding a few inches in height, and, though often of almost microscopical minuteness, are furnished with leaves arranged over a distinct axis of growth, and are propagated by means of reproductive apparatus of a peculiar nature. They have no trace of spiral or other vessels in their tissue, but are formed entirely of cellular tissue, in the stem lengthened into tubes. For a long time they were thought to be destitute of stomates, but these were discovered by Treviranus and Unger, and afterwards by Mr. Valentine. ('Transactions of the Linnæan Society,' vol. xviii. p. 239.) In addition to the stomates, several species are pierced with large round openings, which are sometimes inhabited by a wheel-animalcule—the *Rotifer vulgaris*.

The organs of fructification are of two kinds. The most universal and most conspicuous is the Urn (Sporangium, or Theca), in which the spores, or seed-like bodies, are generated. If the axils of the leaves of a moss are examined at the proper season of the year, there will be found in some of them clusters of articulated filaments swollen at the base, from among which some one will be larger than the remainder, and go on growing while they are arrested in their development. After a while this body is found to have an exterior membranous coating, which separates from the base by a circular incision, but which otherwise adheres to the part beneath it. The latter, which is the young urn, gradually acquires a stalk, called the Seta, upon which it is elevated above the leaves, carrying the outer membrane upwards on its point, so that when full grown it is covered by it as with a cap—then called a Calyptra. The urn itself is closed by a lid, or Operculum, and contains the spores arranged in a cavity surrounding a central column, or Columella. Its rim is bordered by a double row of processes, often resembling jointed teeth, and called the Peristome, one set of which appears to belong to the outer shell of the urn and the other to the inner. Usually the urn grows from a fleshy tubercle called the Apophysis, the station of which is in most cases at the base of the seta, but in *Splanchnum* forms a curious process at the apex of the seta, immediately below the urn.



Fissidens Adiantoides.

1, an entire Plant, much magnified; 2, a cluster of young Urns; 3, an Urn, full grown, with its Calyptra, 4, removed; 5, the Urn with the Operculum fallen off; 6, a portion of the Peristome.

A second set of organs, to which the name of Antheridia or Staminidia has been applied, are also observed. These are also found clustered in the axils of leaves; they consist of membranous, cylindrical, jointed, or jointless bodies, irregularly opening at the point, and discharging a mucous turbid fluid; they are surrounded by paraphyses, or jointed filaments, like the urns themselves. (See the figures on the next column.)

The function of these two sets of organs has long been a matter of dispute. The following account from Mr. Henfrey's report on the 'Reproductive Organs of the Higher Cryptogamia,' made to the British Association in 1851, will supply all the information that is at present known on this subject:—

"On no subject has more discussion been maintained than on the existence of sexes among the Cryptogamous Families. The discovery of the two kinds of organs, the Antheridia and Pistillidia, in the

Gymnostomum ovatum.

1, a Seta, bearing on the apex an urn, from which the operculum is rising, proceeding from an apophysis at the base, where it is surrounded by paraphyses; 2, a group of young Urns, among which a few paraphyses are mixed; 3, a cluster of Staminidia and Paraphyses, surrounded by scale-like leaves; 4, three Staminidia surrounded by four Paraphyses; 5, a Spore; 6, the same in the first stage of germination; 7, the same in a more advanced state.

Mosses and *Hepaticæ*, and of the peculiar organs containing analogous spiral filaments in the *Characeæ*, were for a long time the chief facts brought forward by those who supported the sexual hypothesis; and in the endeavour to carry out the view into the other tribes, a similar nature to that of the antheridia was attributed to most varied structures in the Ferns and other plants. These attempts to find distinct sexual organs were in some instances pursued with so little judgment, that the opinion has of late years fallen in some degree into discredit, and two circumstances contributed still further to strengthen the doubts which were entertained. The first was the exact analogy pointed out by Professor Von Mohl, between the mode of development of the spores of the *Cryptogamia* and the pollen-grains of the flowering plants, which interfere very importantly to prevent any comparison between the sporangia and ovaries, and apparently determined the analogy of the former to be with anthers. The second was the discovery by Professor Nägeli, of organs producing spiral filaments, therefore analogous to the antheridia of the Mosses, on the germ frond, or pro-embryo developed from the spores of the Ferns.

"At the same time, the facts observed in *Pilularia* were altogether equivocal. Mr. Valentine traced the development of the larger spores, exhibiting in germination an evident analogy to ovules, from cells closely resembling the parent-cells of pollen and spores; while Professor Schleiden stated that he had observed a fertilisation of these supposed ovules by the smaller spores resembling pollen-grains, and thus seemed to remove the ground for attributing a fertilising influence to the spiral filaments contained in the so-called antheridia of the Cryptogams.

"To this state the question remained until 1848, when Count Suminski published his observations on the germination of Ferns, showing that the researches of Nägeli had been imperfect, and that two kinds of organs are produced upon the pro-embryo of the Ferns, one kind analogous to the antheridia, and the other to the pistillidia of Mosses; from the latter of which the true Fern stem is produced, like the seta and capsule from the same organ in the Mosses; further stating that he had actually observed a process of fertilisation. Soon after this M. G. Thuret discovered antheridia like those of the Ferns in the *Equisetaceæ;* Nägeli had previously published, in opposition to Schleiden's observations, an account of the production of spiral filaments from the small spores of *Pilularia;* and finally, M. Mettenius discovered them in the small spores of *Isoëtes.* Thus they were shown to exist in all the families above enumerated, with the exception of the *Lycopodiaceæ*, in which they have recently been stated to exist by M. Hofmeister.

"The antheridia of the Mosses occur in the axils of the leaves or collected into a head, inclosed by numerous variously modified leaves at the summit of the stem. They are produced either on the same heads as the pistillidia, or in distinct heads on the same individuals, such Mosses being called monœcious; or the heads are found only on distinct individuals, such Mosses being termed diœcious. The structure of the antheridium is exceedingly simple; it consists of an elongate, cylindrical, or club-shaped sac, the walls of which are composed of a single layer of cells, united to form a delicate membrane. Within this sac are developed vast numbers of minute cellules, completely filling it, and, the sac bursting at its apex at a certain period, these vesicles are extruded. When the nearly perfect sacs are placed in water, the vesicles within appear to absorb water, and swell so as to burst the sac of the antheridium, and often adhering together, they collectively appear to form masses larger than the cavity from which they have emerged. Through the transparent walls may be seen a delicate filament with a thickened extremity, coiled up in the interior of each vesicle. Often before the extrusion, but always shortly after, a movement of this filament is to be observed when the object is viewed in water under the microscope. The filament is to be seen wheeling round and round rapidly within the cellule, the motion being rendered very evident by the distinctness of the thickened extremity of the filament, which appears to be coursing round the walls of the cellule in a circle. According to Unger, this filament breaks out of its parent-cellule in *Sphagnum*, and then appears as a spiral filament moving freely in water, in fact, as one of the so-called *Spermatozoa.*

"The pistillidia of the Mosses are the rudiments of the fruit or capsules. When young, they appear as flask-shaped bodies with long necks, composed of a single cellular membrane. The long neck presents an open canal like a style, leading to the enlarged cavity below, at the base of which, according to Mr. Valentine, is found a single cell projecting free into the open space. The single cell is the germ of the future capsule; at a certain period it becomes divided into two by a horizontal partition, the upper one of these two again divides, and so on until the single cell is developed into a cellular filament, the young seta; the upper cells are subsequently developed into the urn and its appendages, and as this rises, it carries away with it, as the calyptra, the original membrane of the pistillidium, which separates by a circumscissile fissure from the lower part, the future vaginula. These observations of Valentine are not exactly borne out by those of Schimper in some of the detail points. According to this author, the lower part of the pistillidium (the germen of Dr. Brown) begins to swell at a certain time, when a capsule is to be produced, becoming filled with a quantity of what he terms 'green granulations.' As soon as the thickness has become about that of the future seta, the cell-development in the horizontal direction ceases, and its activity is directed chiefly to the upper part, which begins to elongate rapidly in the direction of the main axis. This elongation causes a sudden tearing off at the base, or a little above it, of the cell-membrane enveloping the young fruit, and the upper part is carried onwards as the calyptra; the lower part, when any is left, remains as a little tubular process surrounding the seta. While the young fruit is being raised up by the growth of the seta, the portion of the receptacle upon which the pistillidium is borne, becomes developed into a kind of collar, and at length into a sheath (the vaginula) surrounding the base of the seta, which is articulated into it there.

"M. Hofmeister again describes the details much in the same way as Mr. Valentine. He states that there exists at the point where the style and germen of the pistillidium join, a cell, developed before the canal of the style has become opened. In those pistillidia which produce capsules this cell begins at a certain period to exhibit very active increase; it becomes rapidly divided and subdivided by alternately directed oblique partitions into a somewhat spindle-shaped body, formed of a row of large cells. Meanwhile the cells at the base of the germen are also rapidly multiplied, and the lower part of the pistillidium is greatly increased in size. The spindle-shaped body continues to increase in length by the subdivision of its uppermost cell by oblique transverse walls, and the opposition which is offered by the upper concave surface of the cavity of the germen causes the lower conical extremity of the spindle-shaped body to penetrate into the mass of cellular tissue at the base of the germen—a process which resembles the penetration of the embryo into the endosperm in the embryo-sac of certain flowering plants. The base of the spindle-shaped body, which is in fact the rudiment of the fruit, at length reaches the base of the pistillidium, and penetrates even some distance into the tissue of the stem upon which this is seated. The growth of the upper part going on unceasingly, the walls of the germen are torn by a circular fissure, and the upper half is carried upwards, bearing the calyptra; the lower part forms the vaginula. The upper cell of the spindle-shaped body then becomes developed into the capsule, and the calyptra often becoming organically connected with this, as the base of the seta does with the end of the stem, it in such cases undergoes further development during the time it is being carried upwards by the growing fruit.

"The view now entertained by Schimper, Hofmeister, and others of the reproduction of the Mosses is, that the antheridia are truly male organs, and that they exert, by means of the spiral filaments, a fertilising influence upon the pistillidia, it being assumed that those bodies, or the fluid which they are bathed in, penetrate down the canal of the style, or neck-like portion of the pistillidium, to reach the minute cell, the supposed embryonal cell, situated in the globular portion or germen of the pistillidium, and thus render it capable of becoming developed into a perfect fruit.

"No such process of fertilisation has actually been observed in the Mosses, and therefore all the evidence is at present merely circumstantial, but this is very strong. In the first place it is stated as an undoubted fact by Schimper and Bruch, that in the diœcious Mosses, those on which the antheridia and pistillidia occur in separate plants, fruit is never produced on the so-called male plants, and never on the so-called female, unless the males occur in the vicinity. Several examples are cited in the work of Schimper above referred to. When the sexes occur alone, the increase of the plant is wholly dependent on the propagation by gemmæ or innovations.

"By the discovery of the antheridia and pistillidia in the other higher Cryptogams, the arguments from analogy greatly strengthen the hypothesis of the sexuality of Mosses.

"Further observation is required then for the direct proof of the occurrence of a process of fertilisation in the Mosses; but the facts now before us all tend to prove their sexuality, if we argue from analogy, and the probabilities deduced from the negative evidence above referred to, in regard to the diœcious species.

"It is unnecessary to give any account of the well-known structure of the Moss capsules; yet, in order to render the comparison with the phænomena of the life of Mosses with those of the other leafy Cryptogams complete, it may be worth while to allude to the germination of the spores. The spore is a single cell with a double coat, like a pollen-grain; this germinates by the protrusion of the inner coat in the form of a filamentous or rather tubular process, which grows out and becomes subdivided by septa, so as to form a confervoid filament. The lateral branches bud out from some of the cells, some elongating into secondary filaments, others at once undergoing a more active development, and by the multiplication of their cells assuming the condition of conical cellular masses, upon which the forms of Moss leaves may soon be detected; these cellular masses becoming buds, from which the regular leafy stems arise.

"*Hepaticæ*.—The genera comprehended in this family present a wonderful variety of structure in the reproductive organs, but in almost all of them the existence of the two kinds of organs called pistillidia and antheridia have long been demonstrated, and in most cases the development of the sporangia from the so-called pistillidia has been traced. In those genera in which the plants most resemble the Mosses in the vegetative portion, as in *Jungermannia*, the pistillidia are very like those of the Mosses; this is also the case in *Marchantia*; but in *Pellia*, *Anthoceros*, and other genera, the rudiment of the sporangium bears a striking resemblance to the so-called ovules of the Ferns, *Rhizocarpeæ*, &c., occurring upon the expanded fronds very much in the same way as those bodies do upon the pro-embryoes of the said families. It would occupy too much space to enter into a minute detail of the various conditions that are met with. It is sufficient to say that in all cases the physiological stages are analogous to those of the Mosses; since the pistillidia produced upon the fronds, or leaf-bearing stems, developed directly from the spores, go on to produce a sporangium alone, in which the new spores are developed without the intervention of the stage of existence presented by the pro-embryo of the Ferns and *Equisetaceæ*, where the pistillidia and antheridia occur upon a temporary frond, and the former give origin to the regular stem and leaves of the plant."

The genera of Mosses are principally characterised by peculiarities in the peristome, or by modifications of the calyptra, and of the position of the urn. Linnæus admitted very few genera, but modern muscologists have increased the number very largely.

Mosses are found all over the world where the atmosphere is humid. They are however more common in temperate than in tropical climates. Mosses are among the first plants that spring up on the surface of inorganic matter, at first appearing like a green stain, when they merely consist of germinating spores, but soon clothing themselves with leaves, and then by their decay producing the earliest portion of decomposed vegetable matter with which the soil is fertilised.

Lindley separates the genera *Andræa* and *Anoschisma* from the rest of his *Musci* under the order *Andræaceæ*. The spore-cases in this order open by valves, and have an operculum, but no elaters.

(Bridel, *Bryologia Universalis*; Hedwig, *Theoria Generationis, &c., Plantarum Cryptogamicarum*; Endlicher, *Genera Plantarum*; Hooker and Taylor, *Muscologia Britannica*; Lindley, *Vegetable Kingdom*; Henfrey, in *Report of British Association*, 1851.)

MUSCICA'PIDÆ, *Flycatchers*, a family of Insectivorous Birds, so named from their mode of taking their prey. Thus, M. Temminck states that the Flycatchers (Gobe-Mouches) feed entirely on flies and other winged insects, which they catch as they fly ('Manuel d'Ornithologie'); and our countryman White says:—"There is one circumstance characteristic of this bird (the Spotted Flycatcher, *Muscicapa grisola*) which seems to have escaped observation, and that is, it takes its stand on the top of some stake or post, whence it springs forth on its prey, catching a fly in the air, and hardly ever touching the ground, but returning still to the same stand for many times together." ('Nat. Hist. of Selborne.')

Linnæus, in his last edition of the 'Systema Naturæ,' places the genus *Muscicapa*, containing the True Flycatchers, the Tyrants (*M. Tyrannus*), and several other species to the amount of 21, between the genera *Fringilla* and *Motacilla*.

Cuvier places the Gobe-Mouches (*Muscicapa*, Linn.) between the Pies-Grièches (Butcher-Birds, *Lanius*, Linn.) and the Cotingas (*Ampelis*, Linn.). He describes the group as having the bill depressed horizontally, and furnished with hairs or vibrissæ at its base, and its point more or less hooked and notched; and he makes the Flycatchers consist of the Tyrants (*Tyrannus*, Linn.); the Moucheroles (*Muscipeta*, Cuv.); the Platyrhynques, or Broad-Bills; certain species high on the legs and with a short tail (*Turdus auritus*, Gm.—*Conopophaga*, Vieill.); the True Flycatchers (*Muscicapa*, Cuv.); and other variations of form, principally in the bill, which becomes more slender in some, thus approximating to the Figuiers; and in others has the arête a little more elevated, whilst it is curved towards the point, thus leading to *Saxicola*. Cuvier finishes by observing that there are various genera or sub-genera which come very near to certain links of the series of Flycatchers, though they much surpass those birds in size, such as the Bald Tyrants (*Gymnocephalus*, Geoff.), and *Cephalopterus* (Geoff.). [CORACINA.]

M. Temminck places his genus Gobe-Mouche (*Muscicapa*, Linn.) between *Lanius* (Linn.) and *Turdus* (Linn.).

M. Vieillot places the Myothères, or Flycatchers, between the Chélidons (Swallows and Goatsuckers) and the Collurions (Butcher-Birds).

Mr. Vigors, at the commencement of the section treating of the order *Dentirostres*, observes that the depressed bill and insect-food of the *Todidæ* introduce us at once to the *Muscicapidæ*, with which they are immediately connected by the genus *Platyrhynchus*, Desm. The species that compose the latter group were, he remarks, originally included in the genus *Todus*, and were separated from it only on account of the comparative strength of their legs. "The whole of the *Muscicapidæ*, indeed," continues Mr. Vigors, "with which family *Platyrhynchus* is now united, have a decided affinity to the last tribe, or the birds which feed upon the wing, in their broad-based bills, the vibrissæ that surround them, and their similar habits of darting upon their prey while on the wing. Separated from them chiefly by the strength and more perfect structure of the leg and foot, they form the extreme of the succeeding tribe, in which they are numbered in consequence of these distinguishing characters. The line of affinity between the two tribes may thus be assumed as established." Mr. Vigors then states that the families composing the order *Dentirostres* appear to succeed each other as follows:—*Muscicapidæ*; *Laniadæ*; *Merulidæ*; *Sylviadæ*; *Pipridæ*. These families are thus grouped by him in their typical disposition:—

Normal Group.

Rostris fortioribus . . . . . $\left\{\begin{array}{l}\textit{Laniadæ.}\\ \textit{Merulidæ.}\end{array}\right.$

Aberrant Group.

Rostris debilioribus . . . . . $\left\{\begin{array}{l}\textit{Sylriadæ.}\\ \textit{Pipridæ.}\\ \textit{Muscicapidæ.}\end{array}\right.$

He further remarks that the *Muscicapidæ* contain a multitude of species, diffused over every quarter of the globe, and differing in many points of generic distinction; but hitherto so ill-defined, and so unsatisfactorily grouped, that any attempt to trace them in detail through their affinities in their present confusion would be hopeless. They are all however, he adds, well united together by the essential characters which distinguish the type of the group—the notched, depressed, and angular bill, and the strong hairs or vibrissæ that surround its base. In these characters, as well as in their manners, they partially correspond with the *Laniadæ*, from the earlier families of which they chiefly differ in their inferior power and robustness. Mr. Vigors then enters among the *Laniadæ* by the genus *Tyrannus*, Cuv., which, in his opinion, unites them with the *Muscicapidæ*, in which family indeed that genus has generally been classed, and from which he would separate it, chiefly on account of the strength of the bill, wherein the character of a Shrike is more conspicuous than that of a Flycatcher.

M. Lesson makes the *Muscicapidæ* consist of the genera *Tyrannus*, *Monacha*, *Eurylaimus*, *Platyrhynchus*, *Todus*, *Myiagra*, *Muscicapa*, *Alectrurus*, *Drymophila*, *Formicirora*, *Rhipidura*, *Seisura*, *Psophodes*, and *Enicurus*.

Mr. Swainson ('Classification of Birds') is of opinion that the Water-Chats (*Fluvicolinæ*) seem to connect the Tyrant Shrikes with the Flycatching Family, or *Muscicapidæ*, the most insectivorous of the *Dentirostres*; a group, he remarks, hardly less numerous than that of the Warblers, and composed, like them, almost entirely of small birds. Both families, he continues, are insectivorous, that is, habitual devourers of insects; but very many of the warblers (even in the more typical genera) feed also upon fruits, of which the robin, the blackcap, and the white-throat are notable examples. "The Flycatchers however," adds Mr. Swainson, "properly so called, seem to be strictly and exclusively insectivorous, or, at least, it has not yet been ascertained that any of the species composing the typical group *Muscicapidæ* ever partake of fruits. This peculiarity of diet, independent of many others, separates them from the warblers on one side, and from the *Ampelidæ*, or Chatterers, on the other; while another is to be found in the mode or manner of their feeding. The warblers fly about, hunting down their prey, searching among trees, and roaming from place to place after their favourite food; hence they become ambulating flycatchers, and their feet are consequently large and strong in comparison to the size of their bodies. We need only look to the gold-crested and wood warblers as exemplifications of this remark, even among those species which frequent trees; hut in such, as in the Stonechats, *Saxicolinæ*, and *Motaciliinæ*, as hahitnally walk, the feet are much stronger and the shanks more lengthened. Now, the very reverse of this structure is the typical distinction of the Flycatchers; their legs are remarkahly small and weak—more so, perhaps, than those of any dentirostral hirds—showing at once that their feet are hnt little used; and such we find to he the case. The Flycatchers constitute the fissirostral type of form among the leading divisions of the *Dentirostres*, and they consequently exhibit all the chief indications of that primary type of nature, as it is exhibited in the feathered creation. These, as the intelligent ornithologist already knows, are manifested in a large and rather wide mouth and hill; short, feehle, and often imperfect feet; great powers of flight and often a considerahle length of wing; the development of this latter structure is not always apparent, hut it is the peculiar power of their flight upon which they chiefly depend for procuring subsistence. They are mostly sedentary, and only dart upon such insects as come within a sudden swoop, without attempting to pursue their game further, if unsuccessful in the first instance: they return, in fact, to the spot they left, or to another very near, and there await patiently until another insect passes within the proper distance. This hahit of feeding at once explains tho reason of the feet heing so small and weak, hy showing that they are merely used to support the body; or, at least, that they are not employed in constant exercise or exertion, as in the generality of other hirds. Other characters accompany these, no less indicative of hirds which feed exclusively upon the wing: the hill is always considerahly depressed or flattened, particularly at its hase; and the sides of the mouth are defended with stiff bristles, to confine tho struggles of their prey."

Mr. Swainson thinks that the primary divisions appear to he represented hy the genera *Eurylaimus*, *Muscicapa*, *Fluvicola*, *Psaris*, and *Querula*, and these, according to his views, constitute the types of so many sub-families, very unequal indeed in their contents, yet hlending sufficiently into each other to point out their circular succession. He considers the first two of these to he the typical and suh-typical groups; and the three next to he aberrant.

Prince C. L. Bonaparte ('Geographical and Comparative List') places the *Muscicapidæ* between the *Turdidæ* and the *Laniadæ;* and he makes the *Muscicapidæ* consist of the following sub-families and genera.

a. Muscicapinæ.

Genera :—*Setophaga*, Sw.; *Tyrannula*, Sw.; *Tyrannus*, Vicill.; *Milvulus*, Sw.; *Butalis*, Boic.; *Muscicapa*, Linn.; *Erythrosterna*, Bonap.

b. Virconinæ.

Genera :—*Icteria*, Vieill.; *Vireo*, Vieill.; *Vireosylva*, Bonap.

In considering this arrangement, the student should remember that it only applies to the hirds of Europe and North America.

Mr. Swainson thus defines the family:—Stature small. Bill considerahly depressed its entire length, hroad; the edge of the upper mandible folding over that of the lower; the tip ahruptly bent and notched. Rictus wide, defended with strong rigid hristles, pointing forwards. Feet almost always short (except in the rasorial types, where of course they are longer), small, and weak. Feed solely upon insects captured during flight. Hahits sedentary.

Sub-Family *Querulinæ.*

Bill strong, hroad, much depresssed; gape wide. Rictus with strong hristles. Feet short, resemhling those of the typical *Ampelinæ*. Lateral scales minute. (Sw.)

Mr. Swainson is of opinion that the genus *Querula* is the type of this family, and he ohserves that hy some of the Linnæan writers this remarkahlo hird is classed as a *Muscicapa;* while hy others, even among the moderns, it is considered an *Ampelis;* and he thinks that hoth of these opinions may be reconciled, hy viewing it—as it stands in his arrangement—as the connecting link hetween these families. He remarks that all the other Flycatchers, according to his system, so far as we yet know, feed entirely upon insects; hut there is unquestionable testimony that this species lives also upon fruits, thus uniting in itself the characteristics of the two families which it connects. In the hill, he adds, there is much of the form and strength of that of *Psaris*, hut it is wide and more depressed; whilst the stiff hristles at the rictus botray its insectivorous hahit: the feet are remarkahly short for the size of the hird, and are calculated only, like those of the *Ampelidæ*, for perching. All these characters, in the opinion of Mr. Swainson, not only point out this genus as the fissirostral type, hut perfect the union of the families of *Muscicapidæ* and *Ampelidæ*.

Querula, Vieill., and *Lathria*, Sw., are genera of this suh-family.

Querula.—Bill large, broad, and strong. Gonys long and straight. Nostrils concealed hy incumhent reflected feathers. Wings long and hroad, fourth quill longest. Toes unequal; inner toe shortest, of equal length with the hind toe. Tail even.

Q. rubricollis, the Common Piahau, is black with a purple throat. It is the *Muscicapa rubricollis* of Gmelin.

It is a native of America, where they go in troops in the woods in pursuit of insects.

Common Piahau (*Querela rubricollis*).

Psarianæ.

Bill large, thick, sub-cylindrical. Culmen convex, and without any ridge; the tip ahruptly hent and notched. Head large, depressed. Mouth very widc. Feet weak: lateral toes unequal; interior scales of the tarsi transverse; lateral scales small, numerous. Wings long.

Cayenne Shrike (*Psaris Cayanensis*).

Mr. Swainson (who gives the above as the characters of the subfamily to which, in his opinion, *Alectrura* immediately leads) states that in the *Psarianæ* there are hut three ascertained genera. "Theso hirds," says Mr. Swainson, "like their representatives, *Monacha* and *Psarisoma*, depart considerahly from the types of this family: the hill is less depressed than in any other of the Flycatchers, and its structure is altogether stronger and thicker; they are all natives of tropical America, and are generally found only in thick forests. *Gubernetes* is the genus by which they appear to he connected with the waterchats, through the medium of *Alectrura*. One species only is yet known, the *Gubernetes forficatus*, remarkahle for its long forked tail: to this succeeds *Psaris*, where we find nearly all the species coloured alike; that is, they are more or less of a gray or pearl white, with black head, wings, and tail: they remind us immediately of the gulls, and this analogy is one of the most heautiful, when worked out, in the whole family. The smaller hirds of the genus *Pachyrynchus* immediately follow.

Two or three already prepare us for the next* division (*Querulinæ*), by the great depression of their bills, and the singularly formed red feathers on the throat." ('Classification of Birds,' part iii.) In the 'Synopsis' (part iv.) only two genera are given, *Psaris*, Cuv., and *Pachyrynchus*, Spix.

Psaris.—Bill large. The rictus smooth, often naked round the eye. Wings lengthened; the first quill equal to or longer than the fourth. Tail short, even. Inner toe shorter than the outer. (Sw.)

P. Cayanensis is ash-coloured, head, wings, and tail black. This is the *Lanius Cayanensis cinereus* of Brisson; *Lanius Cayanus* of Linnæus and Gmelin; Pie-grièche grise de Cayenne of Buffon; Cayenne Shrike of Latham; and is the type of Cuvier's genus *Psaris*.

It is a native of South America, particularly Cayenne. Cuvier says that its manners are those of the Shrikes.

Fluvicolinæ.

Legs formed for walking. Tarsi lengthened, strong. They inhabit the sides of marshes and rivers in tropical America. *Scisura* alone is Australian. (Sw.)

Mr. Swainson states that the *Fluvicolinæ*, or Waterchats, with the exception of one genus, whose situation is still somewhat doubtful, are entirely restricted to the warm latitudes of America, where they seem to represent the stonechats and the wagtails of the Old World. "They are," continues this author, "strictly ambulating Flycatchers, and constitute the rasorial division of this family. The legs are consequently very long, and formed especially for walking; the toes are also long, quite divided to their base, and furnished with long and slightly curved claws. This structure enables these birds to run with great celerity; and they are generally seen on the sides of streams and rivers, feeding upon flying insects which resort to such situations; for they never hunt among trees, and rarely perch; such at least are the manners of the typical species; but there are of course various modifications of habit, corresponding to those which will now be glanced at in their structure." Mr. Swainson exhibits some variation in his views as to this group in the third and fourth parts of the 'Classification of Birds.' In the third part, the first genus, with which he begins the series, is that of *Scisura*, differing only from *Rhipidura* by its more lengthened bill and feet: indeed he by no means feels satisfied that *Scisura* is naturally separated from *Rhipidura*, although, for the present, he adopts the group as proposed by Mr. Vigors and Dr. Horsfield. He nevertheless expresses his suspicion that all the genera of the *Fluvicolinæ* may prove to be natives of tropical America, and that *Scisura* is only composed of aberrant species of *Rhipidura* which pass into the *Fluvicolinæ*. Both these divisions (*Scisura* and *Rhipidura*), as well as that of *Seicircus*, have broad fan-shaped tails, which, he observes, plainly indicate the type to which they belong, although the rank they respectively hold cannot, in our present state of knowledge, be clearly ascertained. "Leaving this group," says Mr. Swainson in continuation, "we reach that of *Fluvicola*, by means of certain black and glossy birds of Brazil, some of which have distinct crests: these latter conduct us to the typical *Fluvicolæ*, having the legs unusually long, the bill depressed, the tail lengthened, and the plumage differently varied with white and black. One of the most characteristic of these singular birds is the *Fluvicola cursoria*, of the size of a lark; but some are nearly equal to a small thrush. *Perspicilla*, so called from the naked fleshy lobe which surrounds the eyes like spectacles, is the next genus: this is succeeded by *Alectrura*, one of the most distinct and well defined groups in the whole circle of ornithology: the remarkable development of the tail-feathers in this group only finds a parallel in the genus *Vidua* among the finches and that of *Gallus* on the rasorial circle. Besides these genera, there are several black and white coloured birds having a general resemblance to the foregoing, which would seem to enter among the waterchats; yet, as we have not sufficiently analysed the group, we must leave this point undetermined: among these are the white-headed tody of the old writers, which is either a *Tyrannula* or an aberrant *Fluvicola*, as well as the *Muscicapa leucocilla* of Hahn, which, in outward appearance, so much resembles a manakin, that it may possibly prove a representative of that family in the present circle." In the fourth part the sub-family is made to consist of the following genera, arranged in the order here given:—

Gubernetes, Vig.; *Alectrurus*, Vieill.; *Fluvicola*, Sw. (with its sub-genus *Blechropus*, Sw.; *Pepoaza*, D'Azara); *Scisura*, Horsf. and Vig.; *Perspicilla*, Sw.

Gubernetes.—Bill thick, sub-depressed, raised at the base; culmen rounded; upper mandible slightly notched at the apex; nostrils rounded; the rictus furnished with close-set rigid vibrissæ. Wings moderate; quills, from the first to the fifth nearly equal, the first the shortest, the second the longest; the external beards (pogoniis), except the beards of the first feather, notched in the middle; internal beards entire. Feet with moderate tarsi; the acrotarsia and paratarsia scutellated; soles reticulated with oval scales. Tail very long and forked. (Vigors.)

G. Cunninghami is ash-coloured, longitudinally lineated with brown; throat and rump white; lunulated pectoral band purplish-brown; wings and tail brownish-black; quills longitudinally banded with ferruginous.

Gubernetes Cunninghami. Vigors, 'Zoological Journal.'

Mr. Vigors, whose generic and specific descriptions we have given above, says that this bird, which he named after Colonel Cunningham of Rio Janeiro, appears to have a considerable affinity to the genus *Psaris* of Cuvier in the structure of its bill and wings, but that it differs from it by other such essential characters as to have induced Mr. Vigors to place it in a separate genus. Besides the difference in the structure of the tail—an important character, he observes—in the group of the *Laniadæ*, which still retain some of the powers of flight belonging to the *Fissirostres*, he notes the following differences between the two forms. The rictal bristles of his bird are strong and numerous, while in *Psaris* they are scarcely perceptible. The tarsi, though somewhat weaker than those of *Psaris*, are in a slight degree weaker, while the toes are longer and stronger. The lateral scales of the tarsi are square and far asunder, while in *Psaris* they are rounded and numerous. The hinder scales also are less rounded, less close, and less conspicuous than in the latter genus. ('Zool. Journ.,' vol. ii.)

Muscicapinæ.

Feet weak, formed only for perching, generally short, excepting in *Todus*, but always very slender, and often syndactyle. Bill more or less depressed; gape with stiff bristles. Claws small, considerably curved; lateral toes unequal. Inhabits warm and tropical latitudes, but excluded from North America. (Sw.)

This extensive sub-family contains the ordinary Flycatchers, the generality of which do not exceed the dimensions of *Muscicapa grisola*. Mr. Swainson remarks that the bill, although it is rarely so broad as in the *Eurylaiminæ*, is much more flattened, and the bristles at the gape are more developed. "Their whole structure also," continues Mr. Swainson, "is more slight and delicate; but their colouring, although sometimes elegant, is almost devoid of vivid tints. The different form and length of the bill and feet furnish the characters by which the genera and sub-genera are distinguished; while the species, which are exceedingly numerous, with the exception of the genus *Todus*, are only found in the Old World. The typical genera are *Todus* and *Muscicapa*; the aberrant are *Megalophus*, *Monacha*, and *Rhipidura*: the two first are so numerous in species as to contain sub-genera." Mr. Swainson then enters into a lengthened notice of the different genera and sub-genera; exhibits the circle of *Todus*, which he considers to be complete with that of *Muscicapa*; and gives the following as a table, showing the comparison of *Todus* with the orders of birds and the tribes of the Perchers:—

* In the third part of Mr. Swainson's 'Classification of Birds,' the sub-families stand in the following order:—*Eurylaiminæ*, *Muscicapinæ*, *Fluvicolinæ*, *Psarinæ*, *Querulinæ*. In the fourth part ('Synopsis') they are thus arranged:—*Querulinæ*, *Psarianæ*, *Fluvicolinæ*, *Muscicapinæ*, *Eurylaiminæ*.

Sub-genera of *Todus*.	Genus *Todus*. Analogies.	Tribes of Perchers.	Orders of Birds.
Todus	Bill lengthened, conic, slightly notched	*Conirostres.*	*Insessores.*
Platyrhynchus	Bill short; tip abruptly hooked; notch or tooth very distinct	*Dentirostres.*	*Raptores.*
Conopophaga	Feet syndactyle; head large	*Fissirostres.*	*Natatores.*
Platystera	Bill slender	*Tenuirostres.*	*Grallatores.*
Lepturus	Feet large; toes cleft; wings short; tail long	*Scansores.*	*Rasores.*

This illustration Mr. Swainson considers to be perfect. ('Classification of Birds,' part iii.)

The genera and sub-genera of the *Muscicapinæ* are, in the fourth part of the work last quoted, placed in the following order:—

Rhipidura, Horsf. and Vig.; *Monacha*, Horsf. and Vig.; *Megalophus*, Sw.; *Todus*, Auct. (with the following sub-genera:—*Conopophaga*, Vieill.; *Platyrhynchus*, Desm.; *Todus*, Linn.; *Lepturus*, Sw.; *Platystera*, Jard. and Selby); *Muscicapa*, Linn. (with the following sub-genera:—*Cryptolopha*, Sw.; *Muscipeta*, Cuv.; *Myiagra*, Horsf. and Vig.; *Muscicapa*, Linn.; and *Hyliota*, Sw.)

Rhipidura.—Bill short, depressed, broad at the base, compressed at the apex; the culmen arched; upper mandible notched at the apex; nostrils basal, oval, nearly covered with bristles and plumules; rictus furnished with close-set bristles, generally exceeding the mandibles in length. Wings moderate, subacuminate; the first quill shortest, the second longer by twice, the third and fourth (which last is the longest) gradually longer. Tail elongated, patulous, rounded at the tip. Feet moderate, slender; the acrotarsia and paratarsia entire. (Vig. and Horsf.)

R. flabellifera is brown-black; superciliary and postocular spot, throat, points of the wing-coverts, and stems and tips of the tail-feathers white; abdomen inclining to ferruginous. (Vig. and Horsf.) This is the *Muscicapa flabellifera* of Gmelin; the Fan-Tailed Flycatcher of Latham.

Fan-Tailed Flycatcher (*Rhipidura flabellifera*).

Mr. Vigors and Dr. Horsfield remark that the figure of this species given by Dr. Latham has much more white on the lateral tail-feathers than the bird described by them; but they add that Dr. Latham affirms that the species is subject to much variation.

Mr. Caley, speaking of this species under the name of Fan-Tail, says, "There is something singular in the habits of this bird. It frequents the small trees and bushes, from whence it suddenly darts at its prey, spreading out its tail like a fan, and, to appearance, turning over like a Tumbler Pigeon, and then immediately returning to the same twig or bough from whence it sprung. These actions it continues constantly to repeat. The skin is very tender; and it is difficult, after having taken it off the body, to restore it again to its proper shape."

They are found in Australia. Mr. Caley says that the species is very common about Paramatta, and he does not recollect having missed it at any period of the year. Gmelin, quoting Forster, gives New Zealand as the habitat.

Todus.—Bill lengthened, broad throughout, contracting suddenly at the tip, very flat. Bristles short, weak, or none. Tail short, very slender, rounded. Legs long, weak; toes short, the outer more or less united to the middle one. Tropical America only. (Sw.)

T. viridis is bright-green above; whitish beneath; throat scarlet; sides rosy; lower tail-coverts yellow. This species appears to be the *Rubecula viridis elegantissima*, Green Sparrow, or Green Humming-Bird of Sloane ('Jam.,' vol. ii. p. 306; Ray, 'Syn. Append.,' p. 187); *T. viridis, pectore rubro, rostro recto*, of Brown ('Jam.,' p. 476); Todier de St.-Domingue of Buffon; the Green Tody of English authors.

Sloane says of his specimen that the belly or stomach was pretty thick, and very well filled with *Cimices* and small vermin of the like kind. It loves, he adds, melancholy places, and scarce will stir from any one till they take it. "It is," says Sloane in conclusion, "one of the most beautiful small birds I ever saw." Browne states that it is a very familiar and beautiful bird, and will often let a man come within a few feet, and look for minutes together at it, before it moves. "It keeps," he adds, "much about houses in the country parts, flies very slow, and probably may be easily tamed."

Green Tody (*Todus viridis*).

M. Lesson, who places the genus with doubt between *Platyrhynchus* and *Myiagra*, says that the birds composing the genus have the greatest approximations to the Kingfishers, near which, and in the Syndactylous tribe, Cuvier has arranged them. M. Lesson is of opinion that they are united to the Kingfishers by his genus *Todiramphus*, though he at the same time observes that M. Temminck admits only one Tody, namely, *T. viridis*, placing it near *Platyrhynchus* and before the Moucherolles, an opinion which appears to M. Lesson to be well founded. The Todies, he adds, are very small birds of America, living upon insects which they catch in the mud or in the water. "They are," says he, "in truth, Water Moucherolles; their wide and flattened bill, furnished with asperities, or teeth, permits them to sift the mud and retain their prey. They also seek for small insects under the moss and on the banks of small streams."

The bird is placed by Mr. Vigors among the *Fissirostres*.

This species is a native of the Antilles.

Muscicapa (*Butalis*, Boie).—Bill moderate, triangular, and not much dilated at the base, which is furnished with long and stiff hairs. Nostrils basal, lateral, ovoid, partially covered with hairs directed forwards. Wings rather pointed; first quill small and spurious, second rather shorter than the third and fourth, which are the longest. Tail rather short or moderate, even or slightly forked. Feet rather strong; tarsus and middle toe lengthened; inner toe almost as long as the outer toe.

M. grisola.—All the upper parts ash-brown; forehead approaching to whitish; a longitudinal stripe of a deep brown on the head; throat and middle of the belly white; sides of the neck, breast, and sides, sprinkled with longitudinal stains of ash-brown.

This is the Gobe-Mouche proprement dit of Buffon; Gobe-Mouche Gris of Temminck; Fliegenfänger and Gefleckter Fliegenfänger of the Germans; Stoparola of Aldrovandus and Ray; y Gwybedog of

Two or three already prepare us for the next* division (*Querulinæ*), by the great depression of their bills, and the singularly formed red feathers on the throat." ('Classification of Birds,' part iii.) In the 'Synopsis' (part iv.) only two genera are given, *Psaris*, Cuv., and *Pachyrynchus*, Spix.

Psaris.—Bill large. The rictus smooth, often naked round the eye. Wings lengthened; the first quill equal to or longer than the fourth. Tail short, even. Inner toe shorter than the outer. (Sw.)

P. Cayanensis is ash-coloured, head, wings, and tail black. This is the *Lanius Cayanensis cinereus* of Brisson; *Lanius Cayanus* of Linnæus and Gmelin; Pie-grièche grise de Cayenne of Buffon; Cayenne Shrike of Latham; and is the type of Cuvier's genus *Psaris*.

It is a native of South America, particularly Cayenne. Cuvier says that its manners are those of the Shrikes.

Fluvicolinæ.

Legs formed for walking. Tarsi lengthened, strong. They inhabit the sides of marshes and rivers in tropical America. *Scisura* alone is Australian. (Sw.)

Mr. Swainson states that the *Fluvicolinæ*, or Waterchats, with the exception of one genus, whose situation is still somewhat doubtful, are entirely restricted to the warm latitudes of America, where they seem to represent the stonechats and the wagtails of the Old World. "They are," continues this author, "strictly ambulating Flycatchers, and constitute the rasorial division of this family. The legs are consequently very long, and formed especially for walking; the toes are also long, quite divided to their base, and furnished with long and slightly curved claws. This structure enables these birds to run with great celerity; and they are generally seen on the sides of streams and rivers, feeding upon flying insects which resort to such situations; for they never hunt among trees, and rarely perch; such at least are the manners of the typical species; but there are of course various modifications of habit, corresponding to those which will now be glanced at in their structure." Mr. Swainson exhibits some variation in his views as to this group in the third and fourth parts of the 'Classification of Birds.' In the third part, the first genus, with which he begins the series, is that of *Scisura*, differing only from *Rhipidura* by its more lengthened bill and feet: indeed he by no means feels satisfied that *Scisura* is naturally separated from *Rhipidura*, although, for the present, he adopts the group as proposed by Mr. Vigors and Dr. Horsfield. He nevertheless expresses his suspicion that all the genera of the *Fluvicolinæ* may prove to be natives of tropical America, and that *Scisura* is only composed of aberrant species of *Rhipidura* which pass into the *Fluvicolinæ*. Both these divisions (*Scisura* and *Rhipidura*), as well as that of *Seicircus*, have broad fan-shaped tails, which, he observes, plainly indicate the type to which they belong, although the rank they respectively hold cannot, in our present state of knowledge, be clearly ascertained. "Leaving this group," says Mr. Swainson in continuation, "we reach that of *Fluvicola*, by means of certain black and glossy birds of Brazil, some of which have distinct crests: these latter conduct us to the typical *Fluvicolæ*, having the legs unusually long, the bill depressed, the tail lengthened, and the plumage differently varied with white and black. One of the most characteristic of these singular birds is the *Fluvicola cursoria*, of the size of a lark; but some are nearly equal to a small thrush. *Perspicilla*, so called from the naked fleshy lobe which surrounds the eyes like spectacles, is the next genus: this is succeeded by *Alectrura*, one of the most distinct and well defined groups in the whole circle of ornithology: the remarkable development of the tail-feathers in this group only finds a parallel in the genus *Vidua* among the finches and that of *Gallus* on the rasorial circle. Besides these genera, there are several black and white coloured birds having a general resemblance to the foregoing, which would seem to enter among the waterchats; yet, as we have not sufficiently analysed the group, we must leave this point undetermined: among these are the white-headed tody of the old writers, which is either a *Tyrannula* or an aberrant *Fluvicola*, as well as the *Muscicapa leucocilla* of Hahn, which, in outward appearance, so much resembles a manakin, that it may possibly prove a representative of that family in the present circle." In the fourth part the sub-family is made to consist of the following genera, arranged in the order here given:—

Gubernetes, Vig.; *Alectrurus*, Vicill.; *Fluvicola*, Sw. (with its subgenus *Blechropus*, Sw.; *Pepoaza*, D'Azara); *Scisura*, Horsf. and Vig.; *Perspicilla*, Sw.

Gubernetes.—Bill thick, sub-depressed, raised at the base; culmen rounded; upper mandible slightly notched at the apex; nostrils rounded; the rictus furnished with close-set rigid vibrissæ. Wings moderate; quills, from the first to the fifth nearly equal, the first the shortest, the second the longest; the external beards (pogoniis), except the beards of the first feather, notched in the middle; internal beards entire. Feet with moderate tarsi; the acrotarsia and paratarsia scutellated; soles reticulated with oval scales. Tail very long and forked. (Vigors.)

G. Cunninghami is ash-coloured, longitudinally lineated with brown; throat and rump white; lunulated pectoral band purplish-brown; wings and tail brownish-black; quills longitudinally banded with ferruginous.

Gubernetes Cunninghami. Vigors, 'Zoological Journal.'

Mr. Vigors, whose generic and specific descriptions we have given above, says that this bird, which he named after Colonel Cunningham of Rio Janeiro, appears to have a considerable affinity to the genus *Psaris* of Cuvier in the structure of its bill and wings, but that it differs from it by other such essential characters as to have induced Mr. Vigors to place it in a separate genus. Besides the difference in the structure of the tail—an important character, he observes—in the group of the *Laniadæ*, which still retain some of the powers of flight belonging to the *Fissirostres*, he notes the following differences between the two forms. The rictal bristles of his bird are strong and numerous, while in *Psaris* they are scarcely perceptible. The tarsi, though somewhat weaker than those of *Psaris*, are in a slight degree weaker, while the toes are longer and stronger. The lateral scales of the tarsi are square and far asunder, while in *Psaris* they are rounded and numerous. The hinder scales also are less rounded, less close, and less conspicuous than in the latter genus. ('Zool. Journ.,' vol. ii.)

Muscicapinæ.

Feet weak, formed only for perching, generally short, excepting in *Todus*, but always very slender, and often syndactyle. Bill more or less depressed; gape with stiff bristles. Claws small, considerably curved; lateral toes unequal. Inhabits warm and tropical latitudes, but excluded from North America. (Sw.)

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This species is a native of the Antilles.

Muscicapa (*Butalis*, Boie).—Bill moderate, triangular, and not much dilated at the base, which is furnished with long and stiff hairs. Nostrils basal, lateral, ovoid, partially covered with hairs directed forwards. Wings rather pointed; first quill small and spurious, second rather shorter than the third and fourth, which are the longest. Tail rather short or moderate, even or slightly forked. Feet rather strong; tarsus and middle toe lengthened; inner toe almost as long as the outer toe.

M. grisola.—All the upper parts ash-brown; forehead approaching to whitish; a longitudinal stripe of a deep brown on the head; throat and middle of the belly white; sides of the neck, breast, and sides, sprinkled with longitudinal stains of ash-brown.

This is the Gobe-Mouche proprement dit of Buffon; Gobe-Mouche Gris of Temminck; Fliegenfänger and Gefleckter Fliegenfänger of the Germans; Stoparola of Aldrovandus and Ray; y Gwybedog of the Welsh; Spotted Flycatcher and (provincial) Beam-Bird, Rafter, Post-Bird, &c., of the British.

Spotted Flycatcher (*Muscicapa grisola*).

The Spotted Flycatcher, one of the latest of our summer visitants, rarely arrives in these islands before the latter part of May, when its insect food, which consists principally of flies and other dipterous insects, abounds. Its mode of capturing them is well described by White in the passage quoted at the commencement of this article. Temminck says that it rarely eats caterpillars and ants. Pennant states that it is very fond of cherries; but Mr. Selby says that he has not been able to verify this, and that he is inclined to believe that the Greater Pettychaps (*Sylvia hortensis*), a keen devourer of all the smaller fruits, has in most instances been mistaken for the present bird. The same author tells us that it is of rare occurrence in Scotland. Mr. Gould says that it is found throughout England and a portion of Scotland, wherever there exists a locality suitable to its economy. It quits us in September and October, having bred and brought up its young here. M. Temminck says that it is spread in Europe as far as Sweden, and that it is found in the temperate provinces of Russia; but that it is rare in Holland. Mr. Selby states that its summer or polar migration extends as far as Sweden and Norway. Prince Bonaparte ('Specchio Camparativo') notes it as rare in the summer near Rome; and as found in Europe generally. ('Geographical and Comparative List'). Mr. Gould says, "The Spotted Flycatcher appears to enjoy a wide range over the continent of Europe, being generally dispersed from the border of the Arctic Circle to its most southern boundary; and we have also frequently observed it among collections from India." The nest, loosely constructed of moss, fibres, catkins of the hazel, or small twigs lined with straw and wool or hair and feathers, is often placed upon the jutting ends of beams and rafters in tool-houses, or other garden or farm buildings, whence its name of Beam-Bird. The four or five eggs are grayish-white, with pale orange-brown spots. When the young are able to leave the nest, the parents lead them to some place where insects abound. There the young soon learn to capture their prey after the manner of the old birds.

The sexes are alike in plumage. The young, for a short time after they begin to fly, have the feathers tipped with yellowish-white, which gives them a mottled appearance. The chirp of this Flycatcher, its only note, is weak.

M. atricopilla, Gobe-Mouche Bec-Figue of the French, *M. luctuosa* of Temminck, the Pied Flycatcher. Male with the upper parts black; part of the forehead, a patch on the wing, and the outer web of the two outer tail-feathers on each side, as well as the lower parts, white. Female and young grayish-brown above, brownish-white beneath.

This bird is a visitor of the British Islands, but is not so numerous as the last. It arrives from the middle of April to the beginning of May, and departs in September. The eggs are five or six, pale, 8½-12ths of an inch long, and rather more than half an inch in breadth. It builds in the holes of decayed oaks or pollard-trees. Mr. Heysham, as quoted by Mr. Yarrell, says, "In the season of 1830, a pair had a nest in the identical hole where this species had bred for four successive years. On the 14th of May this nest contained eight eggs arranged in the following manner: one lay at the bottom, and the remainder were all placed perpendicularly round the sides of the nest with the smaller ends resting upon it; the effect of which was exceedingly beautiful."

Eurylaiminæ.

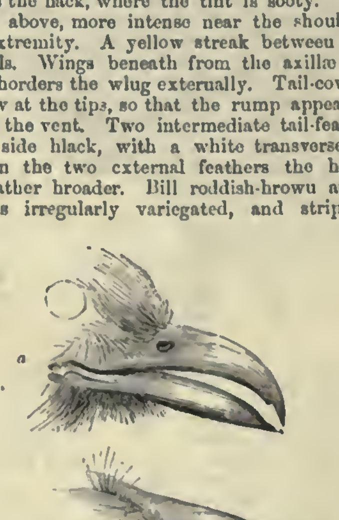
Size large. Structure powerful. Bill short, excessively broad; the upper mandible convex above, dilated at its base, and the margins folding over those of the upper mandible; the tip abruptly hooked. Wings rather short. Feet strong, moderate. The outer toe connected for half its length to the middle toe; hinder toe long; inner toe shortest.

Mr. Swainson, who gives this as the character of the sub-family, observes that the *Eurylaiminæ* are the most remarkable birds of the whole family; the species are very few, and their geographical limits seem to be restricted to the hottest parts of India, where they inhabit the forests. "In size," continues Mr. Swainson, "they exceed all others, save the genus *Querula*, in this family, being about the size of starlings, while the enormous breadth of their bills and the peculiar brightness of their colouring render it impossible for the student to mistake them for any other genus. The bill is not only excessively broad, but the margins of the base are so dilated that they often project over those of the lower mandible, whilst its substance seems much more solid than in the ordinary flycatchers. Although very few species have hitherto been discovered, it is quite clear that the five leading types have come to light, although only one example of the genera *Serilophus*, *Psarisoma*, and *Platystoma* are yet known. It may be here observed that notwithstanding the great width of the bill in all these birds, it is nevertheless much more convex above, and in some instances is even more raised on the culmen than any of the others; the feet also and the whole structure of the body are more robust. Hence, although the width of the mouth and the great size of the head would indicate this to be the pre-eminent typical group, yet all the other characters would place it as the typical. *Serilophus* is evidently the rasorial or crested type; and it departs considerably from the others by the only species yet known being very fond of fruits; this is in conformity with the strong and remarkable analogy it shows, even in its outward appearance, to the wax-winged chatterers (*Bombycilla*)."

The genera given by Mr. Swainson in the 'Synopsis' are—*Eurylaimus*, Horsf.; *Cymbirhynchus*, Vig.; *Platystomus*, Sw. (both of which are placed by M. Lesson in his genus *Erolla*); *Psarisomus*, Sw.; and *Serilophus*, Sw. Mr. Swainson considers *Eurylaimus* to be the pre-eminent type; *Cymbirhynchus* the sub-typical type; *Platystomus* the fissirostral type; and *Serilophus* the rasorial type; by which last and *Megalophus regius* he considers that the *Eurylaiminæ* and *Muscicapinæ* are united.

Eurylaimus.—Bill broader than the head; under mandible very thin, particularly at the base. Nostrils basal, transverse, oval; the aperture naked. Frst quill slightly, second almost imperceptibly graduated. Tail short, rounded.

E. Javanicus (*E. Horsfieldii*, Temm.). Entire length eight inches. Head, sides of the neck, and the whole of the neck and body underneath violet, or rather vinous, varying in intensity. The part of the forehead around the bill nearly black. Upper part of the neck brown, darker towards the back, where the tint is sooty. Wings very deep blackish-brown above, more intense near the shoulder, and lighter towards the extremity. A yellow streak between the coverts and secondary quills. Wings beneath from the axillæ to the shoulder yellow, which borders the wing externally. Tail-coverts black at the base and yellow at the tips, so that the rump appears yellow, which is the colour at the vent. Two intermediate tail-feathers black, four next on each side black, with a white transverse band near the extremity. On the two external feathers the band is near the middle, and rather broader. Bill reddish-brown at the base, with both mandibles irregularly variegated, and striped towards the



a, bill of *Eurylaimus Javanicus*, seen in profile; *b*, seen from above; *c*, anterior toes of the same, to show their relative connexion. Horsfield.

extremity; culmen yellowish; cutting-edges intensely black and shining. Tarsi and toes dusky-yellowish; claws brown, inclining to black.

Eurylaimus Javanicus.

Dr. Horsfield is of opinion that from the observations of Sir Stamford Raffles, in the catalogue of a zoological collection made in the island of Sumatra under his direction, and communicated to the Linnæan Society, we can also in some measure determine the range of this genus: "It extends," continues the Doctor, "from Sumatra eastward to Singapura, and thence south to the eastern extremity of Java near the Straits of Baly, where I discovered it in the year 1806; since that period I have not met with it again. We are indebted to Sir Stamford Raffles for the following remarks on the first species:—'It frequents the banks of rivers and lakes, feeding on insects and worms. It builds its nest pendent from the branch of a tree or bush which overhangs the water.' I found it in Java, in one of the most distant and inaccessible parts covered with extensive forests and abounding with rivers and marshes."

Dr. Horsfield placed the genus among the *Meropidæ* or *Syndyctylæ*.

MU'SCIDÆ, a family of Dipterous Insects of the sub-section *Athericera*. The insects of this family were for the most part included in the genus *Musca* by the older authors; and *Muscidæ* may be regarded as the typical group of the second great division of Two-Winged Flies (the *Brachocera*), in which the antennæ are short and composed of only three joints, and the joints of the palpi are reduced to one or two.

In Macquart's work on the 'Natural History of Insects,' the section *Brachocera* of the *Diptera* is divided into three groups:—First, the *Hexachætes*, in which the proboscis is composed of six setæ in the females; the palpi are ovate and elevated in the males, conical and decumbent in the females, and adhering to the base of the setæ; the third joint of the antennæ curved.

The second sub-division *Tetrachætes*, is thus characterised:—Proboscis composed of four setæ; palpi generally adhering to the base of the setæ; third joint of the antennæ either curved or simple, with the stylet usually terminal; wings generally with four or five posterior cells.

In the third sub-division, *Dichætes*, the proboscis has only two setæ, the palpi are generally placed on the base of the proboscis, and the stylet is situated on the upper surface of the third joint of the antennæ: the wings have usually but one submarginal cell; three posterior cells; the anal cell is usually short, and there are sometimes no transverse cells.

The sub-section *Athericera*, which forms one of the sub-divisions of the great group *Dichætes*, is distinguished by the sucker being inclosed in the proboscis; the antennæ having the last joint usually patelliform.

In the *Muscidæ* the proboscis is always very distinct and susceptible of being entirely retracted within the oral cavity; the sucker is composed of two pieces; the stylet of the antennæ is usually plumose to the apex; the body is short and tolerably broad; the eyes, in the male sex, are usually contiguous.

This family includes several well-known insects as the Common Fly, the Blow-Fly, the Blue-Bottle Fly, and many others.

The larvæ of the *Muscidæ* are thick, fleshy, cylindric, attenuated towards the head, and truncated at the other extremity of the body; the head is soft, with two or three horny points, which serve to pierce the matters upon which they feed; they are also provided with spiracles, the number and figure of which are variable, some being placed upon the head, resembling eyes, and the others, which are larger, placed at the posterior part of the body. They are destitute of legs, and their progression is effected by the hooks of the mouth, which they affix in the surface of the substance upon which they are placed: having first extended the body as far as possible, they then draw the hind parts of the body towards the head, contracting it as much as possible, when they again push the head forward as before. These larvæ feed upon various matters, both animal and vegetable: amongst the herbivorous species, many devour decaying *Fungi*, *Boleti*, &c., the galls and seeds of plants, and the interior of fruit; amongst the carnivorous species, some prey upon the flesh of animals, of which they cause the more rapid decomposition, whilst others live in excrement, manure-heaps, &c., and some are parasitic, living in the bodies of other caterpillars, of which they devour all the inner parts. The larvæ assume the pupa state without throwing off their skin. The pupa state is variable in its duration according to the state of the weather, which may be more or less favourable to the development of the different parts of the inclosed pupa. In order to effect its escape from the pupa, the fly throws off a small cap at one end of the case or skin-cocoon by beating against it with its head. At first these flies are soft, and may be observed creeping along with their wings crumpled up in a small compass. They soon however gain their full size; and the fly acquires its dark colour, and then joins its companions in the air.

Latreille has divided this family into nine primary groups, from various peculiarities of structure; while Macquart, availing himself of the researches of M. Robineau des Voidy, has partially adopted the habits of the groups for the establishment of three sub-families, in which he traces a gradual decrease in the organisation of these insects until his arrival at the confines of insect life.

1. The *Creophila*, characterised especially by the wings, of which the first posterior cell is entirely or partially closed, and by the large size of the alulets. This sub-family comprises those species which are distinguished by their size, colours, robustness of body, strength of flight, &c. They generally deposit their eggs either upon the flesh of dead animals, or are parasitic in the bodies of other larvæ. The chief genera are—*Tachinia*, *Ocyptera*, *Gymnosoma*, *Phasia*, *Dexia*, *Sarcophaga*, and *Musca*.

2. The *Anthomysides*, distinguished from the preceding by having the first posterior cell constantly open, and by the moderate or small size of the alulets. They chiefly frequent flowers, and their larvæ reside in decomposed vegetable matters. The chief genera are—*Aricia*, *Lispe*, *Eriphia*, *Anthomyia*, *Cœnosia*, &c.

3. The *Acalyptera*, differing from the *Anthomysides* by the breadth of the face, in which the eyes of both sexes are separated, and by the want of alulets. Here belong various groups of small size and inferiorly-developed structures, which are for the most part exceedingly prolific. The chief genera are—*Laxocera*, *Scatomyza*, *Ortalis*, *Tephritis*, *Sepsis*, *Lauxania*, *Sphærocera*, and *Phora*.

The genus *Musca*, as now restricted, contains such species as have the third joint of the antennæ twice or three times as large as the second; the first posterior cellule of the wings extends to the margin.

The common House-Fly (*M. domestica* of authors) affords a familiar example of this genus, and is too well known to require description. The larvæ, called maggots, live in putrid substances.

This insect is very common in houses in England. Its favourite position is the window, on the panes of which it may be constantly seen walking up and down. The power which this insect possesses of walking upon smooth upright surfaces has in consequence been a frequent theme of conjecture, and of not a small amount of observation. Dr. Derham, in his 'Physico-Theology,' speaking on this subject, says that flies have "skinny palms to their feet to enable them to stick to glass and other smooth bodies by means of the pressure of the atmosphere, after the manner as I have seen boys carry heavy stones with only a wet piece of leather clapped on the top of a stone."

This opinion, which has been entertained by the majority of entomologists of the present day, has acquired additional weight by the elaborate investigations of Sir Everard Home, undertaken at the suggestion of Sir Joseph Banks, with the assistance of that (then) unrivalled microscopic artist, M. Bauer, and published in the 'Philosophical Transactions' for 1816. The suckers, of which several kinds of flies possess three to each foot, are attached beneath the base of the claws, and are of an oval shape and membranous texture, being convex above, having the sides minutely serrated, and the under concave surface covered with down, or hairs. In order to cause the alleged vacuum, these suckers are extended; but when the fly wishes to raise its legs they are brought together, and folded up as it were between the books. Messrs. Kirby and Spence have likewise adopted this opinion, considering it as "proved most satisfactorily." Other authors of no mean repute have however entertained a different opinion, and have entirely rejected the idea of a vacuum being produced. Thus Dr. Hooke describes the suckers as palms, or soles, beset underneath with small bristles, or tenters, like the cone-teeth of a card for working wool, which he conceives gives them a strong hold upon objects, having irregular or yielding surfaces; and he imagined that there is upon glass a kind of smoky substance, penetrable by the points of these bristles. The same opinion is also given by Shaw in his 'Nature Displayed;' and more recently, Mr. Blackwall has considered that the motions of the fly are to be accounted for upon mechanical principles alone; thus, upon inspecting the structure of the parts of the suckers, it was immediately perceived that the function ascribed to them by Dr. Derham and Sir E. Home is quite incompatible with their organisation. "Minute hairs, very closely set and directed downwards, so completely cover the inferior surface of the expanded membranes, improperly denominated suckers, with which the terminal joint of the foot of flies is provided, that it cannot possibly be brought into contact with the object on which those insects move by any muscular force they are capable of exerting. The production of a vacuum between each membrane and the plane of position is therefore clearly impracticable, unless the numerous hairs on the under side of these organs individually perform the office of suckers; and there does not appear to be anything in their mechanism which in the slightest degree countenances such an hypothesis. When highly magnified, their extremities, it is true, are seen to be somewhat enlarged; but when they are viewed in action or in repose, they never assume a figure at all adapted to the formation of a vacuum." Moreover, on enclosing a House-Fly in the receiver of an air-pump, it was demonstrated to the entire satisfaction of several intelligent gentlemen present that the fly, while it retains its vital powers unimpaired, can not only traverse the upright sides, but even the interior of the dome of an exhausted receiver; and that the cause of its relaxing its hold, and ultimately falling from the station it occupied, was a diminution of muscular force, attributable to impeded respiration. Hence Mr. Blackwall is induced to believe that insects are enabled to take hold of any roughness or irregularity of surface, by means of the fine hairs composing the brushes, the most carefully polished glass not being found free from flaws and imperfections when viewed in a favourable light with a powerful lens. A still different opinion has been maintained by other authors upon this subject, who, setting aside all idea of a vacuum, have conjectured that the suckers, as they have been termed, contain a glutinous secretion, capable of adhering to well-cleaned glass; thus Abbé de la Pluche states that when the fly marches over any polished body, on which neither her claws nor her points can fasten, she sometimes compresses her sponge, and causes it to evacuate a fluid, which fixes her in such a manner as prevents her falling, without diminishing the facility of her progress. "But it is much more probable," he adds, "that the sponges correspond with the fleshy balls which accompany the claws of dogs and cats, and that they enable the fly to proceed with a softer pace, and contribute to the preservation of its claws, whose pointed extremities would soon be impaired without this prevention." Notwithstanding the ridicule which has been thrown upon this opinion in a recent entomological work, it appears, from still more recent investigations, to be the best founded of any hitherto advanced. Thus, in general, the foot of the fly is described as being composed of two hooks and two flaps, or hollow cups, which act as suckers. Rymer Jones, in his 'General Outlines of the Animal Kingdom,' 1841, says—"The House-Fly is furnished with a pair of membranous flaps, which, under a good microscope, are seen to be covered with innumerable hairs of the utmost delicacy; these flaps, or suckers, as they might be termed, adhere," &c.

The structure of the foot of the fly has recently been examined by Mr. Hepworth, who says:—"The flap varies in form in different species, from an irregular circle to that of an irregular triangle; and viewing it from one side, it is somewhat thicker at the base (near its attachment), the under surface being, when isolated, convex, but perfectly flat as a whole, when applied to a surface of that form. It appeared to be composed of an upper and under layer of areolar tissue, or something similar to it, between which a bundle of tubes, along with the fasciculi of a large muscle pass; these are placed at its base, and (sometimes protected by a 'coat of mail,' formed by long scales overwrapping each other as a Venetian blind, or in alternate ones, as the scales of a fish, &c., but more frequently wanting) expand in a radiated form; each tube, as it passes along with its fellows on each side, gives off a number of tubules alternately with them; these dip downwards from the under surface, and become expanded into trumpet-shaped extremities, the flap becoming thinner and thinner as it approaches its margin, which sometimes terminates in an irregularly serrated edge, and at others by finely pointed hairs. The fly has the power of attaching itself to smooth surfaces by these trumpet-shaped extremities, and also of secreting a fluid from them, when vigorous, and it has occasion to make extra exertions; but in a partially dormant state (the best for making observations), it does not appear to be able to give out this secretion, although it can still attach itself; indeed this fluid is not essential for that purpose: when it is secreted, it is deposited on the glass with great regularity. I have often attempted to preserve these markings by applying colouring matter whilst they were moist, but have not yet succeeded. The tubules are often seen protruding from under the margin of the flap in a semi-arch-like form, giving it a fringed appearance. The foot of the male *Dytiscus* is a type, not only of many of the beetle tribe (not aquatic), but of the whole of that of flies possessed of flaps. The first joints of the tarsus of the anterior legs of this insect are extremely dilated, so as to form a broad circular palette. On examining the inferior surface of this expanded portion, it is seen to be covered with a great number of sucking cups, two or three being larger than the rest, but they form collectively a wonderful instrument of adhesion." ('Quarterly Journal of Microscopical Science.')

MUSCLE is an animal tissue composed of bundles of soft and usually reddish fibres, endowed with a peculiar power of contracting.

The muscles are divided into two classes—the voluntary and the involuntary. The former class, those over which the will exercises a direct control, are subservient to all the actions by which the animal is placed in active relation with the external world, as in all the motions of the limbs, of speech, of the eyes, ears, &c., and they are therefore often called the muscles of animal life; the latter class, comprehending those whose actions are connected with the internal and nutritive functions of the body, over which the will has no immediate or constant control, form the muscular system of organic life, as the heart, the muscular coat of the stomach, &c.

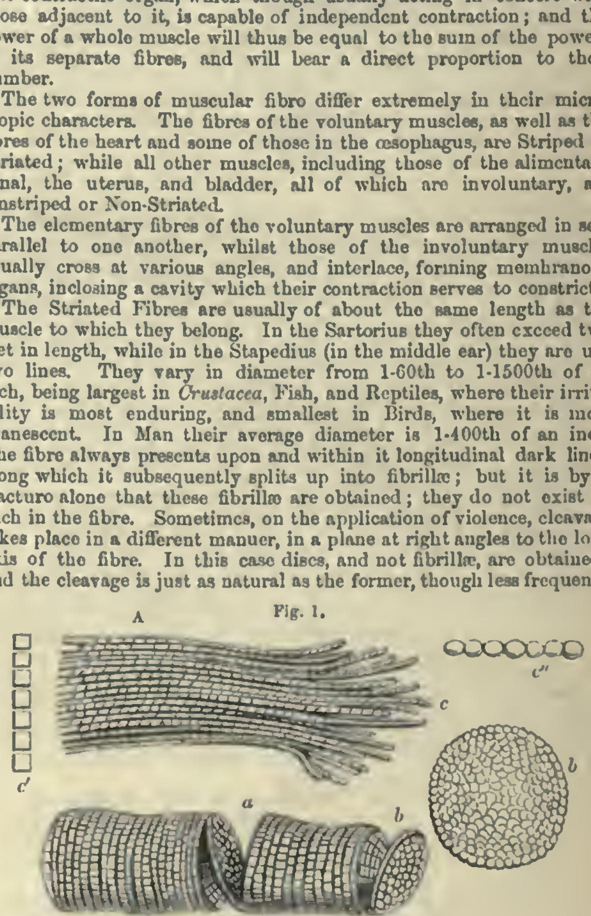
Each voluntary muscle is composed of a number of parallel or nearly parallel fleshy bundles, inclosed in coverings of cellular tissue, by which each is connected with and at the same time isolated from those adjacent to it. Each bundle is again divided into smaller fasciculi similarly ensheathed, and so on through an uncertain number of gradations till we arrive at the muscular fibre, the only definite and fixed form in the system, and the only part which possesses characters common to the muscles of all classes of animals. The muscles being thus divided, each fibre or each fasciculus may be regarded as a separate contractile organ, which though usually acting in concert with those adjacent to it, is capable of independent contraction; and the power of a whole muscle will thus be equal to the sum of the powers of its separate fibres, and will bear a direct proportion to their number.

The two forms of muscular fibre differ extremely in their microscopic characters. The fibres of the voluntary muscles, as well as the fibres of the heart and some of those in the œsophagus, are Striped or Striated; while all other muscles, including those of the alimentary canal, the uterus, and bladder, all of which are involuntary, are Unstriped or Non-Striated.

The elementary fibres of the voluntary muscles are arranged in sets parallel to one another, whilst those of the involuntary muscles usually cross at various angles, and interlace, forming membranous organs, inclosing a cavity which their contraction serves to constrict.

The Striated Fibres are usually of about the same length as the muscle to which they belong. In the Sartorius they often exceed two feet in length, while in the Stapedius (in the middle ear) they are not two lines. They vary in diameter from 1-60th to 1-1500th of an inch, being largest in *Crustacea*, Fish, and Reptiles, where their irritability is most enduring, and smallest in Birds, where it is most evanescent. In Man their average diameter is 1-400th of an inch. The fibre always presents upon and within it longitudinal dark lines, along which it subsequently splits up into fibrillæ; but it is by a fracture alone that these fibrillæ are obtained; they do not exist as such in the fibre. Sometimes, on the application of violence, cleavage takes place in a different manner, in a plane at right angles to the long axis of the fibre. In this case discs, and not fibrillæ, are obtained; and the cleavage is just as natural as the former, though less frequent.

Fig. 1.



Fragments of Elementary Fibres, showing a Cleavage in opposite directions.

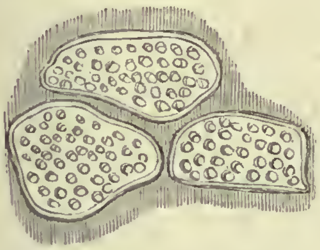
A, Longitudinal Cleavage: the longitudinal and transverse lines are both seen; *c*, fibrillæ separated from one another by violence at the broken end of the fibre, and marked by transverse lines equal in width to those on the fibre; *c′*, *c″*, represent two appearances commonly presented by the separate single fibrillæ (more highly magnified). At *c′* the borders and transverse lines are all perfectly rectilinear, and the included spaces perfectly rectangular. At *c″* the borders are scalloped and the spaces bead-like. When most distinct and definite, the fibrilla presents the former of these appearances.

B, Transverse Cleavage: the longitudinal lines are scarcely visible; *a*, incomplete fracture following the opposite surfaces of a disc, which stretches across the interval and retains the two fragments in connexion. The edge and surface of this disc are seen to be minutely granular, the granules corresponding in size to the thickness of the disc, and to the distance between the faint longitudinal lines. *b*, another disc, nearly detached. *b′*, detached disc more highly magnified, showing the sarcous elements. (Bowman, in 'Todd's Cyclopædia.')

Hence the fibre must be regarded neither as a bundle of fibrillæ nor a pile of discs, but as "a mass in whose structure there is an intimation of the existence of both, and a tendency to cleave in the two directions." The same particles compose the disc and the fibrilla, and they have received the names of the primitive or sarcous elements. The cross stripes of the fibre are formed, according to the views of almost all the best observers of the day, by the apposition, side by side, of the dark points seen on the separated fibrillæ. That they are not caused by a structure distinct from the fibrillæ, and present only on the surface of the fibre, is evident, according to Todd and Bowman, from the following facts :—

1. That a transverse section of a Fibre shows it to be solid and not hollow, and that the ends of the fibrillæ, as seen on its section, exist throughout its interior, just as on its surface.

Fig. 2.



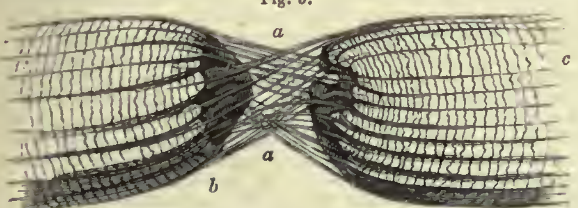
Transverse section of three Elementary Fibres of the dried pectoral muscle of a Teal, treated with weak citric acid.

2. That fibrillæ taken from any part of a fibre are marked with light and dark points, corresponding in distance and force with the transverse stripes of the fibre.

3. That with a high magnifying power applied to a thick fibre we may bring all parts of its interior into focus in succession, and perceive throughout the same kinds of stripes.

The Sarcolemma, or Tubular Sheath inclosing the striated fibre, consists of a transparent, very delicate, but tough and elastic membrane, which isolates the fibre from all other tissues. It most commonly has no appearance of structure, but occasionally small corpuscles, the remains of cell-nuclei are observed in it.

Fig. 3.

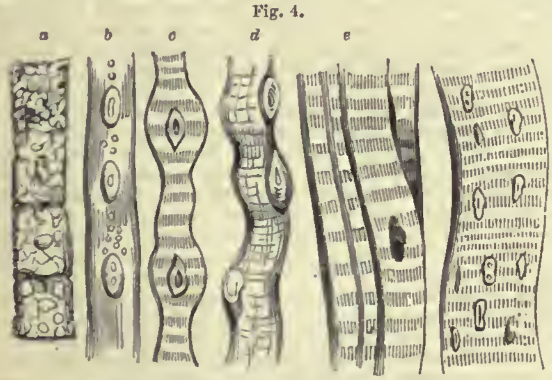


Fragments of the Elementary Fibre of a Skate held together by untorn but twisted Sarcolemma.

If the fibre be immersed in acid, it swells, bursts the sheath, and forms small protrusions or herniæ.

The researches of Valentin and Schwann have thrown much light on the development of muscular tissue in the embryo. In its earliest stage, muscle consists of a mass of nucleated cells which first arrange themselves in a linear series, and then unite to form the elementary fibres.

Fig. 4.



Stages of Development of Striated Muscle Fibre.

a, arrangement of the primitive cells in a linear series.

b, the cells united, the nuclei separated, and some broken up; longitudinal lines becoming apparent. (From a fœtal calf, three inches long.)

c, *d*, transverse stripes apparent. In *c* the nuclei are internal, and bulge the fibre; in *d* they are prominent on the surface. (From a fœtal calf, two months old.)

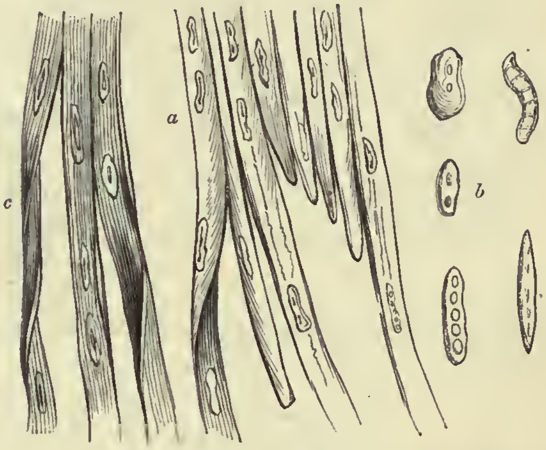
e, transverse stripes fully formed and dark; nuclei disappearing from view. (From the human infant at birth.)

f, elementary fibre from the adult, treated with acid, showing the nuclei. (From Schwann. The rest from Bowman.)

As the cells unite, a deposit of contractile material gradually takes place within them. The deposition assumes a granular form, the granular or sarcous elements being of the same size as in the perfect muscle; for this reason the transverse stripes resulting from their apposition are of the same width as in the adult. Muscles grow by an increase, not of the number, but of the bulk of their elementary fibres.

The Unstriped or Non-Striated fibres consist of modified simple cells, usually fusiform, more rarely shorter and broader fibres, which Kölliker calls "contractile or muscular fibre-cells." They are generally of a pale colour, bulged at intervals by oval or elongated corpuscles, or nuclei, which have frequently one or more nucleoli in their centre (*fig.* 5). Their texture seems to be homogeneous. By transmitted light they have usually a soft and very finely mottled aspect; their ordinary diameter varies from 1-3000th to 1-2000th of an inch.

Fig. 5.



Fibres of Unstriped Muscle.

c, in their natural state; *a*, treated with acetic acid, showing the corpuscles; *b*, corpuscles or nuclei detached, showing their various appearances.

Muscular fibre is chemically distinguished from the fibre of cellular tissue by the circumstance that it does not yield gelatin by prolonged boiling in water, but dissolves in acetic acid, from which it may be precipitated by ferrocyanide of potassium, showing that it belongs to the protein-compounds.

In consequence of the difficulty that exists in separating muscular fibre from cellular tissue, vessels, and nerves, it is impossible to speak with certainty respecting the behaviour of pure muscle towards re-agents. If very small pieces of muscle are freed as much as possible from fat and cellular substance, and immersed in water, blood, colouring matter, and the extractive matter with which muscle abounds, are gradually taken up, and colourless muscular fibres are left.

Cold water and alcohol produce little effect on them, but in boiling water they first contract and become firm, and subsequently soften. Concentrated acetic acid dissolves them; in the dilute acid they swell and assume a transparent fibrous appearance. The alkaline carbonates increase their firmness. Solutions of muscular fibre in dilute acids are precipitated by ferrocyanide of potassium and tannin in a precisely similar manner to acid solutions of fibrin. Dried muscular fibre may be easily pulverised; in that condition it resembles the whole class of protein-compounds in exhibiting strong positively electrical properties.

On making incisions into the warm flesh of an animal just killed, we obtain by pressure an acid fluid which rapidly coagulates, in consequence of the presence of a little fibrin: if the flesh has been kept for some time, the fluid obtained by pressure no longer coagulates, although it exhibits an acid re-action. No quantitative analysis of human flesh has yet been made, but the flesh of several animals has recently been submitted to analysis. The amount of water averages about 80%, and the greater part of the solid residue consists of fibrin; the other constituents, albumen, hæmatoglobulin, fat, extractive matters, lactic acid, the lactates, and other salts, occur in the expressed juice. The proportions of these constituents have been determined by Berzelius, Braconnot, Schlossberger, Schultz (and Marchand). In the flesh of oxen they found :—

	Berzelius.	Braconnot.	Schlossberger.	Schultz.	Marchand.
Water	77·17	77·03	77·50	77·50	76·60
Fibrin, cells, vessels, and nerves	17·70	17·18	17·50	15·00	18·00
Albumen and hæmatoglobulin .	2·20	2·70	2·20	4·30	2·50
Alcohol-extract and Salts . .	1·80	1·94	1·50	1·32	1·70
Water-extract and Salts . .	1·05	1·15	1·30	1·80	1·10
Phosphate of Lime with Albumen	0·08	—	traces	—	0·10
Fat and Loss	—	—	—	0·08	—
	100·00	100·00	100·00	100·00	100·00

The dried muscular flesh of the ox has been analysed by Playfair and Böckmann, and found to be identical in its composition with dried blood:—

	Flesh (Beef).		Ox-Blood.	
	Playfair.	Böckmann.	Playfair.	Böckmann.
Carbon . .	51·83	51·89	51·95	51·96
Hydrogen . .	7·57	7·59	7·17	7·33
Nitrogen . .	15·01	15·05	15·07	15·08
Oxygen . .	21·37	21·24	21·39	21·21
Ashes . .	4·23	4·23	4·42	4·42
	100·01	100·00	100·00	100·00

Deducting the ashes or inorganic matter, the composition of the organic part is—

Carbon . .	54·12	54·18	54·19	54·20
Hydrogen . .	7·89	7·93	7·48	7·65
Nitrogen . .	15·67	15·71	15·72	15·73
Oxygen . .	22·32	22·18	22·31	22·12
	100·00	10·000	99·70	99·70

Which corresponds to the formula—C_{48}, H_{39}, N_6, O_{15}.

In 100 parts of the ashes yielded by the incineration of ox-flesh, Enderlin found—

		Soluble Salts.
Tribasic Phosphate of Soda (3 N_a O, P O_5) .	45·100	91·036
Chlorides of Sodium and Potassium . .	45·936	
		Insoluble Salts.
Phosphates of Lime, Magnesia, and Peroxide of Iron		6·840
Loss		2·124
		100·000

The following analyses of the flesh of other animals have been made by Schlossberger.—

	Calf.		Swine.	Roe.	Pigeon.	Chicken.	Carp.	Trout.
Water . . .	79·7	78·2	78·3	76·9	76·0	77·3	80·1	80·5
Muscular fibre and vessels . . .	15·0	16·2	16·8	18·0	17·0	16·5	12·0	11·1
Albumen and hæmato-globulin .	3·2	2·6	2·4	3·3	4·5	3·0	5·2	4·4
Alcohol-extract and salts . . .	1·1	1·4	1·7	2·4	1·0	1·4	1·0	1·6
Water-extract and salts . . .	1·0	1·6	0·8		1·5	1·2	1·7	0·2
Phosphate of lime with albumen .	0·1	traces	traces	0·4	—	0·6	—	2·2

The analyses of Schultz correspond in many points with those of Schlossberger. In calves' flesh Schultz found a little more animal fibre than Schlossberger: in the flesh of a pig four weeks old Schultz found 21·1 parts of muscular fibre and 3·45 of albumen and hæmatoglobulin; and in the flesh of a pig two years and a half old he found 20·3 parts of the former and 4·2 of the latter. Schultz also found that the amount of muscular fibre was less in the flesh of Fishes than in that of the *Mammalia;* thus in the flesh of *Cyprinus nasus* and *C. barbus*, the proportions of fibre were 13·5 and 17·18 respectively.

A series of experiments were performed by Helmholtz, on the consumption of tissue during muscular action.

Powerful muscular contractions were induced by passing an electric current through the amputated leg of a frog as long as convulsions continued to be manifested. The flesh of the two legs was then analysed. The albumen was apparently scarcely affected, the mean of six experiments giving 2·10§ of albumen in the electrised, and 2·13§ in the non-electrised flesh. With regard to the extractive matters, it appeared that in all the experiments, without a single exception, the water extract in the electrised flesh was diminished, while on the other hand the spirit- and alcohol-extracts were increased by that process. The amount of fat was unaffected. No urea could be found in the alcohol extract.

There is a great difficulty in performing experiments of this nature on warm-blooded animals, in consequence of the rapidity with which isolated portions of muscle lose their irritability. The best results were obtained with decapitated pigeons:—

	a. In electrised Muscle.	*b.* In non-electrised Muscle.	*a.* : *b.*
Albumen	2·04 . . .	2·13 . .	
Water-Extract . . .	0·64 . . .	0·73 . . .	0·88 : 1
Spirit-Extract . . .	1·68 . . .	1·58 . . .	1·06 : 1

It remains to be considered whether the fibrin takes part in this decomposition: à priori we should infer that it did, for the protein-compounds seem universally the conductors of the highest vital energies; and further, the increased amount of sulphates and phosphates in the urine after muscular exertion indicates a decomposition of the sulphur and phosphorous compounds.

The above facts sufficiently show that muscular action is always accompanied by a chemical change in the composition of the acting muscle. (Simon, 'Animal Chemistry,' translated for Sydenham Society by Dr. Day.)

The following account of the development of muscular tissue is given by Kölliker in his 'Manual of Human Histology':—

"The rudiments of the muscles consist originally of the same formative cells as those of which the rest of the body of the embryo is constituted; and it is not till afterwards that the muscles, tendons, &c., are gradually developed by a histological differentiation. In man the muscles are not evident before the end of the second month; at first however they cannot be detected by the unaided eye: they are soft, pale, gelatinous, and not to be distinguished from their tendons. In the tenth and twelfth week they are more distinct, especially in specimens preserved in alcohol; and at this time the tendons also may be distinguished as somewhat clearer but at the same time transparent streaks.

"In the fourth month both the muscles and tendons are still more distinct, the former being on the trunk of a light reddish colour, the latter more transparent and grayish, both retaining a soft consistence. From this period both textures acquire more and more of the configuration which they afterwards retain, so that at the maturity of the embryo—excepting that the muscles are still softer and paler, and the tendons more vascular and less white—they no longer present any difference worth notice.

"With respect to their intimate conditions, the primitive fasciculi, in the embryo, at the end of the second month, present the aspect of elongated bands 0·001‴ to 0·002‴ broad, with nodular enlargements at different points, at which places are situated elongated nuclei; the bands exhibit either a homogeneous or finely-granular aspect, and but rarely an extremely faint indication of transverse striation. In their further development, these primitive muscular fasciculi, which, as comparative histology teaches, originate in cells arranged in a linear series, continue to increase in breadth and length, and their contents, the original cell-contents, are developed into the muscular fibrils. In the fourth month they measure for the most part 0·0028‴—0·005‴, some even 0·006‴, whilst others do not exceed 0·0016‴ and 0·002‴. The larger ones are still always flattened, but of uniform width, and also considerably thicker than before, mostly with evident longitudinal and transverse striæ, and even with fibrils, which admit of being isolated. It is partially evident even in a longitudinal view, but still better in a transverse section, that in many cases the fibrils do not occupy the entire thickness of the primitive tube, but that they are deposited around its periphery; the interior being as yet filled with a homogeneous substance as at first, and which now appears like a canal within the fibrils. All the primitive tubules possess a sarcolemma, which on the application of acetic acid or soda appears as a very delicate membrane, which by the imbibition of water may occasionally be raised from the fibrils. The tubes moreover, as at first, present nuclei lying close upon the sarcolemma, and which frequently cause rounded elevations on the surface of the tube, and may be observed actively engaged in the process of multiplication. They are all vesicular, roundish, or elongated, with very distinct, simple, or double nucleoli, measuring 0·0004‴—0·0008‴, and frequently with two secondary cells in the interior. They are much more numerous than previously, and most frequently disposed in pairs closely approximated; but often also in groups of three or four, or even six, either contiguous or arranged serially. From this period to that of birth no further important change takes place in the muscular fasciculi, except an increase in their size. In the new-born infant they measure 0·0056‴—0·0063‴, are solid, rounded, polygonal, longitudinally or transversely striated, according to circumstances, as in the adult, with very long isolated fibrils, and no longer any appearance of nuclei.

"From what has been remarked, it is clear that the sarcolemma represents the sum of the membranes of the coalesced cells, and that the nuclei of the youngest fasciculi are the original cell-nuclei, whose descendants are represented in the nuclei of the older fibres, which have multiplied by an endogenous process. The muscular fibrils are the altered contents of the original tubes, become solid; they appear, demonstrably in many instances, to be formed on the inner surface of the sarcolemma, from without to within, but in other cases probably in the whole of the tube at once.

"The growth of the entire muscle is chiefly to be referred to the increase, both longitudinal and in thickness, of the primitive fasciculi; and the rudiments of all the future primitive fasciculi appear to be formed—probably even as early as the original rudiments of the muscle itself—in every case at the middle period of fœtal life. In the embryo, at the fourth or fifth month, they are perhaps five times as thick as in one at two months; in the new-born infant they measure for the most part twice, occasionally even three and four times as much as in the fourth and fifth month, and in the adult their size is perhaps five times greater than in the new-born child. The number of fibrils must necessarily increase in proportion to the size of the fasciculus, because, according to Harting, they are but little thicker in the adult than in the fœtus."

The development of the tendons takes place subsequently to that of the muscular fibre, and in no case previously. It is not till the end of the third or fourth month that their elementary constituents can be made out.

All the muscles receive large arteries and veins from the trunks passing near to them, whose branches run in the cellular interspaces between the fasciculi, and form at last an irregular network among the fibres. They receive also a large supply of nerves, probably more than any other organs in the body. Nearly one-half of the brain and spinal chord is for the supply of nerves through which the will may act upon the voluntary muscles, or through which their motions may be excited by other stimuli. The involuntary muscles are chiefly supplied from the ganglionic or sympathetic system of nerves. [NERVOUS SYSTEM.]

The colour of the muscles is dependent partly on the blood which they contain, but chiefly on a peculiar colouring matter, very similar to that of the blood, which is fixed in their tissue. Their colour is distinctly though remotely connected with the quantity and condition of red blood in the system, and its depth is one of the best signs of robustness and full health. Thus, in all quadrupeds and birds the muscles are more or less red, and the colour is deepest in the parts which are most actively employed, but pale and scarcely perceptible in those which have not been frequently exerted, and also in those animals which, by being closely stalled and stabled, are killed in a condition of great debility; hence the difference between red and white meats. In *Amphibia*, which have less red blood than *Mammalia* and Birds, the muscles are usually pale. In Fish, which have still less, they are, with the exception of the heart and those which move the fins and are particularly exerted, quite white. There are however some exceptions, as the salmon and tunny. In animals of a still lower order, the muscles, though still preserving the same structure, are all quite white.

The peculiar vital power of the muscular tissue is its contractility; that is, the power which its fibres possess, when stimulated by the will or other means, of shortening themselves, and thus approximating the points to which their extremities are attached. When muscles contract they become shorter, harder, and thicker; but their actual size remains the same, for what they lose in length they exactly gain in breadth and thickness. The fasciculi are also wrinkled or thrown into undulated lines, which are most visible when the contraction is least powerful and rather trembling, and the fibres vibrate so as to produce a distinct sound. The more powerful the contraction the more rapid are the vibrations of the muscular fibres; the higher the note which they produce, and the greater the difficulty of perceiving them with the eye. The simplest method of observing the sound of muscular contraction is that which Dr. Wollaston pointed out ('Croonian Lecture,' 1809): when the tip of the thumb, or of one of the fingers, is put into the external ear, while some of the muscles of the former are in a state of contraction, a sound is heard like that of carriages running rapidly over a distant stone pavement. This sound is not heard when the same degree of pressure is applied to the same part by any other means than those in which muscular contraction is concerned. By rubbing a piece of stick over the notched edge of a board so as to produce a similar sound, and counting the number of notches whose edges were struck in a given time, Dr. Wollaston concluded that the number of vibrations of a contracted muscle is between 20 and 30 in a second.

The relaxation of a muscle presents phenomena exactly the converse of those of its contraction. The power by which the voluntary muscles are lengthened after having contracted is generally the extension to which, when they cease to act, they are subjected by some other muscles (their antagonists), whose action is the opposite of their own. The hollow involuntary muscles are usually extended after contraction by the accumulation of fluids or other substances forced into their cavities by some external power. It may be yet a question whether muscles have a vital and independent power of dilatation as well as of contraction; but on the whole the evidence is in favour of their possessing such a power, for the heart will contract and dilate when empty, if external stimuli are applied, and the hearts of reptiles when hung in the air will sometimes go on contracting and dilating till they are nearly dry and stiff. Were there no vital power of dilatation, it is difficult to conceive how the heart or any other muscle when separated from the body should, after having once contracted, be dilated so as to be able to contract again.

When muscles shorten however it is not always by an exercise of their peculiar vital contractility, but often by their elasticity, by which, like all the other tissues, they are always maintained in a certain degree of tension. Thus when a muscle is divided, its ends retract as well after death, or when its nerves are cut, as during life and health. It is by this power that muscles, after having been much extended, generally return to their natural size; thus, when a muscle on one side of the joint of any limb shortens, it is evident that its antagonist on the opposite side must be lengthened in the same proportion, and when the contracting muscle ceases to act the elasticity of the extended one (increased by the tension to which it has been subjected) will be alone sufficient in most cases to restore the limb to its position of rest.

The actual power with which a muscle contracts is in direct proportion to the number of its fibres, and inversely as their length. Hence, in all the muscles in which great strength is required, as in the chief muscles of the shoulder and hip, the fibres do not run straight from the general point of origin to that of insertion, but the whole mass of the muscle is divided into a number of small portions, in which a multitude of short fibres are attached to separate points within the muscle, so that they may act separately, or, when great exertion is necessary, altogether, and with far greater power than a smaller number of long straight fibres could. The strength of a muscle is very commonly increased by its fibres not running parallel to the line in which the muscle has to draw the part to which it is attached, but with various degrees of obliquity to that line. Thus in many muscles the fibres and fasciculi are attached obliquely to one or both sides of a tendon, as the fibres of a feather are attached to its shaft; by which arrangement, though each muscular fibre contracts in its own direction, the general result of their contraction and the direction in which the resistance will act upon them forms an oblique angle with their direction, and much of the danger of their being ruptured is removed. There are indeed but few instances of rectilineal muscles in the body; in nearly all, the fibres are placed more or less obliquely to the line in which they have to draw the part to which they are attached; a plan by which, though individually they lose in active power, they gain in resistance, and by which a far greater number may in the same space be brought to bear upon a given point.

An almost infinite variety of arrangement is found in the muscular fibres adapted to the especial purpose which each muscle has to fulfil, whether it be chiefly strength of action, or rapidity or extent of motion; and all are guided by the nicest mechanical rules. Wherever strength is more necessary than a wide extent of motion, the fibres are increased in number and placed obliquely to the direction of the resistance; wherever extent of motion is more needed than strength, the fibres are long, and run almost straight from one point to the other, so as to give the full benefit of their contraction; where velocity is required, they are placed at a part of a lever close by the centre of motion, the resistance being placed on a part more distant from the centre. In general, the absolute power exerted by a muscle in contracting is much less than its efficient power, a great part of its force being lost in its being inserted obliquely on the lever which it has to move, or in the distance of the resistance from the centre of motion, or in the resistance which other muscles and the adjacent tissues, which have to be extended, present, &c. But it is constantly found that where power is lost, a corresponding gain of velocity or extent of motion, or of convenience and compactness of form, and readiness of action, is obtained.

(On the subject of the Structure of Muscle and its Functions, the student will find information in the following works: Carpenter, 'Principles of Human Physiology;' Todd and Bowman, 'Physiological Anatomy;' Valentin, 'Textbook of Physiology;' Kirkes, 'Handbook of Physiology;' Kölliker, 'Manual of Human Histology;' Wagner, 'Manual of Physiology.')

MUSCLE, or MUSSEL. [MYTILIDÆ.]

MUSCULAR TISSUE. [MUSCLE.]

MUSHROOM. [AGARICUS; FUNGI.]

MUSK. This substance is an extremely odorous secretion, lodged in a bag which is attached and peculiar to the abdomen of the male Musk-Deer (*Moschus Moschiferus*). [MOSCHIDÆ.] The elevated regions frequented by the creature, its timidity, and speed in flight, render it very difficult to obtain the substance, while the high price borne by it offers great inducements to substitute other articles for that which is genuine. The musk-bag varies much in form, colour, size, and quality, circumstances which suggest the belief that it is procured either from two or more species of musk-animals, or that it has been obtained at different periods of the year, or from very differently-aged animals. In the very young animal the bag is quite empty, while in the old and feeble the musk is in small quantity and of inferior strength. It is said to be secreted in greatest abundance during the rutting season, and to have then its sensible qualities most developed. The secretion has a much stronger odour in the animal which inhabits Tibet and China than in that which frequents the more northern districts of Siberia. In the fresh state the musk has an extract-like consistence, and a reddish-brown colour, with an odour so powerful that the huntsmen can scarcely endure it. This odour diminishes by drying, and the musk acquires a friable granular state, and a dark brownish colour. In Siberia the chase occurs in spring and summer. In Tibet the pursuit is restricted by the government to certain periods, and the bags which are obtained are stamped with the royal signet. In commerce two and occasionally three varieties of Musk are met with.

1. The Tonquin, or Tibet Musk, received through the East India Company, occurs in small oblong rectangular boxes, lined with lead, and covered with paper or silk. Each bag, or pod, as it is termed, is wrapped in thin blue or red paper, on which are marked some Chinese characters. Sometimes the bags are enveloped in a deep yellow brownish nearly transparent paper, which becomes brittle by time. The most distinctive mark of this sort of musk is, that it is slightly flattened, nearly round, and very rarely pear-shaped. The yellow or yellowish-brown hairs, chiefly at the sides, are often cut, while those which remain in the centre are darker coloured, finer, and less bristly. Generally the hairs converge or point towards a small natural opening. The pods are mostly about two inches and a half long and one inch and three-quarters broad. The weight of different specimens varies considerably, some being merely 3 drachms 30 grains, others 9 drachms

47½ grains; the average is 6 drachms 12 grains. The average quantity of musk contained in the sacks is about 2½ drachms.

By careful removal of the bag there remains the musk, which is solid, in grains of different sizes, adhering to each other, soft, and unctuous to the feel, of a reddish-brown colour, like a clot of blood dried, having frequently a number of hairs intermixed, derived from the inner side of the orifice already described. The taste is bitterish, acrid, disagreeable, and somewhat astringent. The odour is strong, peculiar (musky), penetrating, very lasting, and extraordinarily diffusible. It is stated that a single grain can constantly fill the air of a large apartment with a sensible impregnation for many years, without its weight being perceptibly diminished; and one part can communicate its odour to 3000 parts of an inodorous powder.

It should be kept in glass-bottles, very closely stopped, and preserved in a place neither very dry nor too damp.

By the analysis of Geizar and Reiman it appears to consist of—1, a peculiar volatile principle (which can exist in a free state); 2, ammonia; 3, a peculiar fixed uncrystallisable acid (these three are in undeterminable quantity); 4, stearine and oleine; 5, cholesterine; 6, a peculiar bitter resin; 7, osmazome, with several salts; 8, a mouldy-like substance, in part combined with ammonia, and numerous salts; 9, sand; 10, water, acid, &c., with some volatile odorous matter.

It has not been ascertained upon what musk depends for its peculiar properties. It has been conjectured that a kind of putrefaction goes on which evolves the peculiar odour. Moisture seems to favour this, and musk which when dry yields little scent, becomes powerful when moistened. The odour is augmented by adding a few drops of the solution of subcarbonate of potass.

2. Kabardin, Russian or Siberian Musk, is either received through St. Petersburg, or, it is said, sent to China, and laid for some time among the bags of genuine Tonquin Musk, to acquire the odour of the latter, and then shipped to Europe. The pods of this sort are in general larger, more oval, more compressed, and the margins often have large portions of the skin of the abdomen attached to them. The colour of the hairs is a dirty milk-white. The musk exhibits a more homogeneous and less granular appearance, having a much fainter odour and taste than the preceding kind. The odour is augmented by moisture, but is somewhat nauseous and disagreeable. The wood-cuts show the difference of aspect of the two kinds.

1, Tonquin Musk. 2, Kabardin Musk.

Musk is more soluble in water than in alcohol. Of 100 parts of genuine Tonquin Musk, boiling-water dissolves 90 parts, alcohol only 50. Of Kabardin Musk water dissolves only 50 per cent. It is likewise soluble in ether, acetic acid, and yolk of egg.

3. A very small kind of pod is sometimes met with, which is not flattened, but perfectly round: the hairs of a yellowish-brown colour. This is probably the musk-bag of the *Moschus Altaicus*.

It is safest to purchase the musk out of the pod, as there is then less opportunity of adulteration. Infusion of genuine musk is not precipitated by a solution of bichloride of mercury (corrosive sublimate); but genuine musk is precipitated by nitric and other strong acids, by acetate of lead (sugar-of-lead), and infusion of galls. The musk-bags are used by perfumers to prepare Essence of Musk. An artificial musk is sometimes made with nitric acid and oil of amber.

MUSK-BEETLE. [CERAMBYCIDÆ.]

MUSK-DEER. [MOSCHIDÆ.]

MUSK-DUCK. [DUCKS.]

MUSK-ORCHIS. [HERMINIUM.]

MUSK-OX. [BOVIDÆ.]

MUSK-RAT. [ONDATRA.]

MUSK-ROOT, the root of a plant brought to this country from Russia and Persia, and known also by the name of Sumbul. This root exhales a powerful smell of musk, and has been used in medicine as a substitute for that substance. The plant yielding it is not known, but the root has the appearance of belonging to the natural order *Umbelliferæ*. Its tissues are full of starch.

MUSOCA'RPUM, a genus of Fossil Plants, the fruits of which only are known. It occurs in the Coal-Measures of Lancashire. (Brongniart).

MUSOPHA'GIDÆ (Swainson), a family of Birds, the type of which is the genus *Musophaga*, the species of which are called Plantain-Eaters. Mr. Vigors notices the genera *Musophaga* and *Corythaix* as nearly and evidently allied to the Gallinaceous Families, and as being found among the Scansorial Birds; and speaks of the genus *Vinago* [COLUMBIDÆ] as united by their comparatively stronger and more solid bills to *Penelope* and *Crax*, which in his arrangement form the opposite extreme of the order *Rasores*, as well as to *Musophaga* and *Corythaix*, which approach the whole of the Rasorial groups and connect them with the Perchers. [INSESSORES.]

The *Musophagidæ* constitute, according to Mr. Swainson, the fifth great division of the conirostral tribe of Perchers. Not that he considers it as by any means clear that *Musophaga* is the real type of the whole family, though he designates that genus as the most conspicuous of the group.

He thus characterises the family:—

Bill short; upper mandible high; the culmen arched; the margins either serrated or entire; the under mandible very thin. Feet short formed for clinging. The toes various.

The place which this family occupies in Mr. Swainson's arrangement is next to the *Fringillidæ*, at the end of the Perching Birds, and immediately before the *Scansores*, intermediate between the Finches and Hornbills. He observes that those which betray their affinity to the bullfinches are small, whilst others, whose size and peculiar structure assimilate them more to the hornbills, are of a size proportionate to those birds, remarking that, with the exception of one genus, they all possess a short but very strong and thick bill, more or less curved on the top, the cutting margins being minutely serrated, like the teeth of a saw. The food, it is stated, seems to be entirely vegetable, and of the most tender and delicate description: and Mr. Swainson remarks that it is singular to observe that the bill in this family (in outward appearance much stronger than that of the Finches) should yet be employed in procuring the softest vegetable food; while the short bill, posterior nostrils, hopping gait, and purely vegetable food are all exemplified in such birds as *Buceros galeatus*, and proclaim the affinity of the Plantain-Eaters to the Hornbills.

Mr. Swainson further remarks that the economy of these birds, so far as they have been observed by travellers, is directly against the theory of their being likened to the Gallinaceous Order; and he quotes some of the statements of Cuvier and those of Yarrell in support of his opinion. The former, in the 'Règne Animal,' states that *Corythaix* and *Musophaga* appear to him to have some analogy with the Gallinaceous Birds, and particularly with the Hoccos. They have the wings and the tail of those birds, and, like them, keep on trees; their bill, he continues, is short, and the upper mandible convex; their feet have a short membrane between the anterior toes; but it is true that the external toe is often directed backwards like that of the owls. Their nostrils also are simply placed in the horn of the bill, the edges of the mandibles are dentilated, and the sternum (at least that of the Touraco) has not the great notches which are ordinary in the Gallinaceous Birds. Mr. Swainson observes that this admission of Cuvier, that *Corythaix* and *Musophaga* only present "quelque analogie avec les gallinacés," and that they have not the notched sternum of the latter, is directly opposed to the theory of these birds leading to the *Gallinacea*, a view of the subject which is confirmed by Mr. Yarrell's observations. Mr. Swainson separates the family into the following sub-families and genera:—

Phytotominæ, Plant-Cutters.—Bill serrated, but not swollen. Feet with two or three toes forward, and one backward. (Sw.)

Phytotoma (Molina).—Bill short, compressed, the base widened; high at the base, and gradually curved; the lower mandible much weaker, straight; the commissure slightly arched, with the margins crested. Tongue short, pointed. Nostrils basal, small, rounded. Wings moderate; the first two quills graduated; tail moderate, even. Feet strong. Lateral toes unequal, the inner shortest. Claws slender slightly curved. (Sw.)

P. Rara. Molina describes the Rara, or Chilian Plant-Cutter as nearly of the size of a quail, with the bill rather large, conical, straight, a little pointed, serrated, and half an inch in length; the tongue very short and obtuse, the pupil of the eye brown. Three well-proportioned anterior toes, the fourth posterior and a little shorter. The tail moderate, but rounded. The colour is an obscure gray upon the back, rather brighter on the belly; the points of the quills and of the tail are black. The sound of its voice is hoarse and interrupted, and seems to express its name. It feeds on plants, but previously has the destructive habit of cutting them off close to the root, and often capriciously cuts off a quantity of them without touching them further. For this reason the peasants persecute this species, and carry on a continual war against these birds; moreover children who destroy their eggs are rewarded. The nest is built in obscure and but little frequented places on the most lofty trees, and thus these Plant-Cutters escape the persecutions of their enemies. Notwithstanding such precautions however, their numbers are considerably diminished. "I do not know," says Molina in conclusion, "whether this is because a price is set on its head, or on account of its naturally small degree of fecundity."

Chilian Plant-Cutter (*Phytotoma Rara*).

Mr. Swainson observes that in *Phytotoma* the four toes appear to be arranged as in the Finches, but in *Hyreus*, the other genus of this sub-family, the toes are only three. He compares the size and entire aspect of *Phytotoma* to that of a Bullfinch.

Colinæ, Colies.—The only definition of this sub-family given by Mr. Swainson is, "all the four toes placed forward," and the only genus contained in it is—

Colius (Brisson and Gmelin).—Bill short, strong, conical, slightly compressed, entire, with the mandibles equal and the edges arched. Nostrils rounded; nails arched and long, that of the hind toe shortest. Wings short; third quill longest. Tail graduated and very long.

The plumage of the species is soft and silky, and the colours generally sombre, whence they are called at the Cape, according to Le Vaillant, Oiseaux Souris (Mouse-Birds). Africa and the East Indies are the localities where they have been found, the *Colius viridis* of Latham, said to be from Australia, belonging probably to another genus. The Colies are gregarious, live upon fruits, and are the scourges of gardens. They walk badly, but they climb almost continually on the branches of trees, where they hold on, assisting themselves with their bills like the Parakeets. They build their nests, which are spacious and round, in little groups; and Le Vaillant affirms that they sleep suspended with their heads downwards, and that, when it is cold, thy are found so benumbed in the morning, that they may be taken one after the other. The number of eggs is generally five or six, and the flesh of the birds is said to be delicate. (Lesson.)

C. Senegalensis (Latham). Round the eye a naked reddish skin; forehead yellow; colour pearl-gray, with greenish reflections; abdomen ruddy.

This appears to be the *Colius Quiriwa* of Le Vaillant; and the Coliou Huppé du Sénégal of Buffon.

Musophaginæ, Plantain-Eaters.—Three toes forward and one backward; the outer toe placed obliquely. (Sw.)

Corythaix (Illiger).—Bill short, rather small, high, and greatly compressed. The frontal feathers reposing over and concealing the nostrils. Culmen high, curved to the tip. Lower mandible narrow; both mandibles distinctly notched at the tip and finely serrated. Wings short, rounded; the first three quills graduated. Tail long,

Colius Senegalensis.

broad, rounded. Feet short, strong. Middle toe longer than the tarsus; lateral toes equal, hind toe shortest; external toe capable of being turned a quarter of the way backward. Claws short, thick, and much compressed.

The following cuts will give but an imperfect idea of these elegant birds.

Head of *Corythaix Senegalensis*

The Touracos are most elegant birds, and feed principally on soft fruits. The prevailing colour of these birds is green, varied in some species with purple on the wings and tail. They are natives of Africa, where they perch on the highest branches of forest trees, and thus keep out of gun-shot, as Le Vaillant found to his cost. Having at last succeeded in bringing one to the ground, he could not find it, and, stamping in his rage at the loss, he broke through into one of the covered pits which the Hottentots employed to catch ferocious animals, particularly elephants. This accident might have been fatal. "When I recovered my first surprise," says he, "I began to consider how I should extricate myself from this embarrassment, extremely happy that I had not been impaled on the sharp-pointed stake placed in the bottom of the pit, and still happier that I found in it no company. I was however apprehensive that some might arrive every moment, especially if I should be obliged to remain there during the night." In this dilemma Le Vaillant fired his fusee at intervals; the shots at last were answered, and he was delivered by his Hottentots. But he did not forget his Touraco, and now, by the aid of his dogs, which had followed the Hottentots, found it squatted under a tufted bush. He afterwards laid snares for them on the fruit-trees, to which they resorted to feed, and took them alive.

Corythaix Senegalensis.

C. erythrolophus (Swainson). Crest, which is red, erect and compressed; sides of the head, ears, chin, and patch round the eye (which is large, red, and brilliant), white; general plumage green, inclining to bluish on the body and belly; quills rich purple violet; tail rounded; bill yellow; feet grayish-black.

Corythaix erythrolophus.

This beautiful species is the *Opæthus erythrolophus* of Vieillot; the *Musophaga Paulina* of Temminck; and *Corythaix igniceps* of Lesson. If is a native of Africa.

Several specimens of Touracos are to be found in our museums, and several species have lived at the gardens of the Zoological Society, Regent's Park.

Head of *Corythaix erythrolophus.*

Chizærhis (Wagler).—Bill large, high and thick at the base, compressed beyond. Culmen thick, convex, considerably arched. Lower mandible not half so high as the upper; the tips of both deeply notched, with their margins finely crenated. Nostrils basal, placed close to the top of the bill, naked, lunular, and pierced in the substance of the bill. Wings lengthened; the four first quills graduated. Tail lengthened, slightly rounded; the tips very obtuse. Feet as in *Corythaix.* (Swainson.)

C. variegata. Light gray above; a blackish stripe down each feather; front, top of the head, chin, and throat as far as the breast, chestnut-brown; under plumage beyond the breast white, but each feather with a dark middle stripe; primary and secondary quills blackish, with a spot of pure white varying in size in the middle of their inner webs; tertiaries and middle tail-feathers gray, tipped with black; lateral tail-feathers black; bill yellow; feet gray. Crest placed very far back on the nape. Total length about 20 inches.

Chizærhis variegata.

This appears to be the Touraco Huppé-col of Le Vaillant; *Phasianus Africanus* of Latham; and *Musophaga variegata* of Vieillot. It is a native of Africa.

Musophaga (Isert).—Bill resembing that of *Chizærhis;* but the base enormously dilated, so as to spread like a casque or helmet over the fore part of the head as far as the crown, where its thickened sides form a semicircle. Nostrils naked, oval, open, placed nearer to the tip than to the eyes, and pierced in the substance of the bill Wings, feet, and tail as in the *Corythaix.* (Swainson.)

M. violacea. Bill rich yellow, passing into crimson; orbits naked, and, like the compact velvety feathers of the crown, glossy-crimson; a white stripe beginning below the eye and extending above the ear; secondary and part of the primary quills carmine, with lilac reflections, margined and tipped with blackish-violet, which is the general colour of the plumage, only that it changes into a very deep green on the under parts, and is very rich on the tail; legs strong and black; gape wide, opening beneath the eyes.

This magnificent bird appears to be the *Cuculus regius* of Shaw.

It is a native of Africa—Gold Coast and Senegal.

Musophaga violacea.

MUSQUASH. [ONDATRA.]

MUSSEL, a form of Conchiferous *Mollusca.* [MYTILIDÆ.]

MUSTARD. [SINAPIS.]

MUSTARD-TREE. The plant referred to by this name in Scripture is, according to Dr. Royle, the *Salvadora Persica* of botanists. It is a native of the East Indies. [SALVADORA.]

MUSTELA. [MUSTELIDÆ.]

MUSTELIDÆ, the Weasel Tribe, a family of Digitigrade Carnivorous Animals, of which the Common Weasel is the type.

The genus *Mustela* of Linnæus, in the last edition of the 'Systema Naturæ,' which underwent his revision, comprised the following species:—*M. Lutris, M. Lutra, M. Lutreola, M. barbara, M. Gulo, M. Martes, M. Putorius, M. furo, M. Zibellina, M. erminea,* and *M. nivalis.* The genus thus established consisted of the Otters and Gluttons, as well as the true Weasels, and was placed between *Viverra* and *Ursus.*

Cuvier divides the Martes (*Mustela,* Linn.) into the following subgenera:—

Putorius (Cuv.).—The animals of this sub-genus are, he observes, the most sanguinary of all. The lower canine has no internal tubercle, and their upper tuberculous tooth is wider than it is long; they have only two false molars above and three below. They may be recognised by the extremity of their muzzle, which is rather shorter and stouter than that of the Martes; and they all diffuse a most disagreeable odour.

The species arranged under this sub-genus are the common Fitchet, or Polecat (*Mustela Putorius,* Linn.), the Ferret (*M. furo,* Linn.), the Polecat of Poland (*M. Sarmatica,* Pall.), the Siberian Polecat (*M. Sibirica,* Pall.), the Weasel (*M. vulgaris,* Linn.), and the Stoat or Ermine Weasel (*M. erminea,* Linn.).

As approximated to these he records the Mink, Norek, or Polecat of the northern rivers (*M. Lutreola,* Pall.), which frequents the banks of waters in the north and east of Europe from the Icy Sea to the Black Sea, feeds on frogs and crayfish, and has the feet a little palmated between the bases of the toes, but which its teeth and round tail approximate to the Polecats more than the Otters. It is reddish-brown, and has the circumference of the lips and under part of the jaw white. Its odour is only musky, and its fur very beautiful.

Some, Cuvier observes, think this the same as the Polecat of the North American rivers (*M. Vison,* Gmelin), to which the name of Mink has been transferred, and which has also the feet semi-palmated; but this animal has generally white on the point of the chin only, and sometimes a narrow line under the throat, and is a different species.

Among the Polecats of warm climates, Cuvier notices the Javanese Polecat (*Putorius nudipes,* F. Cuv.), the African Polecat (*P. Africanus,* Desm.), the Striped Polecat of Madagascar (*P. striatus,* Cuv.), and the Cape Polecat (the Zorille of Buffon; *Viverra Zorilla.* Gm.).

The Martes, or Martens, properly so called (*Mustela,* Cuv.).

These, according to Cuvier, differ from the Polecats in having an additional false molar above and below, and a small internal tubercle on their lower canine; two characters which a little diminish the cruelty of their nature.

Belonging to Europe he notices, as very closely allied to each other, the Common Marten (*Mustela Martes,* Linn.), and *M. foina.*

As the production of Siberia, he calls attention to the Zibelline Marten (*M. Zibellina*), so celebrated for its rich fur, which is brown, with some gray spots on the head, and is distinguished from the preceding by having hairs even under the toes, a provision adapted to its habitation in the most frozen mountains. The painful chase of this species is laboriously followed in the midst of winter among frightful snows, and to the pertinacity with which it has been persevered in, notwithstanding the meteoric terrors that surround the hunter, the discovery of the eastern countries of Siberia has been ascribed.

North America, observes Cuvier, produces many Martes, which travellers and naturalists have indicated under the names of Pekan, Vison, Mink, &c. One of these, the White Vison of the furriers (*M. lutrocephala,* Harl.), has the feet as hairy and the hair nearly as soft as the Zibelline, but of a bright fulvous colour, and is almost whitish on the head. That, he remarks, which he shall call Pekan (*M. Canadensis,* Gm.), and which comes from Canada and the United States, has the head, the neck, the shoulders, and the upper part of the back mingled with gray and brown; the nose, the rump, the tail, and the limbs are blackish.

The Mouffettes (*Mephitis,* Cuv.).

These, like the Polecats, have two false molars above and three below; but their upper tuberculous tooth is very large, and as long as it is wide, and their lower canine has two tubercles on its internal side, which approximates them to the Badgers, as the Polecats are approximated to the Grisons and the Gluttons. The Mouffettes have besides, like the Badgers, the anterior claws long and adapted for digging, and they are even half plantigrade: the resemblance is continued even in the distribution of the colours. Cuvier truly remarks in conclusion, that in this family, remarkable for its fœtid odour, the Mouffettes are distinguished by a stench far exceeding that of the other species.

The Mouffettes, or Skunks, are generally striped with white upon a black ground; but the number of stripes varies in the same species. The most common is the North American species (*Viverra Putorius,* Gm.), which is black, with white stripes more or less wide and numerous, and the tip of the tail black. The odour of this suffocating animal has been compared to that of the Polecat, mingled with an overpowering stench of garlic, and nothing can be more intolerable. Cuvier also notices the Chinche (*V. mephitis,* Gm.), with the tail white; the stripes on the back sometimes occupy the whole of its width.

Mydaus (F. Cuv.).—Cuvier considers that this may be made a distinct sub-genus. With the teeth, feet, and colours of the Skunks, it has a truncated muzzle in the form of a snout, and the tail is reduced to a small pencil of hairs.

Only one species, *M. meliceps,* is known.

The Otters (*Lutra,* Storr.).

The Martes of Cuvier are placed between the Ratels and the Dogs.

The same position is assigned to this family by M. Lesson.

Professor Bell, in his 'British Quadrupeds,' makes the *Mustelidæ* consist of the following genera:—

Lutra, Mustela, and *Martes,* Ray.

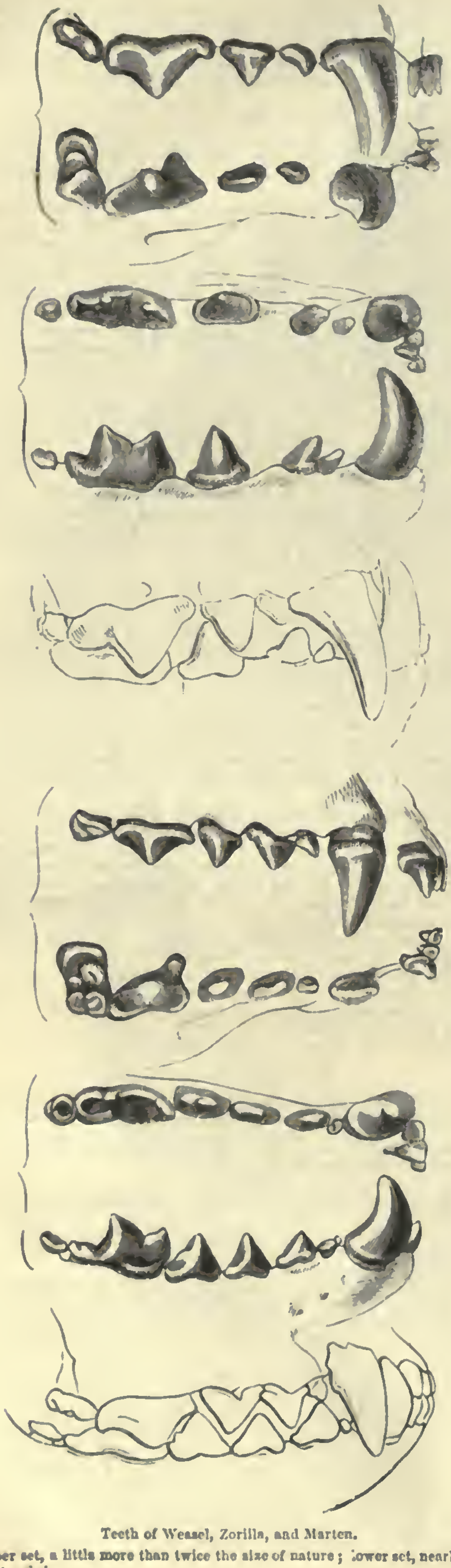
He places the *Mustelidæ* between the *Ursidæ* and the *Felidæ* in the same work.

Dr. J. E. Gray arranges his sub-family *Mustelina,* the fifth of his family *Felidæ,* next to his sub-family *Canina.* The *Mustelina* contain the following genera:—

Martes, Mustela, Putorius, Gymnopus, Vison, Zorilla, Galera, Ratelus, Gulo, Helictis, Mephitis, Chinchia, Marputius, Conepatus, Mydaus, Arctonyx, Meles, Taxidea, Lontra, Lutra, Aonyx, Pteronura, and *Enhydra.* ('Synopsis: Brit. Mus.')

We shall here confine ourselves to the Weasels, properly so called, including the Martens, Skunks, and *Mydaus.*

The dentition of the Common Weasel, the *Zorilla,* and the Marten, is very similar; and indeed F. Cuvier unites the three, giving two plates to show the slight variations. He observes, that the only difference that they present with reference to this part of their organisation is that the Martens have in both jaws a rudimentary false molar more than the Weasel and the *Zorilla;* and that the *Zorilla* has the internal tubercle of the lower canine more developed than it is found in the analogous tooth of the Martens and Weasels, or Polecats. In other respects their systems of dentition are quite identical.



Teeth of Weasel, Zorilla, and Marten.

Upper set, a little more than twice the size of nature; lower set, nearly twice the natural size.

Mustela.—Body elongated, vermiform. Feet short; toes separate; claws sharp. Molar teeth, $\frac{4-4}{5-5}$.

M. vulgaris, the Common Weasel. Reddish-brown above; white beneath; tail of the same colour as the body.

It is found in Europe and North America. Pennant states that this species inhabits the Hudson's Bay countries, Newfoundland, and the United States. Godman, in his account of the animals of the United States, omits it. Prince Bonaparte thinks that what has been considered as the Common Weasel in the United States is the Ermine in its summer fur. Lawson notices it in his 'History of Carolina,' saying that it is the same as in England, but very scarce. Catesby also mentions it, writing 'Weasle;' and in the 'New Description of Virginia' (1649), 'Wecsels' are mentioned among their congeners, but with this saving clause, evidently written to soothe settlers—"but these vermine hurt not hens, chickins, or eggs, at any time." Sir John Richardson remarks that both the Weasel and the Ermine are indubitably inhabitants of the American continent, the Ermine extending to the most remote arctic districts, and the Weasel as far to the north, at least, as the Saskatchewan River.

Common Weasel (*Mustela vulgaris*).

Mr. Bell observes that the near approximation in figure and character, and the great general similiarity in habits, which a comparison between the Stoat and Weasel presents, have occasioned considerable confusion in some of the accounts which have been given of their history; though the difference of size and colour would at once be sufficient to distinguish the species, were there no other points of disagreement between them.

"The Stoat," says Mr. Bell, "is brown above, dirty white beneath; the tail always black at the tip, longer and more bushy than that of the Weasel, and the former animal is twice as large as its elegant little congener. The Weasel, on the other hand, is red above, pure white beneath, the tail red and uniform. Their habits also, though generally similar, are in many of their details considerably distinct; and we are fully borne out by observation in saying that the accusations against the Weasel of the mischief which he is said to perpetrate in the farm-yard and the hen-roost, as well as amongst game of every description—on hares and rabbits no less than on the feathered tribes—are principally due to the Stoat. It is not meant to be asserted that the Weasel will not, when driven by hunger, boldly attack the stock of the poultry-yard, or occasionally make free with a young rabbit or a sleeping partridge; but that its usual prey is of a much more ignoble character is proved by daily observation. Mice of every description, the field and the water vole, rats, moles, and small birds, are their ordinary food; and from the report of unprejudiced observers it would appear that this pretty animal ought rather to be fostered as a destroyer of vermin than extirpated as a noxious depredator. Above all, it should not be molested in barns, ricks, or granaries, in which situations it is of great service in destroying the colonies of mice which infest them. Those only who have witnessed the multitudinous numbers in which these little pests are found, in wheat-ricks especially, and have seen the manner in which the interior is sometimes drilled, as it were, in every direction by their runs, can at all appreciate the amount of their depredations; and surely the occasional abduction of a chicken or a duckling, supposing it to be even much more frequently chargeable against the Weasel than it really is, would be but a trifling set-off against the benefit produced by the destruction of those swarms of little thieves."

Mr. Bell adds, as ground for this defence of the Weasel, that a friend of his assured him that at least three bushels of different species of mice had been killed out of one wheat-rick, a number that will not surprise those who have seen a good thoroughly-routing mouse-hunt in a grain rick-yard or granary where the mice have taken up their quarters in earnest. Great good the Weasel certainly does, and its usual mode of attack when it reaches its prey shows that small quadrupeds and birds form its staple. It inflicts a bite on the head which pierces the brain, and seldom fails to lay the victim dead at its feet by a single stroke. But there can be no doubt that it is a destroyer of newly-hatched gallinaceous and game-birds and young ducks, as well as the smaller feathered tribes; and that, although it does good service in keeping down the mice, it is a bad neighbour to the hare and rabbit warren. Not that the Weasel will do one-third of the mischief that a Stoat will, nor upon animals of such large growth, but it will do enough. It is a most active and persevering hunter; few trees will stop it when in search of birds'-nests, which it robs not only by sucking the eggs, but by carrying off the young. It will hunt the mole, the field-mouse, and other small quadrupeds in their usual haunts, not only by the eye but also by the scent, like a Stoat; and most amusing it is to see one of these flexible agile little creatures tracing up the scent when it is at fault. They will quarter the ground like a dog till they hit it off, and, to lose no help from their eye, will occasionally sit up, raising themselves on their hind quarters to gain a more extended view around them. Their perseverance will tire down animals larger and stronger than themselves; nor will water stop them when their game takes to it for safety. In they plunge, and seldom quit their object till the fatal bite is inflicted. The brain is generally first eaten, and the body of the victim kept as a supply near the haunt of the little hunter; but it seems very questionable whether they are addicted to those blood-sucking propensities which the vulgar attribute to them; and our own experience coincides with that of Mr. Bell, who considers this alleged habit to be much exaggerated, and whose own observation, as far as it had gone, tended to confirm the opinion of those who deny the existence of such a propensity altogether.

The last-named acute zoologist also throws well-grounded doubt on the assertion that the Weasel will attack and destroy snakes; and indeed he believes such a notion to be entirely erroneous. He placed a weasel and a common snake together in a large cage, in which the former had the opportunity of retiring into a small box in which it slept. Mutual fear was manifest, and the animals kept at a distance; the snake however showing as much disposition to be the assailant as the weasel, which at last gave the snake an occasional slight bite on the side or on the nose, without however materially injuring the reptile, and evidently without any instinctive desire to feed upon it. After they had remained two or three hours together the animals appeared almost indifferent to the presence of each other. The snake was then removed.

"How different was this weasel's conduct," says Mr. Bell, after relating the experiment above stated, "when a mouse was introduced into the cage: it instantly issued from its little box, and in a moment one single bite on the head pierced the brain, and laid the mouse dead without a struggle or a cry. I have observed that when a weasel seizes a small animal, at the instant that the fatal bite is inflicted it throws its long lithe body over its prey, so as to secure it should the first bite fail; an accident however which I have never observed to occur when a mouse has been the victim. The power which the Weasel has of bending the head at right angles with the long and flexible though powerful neck, gives it great advantage in this mode of seizing and killing its smaller prey."

This destroyer becomes itself a victim to birds of prey. We have all heard the story of the eagle and cat, and how the maddened quarry brought the mighty bird that had snatched it away down again to the earth in the agonies of death. In the 'Magazine of Natural History' a similar anecdote is recorded of a stoat and an eagle, not however with any strong voucher. But Mr. Bell, on the authority of Mr. Pindar, residing when the event occurred at Bloxworth in Dorsetshire, relates the following passage in the life of a weasel; and as there is no ground whatever for doubt, it affords a striking instance of the murderous instinct of this little quadruped.

Mr. Pindar, while riding over his grounds, saw at a short distance from him a kite pounce on some object on the ground, and rise with it in his talons. "In a few moments however the kite began to show signs of great uneasiness, rising rapidly in the air, or as quickly falling, and wheeling irregularly round, whilst it was evidently endeavouring to force some obnoxious thing from it with its feet. After a sharp but short contest the kite fell suddenly to the earth, not far from where Mr. Pindar was intently watching the manœuvre. He instantly rode up to the spot, when a weasel ran away from the kite, apparently unhurt, leaving the bird dead, with a hole eaten through the skin under the wing, and the large bloodvessels of the part torn through."

With similar courage the Weasel will attack dogs, and even men, when its nest is invaded. This is framed of dry leaves and herbage, and is generally lodged in some snug locality, such as a crevice in a bank, the hollow of a tree, or a dry ditch, which keeps it warm and comfortable. Here four or five young are brought up from each birth, and the number of these litters is two, or even three, in the year.

The female Weasel is smaller than the male, and Mr. Bell well observes that it is probably the "little reddish beast" called by the country people a Cane, mentioned in White's 'Selborne,' and described as not much bigger than a field-mouse, but much longer. Mr. Blyth informed Mr. Bell that the animal was known in Surrey by the name of Kine.

This species sometimes, but rarely, turns white in the winter, and in this state it is the *Mustela nivalis* of Linnæus. Mr. Bell received one from Scotland with two white spots on each side of the nose, which it retained throughout the summer.

Pennant gives the following national names for this species:—Bronwen of the Welsh; La Bellette of the French; Donnola, Ballotula, and Benula, of the Italians; Comadreia of the Spanish; Doninha of the Portuguese; Wisel of the Germans; Weezel of the Dutch; Vesla of the Swedes; and Væsel of the Danes. The Anglo-Saxon name is Wesle.

M. erminea, Linn., the Ermine-Weasel. Body reddish-brown above, white beneath (in winter wholly white); extremity of the tail always black. (Bell.)

Winter Dress.—Yellowish-white, the yellow hardly visible on the head, but gradually showing itself more and more on the body and increasing in intensity, so that some are of a pale yellow colour on their hind parts. In high northern latitudes, and in severe winters lower down, the white on the upper parts is quite pure.

Ermine (*Mustela erminea*) in winter dress.

Summer Dress.—About the end of March the upper parts change to reddish-brown, of rather a dull tint; the lower parts continue white. The tail, as noticed in the specific character, remains black at the extremity during all the changes.

Ermine (*Mustela erminea*) in summer dress.

In northern latitudes, even in the alpine districts of Scotland, Mr. Bell observes that this change is universal; but farther south it becomes an occasional and even rare occurrence.

With regard to the mode in which this alteration is brought about, Mr. Bell expresses his belief that the winter change is effected not by the loss of the summer coat and the substitution of a new one, but by the actual change of colour in the existing fur; and he cites, in proof of this view of the subject, the case of the Hudson's Bay Lemming, which in Captain Sir John Ross's first Polar Expedition was exposed in its summer coat on the deck to a temperature of 30° below zero, and the next morning the fur on the cheeks and a patch on each shoulder had become perfectly white. Next day the shoulder-patches had considerably extended, and the posterior part of the body and flanks had turned to a dirty white. At the end of a week the winter change was complete, with the exception of a dark band across the shoulders prolonged down to the middle of the back.

That change of temperature, and not merely change of season, is necessary to effect the alteration of colour, is evident from Mr. Hogg's observations. (5th vol. of Loudon's 'Magazine of Nat. Hist.;' Bell, 'British Quadrupeds.')

Mr. Hogg, whose remarks appear to have been made in the county of Durham, states that within the last nine years from the dete of his communication he had met with two Ermines alive, and in the most different winters that had occurred for a great many years. One was observed in the extremely severe winter (January to March) of 1823; the other in the extremely mild January of 1832.

"In consequence of the months of December, 1831, and January, 1832, having been so extremely mild, I was," says Mr. Hogg, "greatly surprised to find this stoat clothed in his winter fur; and the more so, because I had seen, about three weeks or a month before, a stoat in its summer coat or brown fur. I was therefore naturally led to consider whether the respective situations which the brown and white stoats seen by me this warm winter inhabited, could alone account for the difference of the colour of their fur, in any clear and satisfactory manner. The situation then where the Brown Stoat was seen, is in nearly 54° 32′ N. lat., 1° 19′ W. long., upon a plain elevated a very few feet above the level of the river Tees, in the county of Durham. Again, the place where I met with the Ermine, or White Stoat, on the 23rd January, 1832, is in the North Riding of Yorkshire, in nearly 54° 12′ N. lat., 1° 13′ W. long.; it is situated at a very considerable elevation, and in the immediate neighbourhood of the lofty moorlands called the Hambledon Hills. These constitute the south-western range of the Cleveland Hills, which rise in height from 1100 feet to 1200 feet above the sea. At the time, the Ermine was making his way towards the hills, where, no doubt, he lived, or frequently haunted; and consequently the great coldness of the atmosphere, even in so mild a winter, upon so elevated and bleak a spot as that moorland, would satisfactorily account for the appearance of the animal in its white fur; although the place is, in a direct line, more than 23 miles distant to the south of the fields near the Tees, inhabited by the Brown Stoat."

The Ermine-Weasel, the length of whose head and body is 9 inches 10 lines, the tail being 4 inches 8 lines, is the Carlwm of the Welsh; Stoat, Stout, and Greater Weasel of the English; L'Hérmine and Le Roselet of the French; Armellino of the Italians; Armino and Armeline of the Spanish; Hermelin of the Germans; Hermelin and Lekatt of the Swedes; Hermilyn of the Dutch; Hermelin and Lekat of the Danes; Seegoos and Shacooshew of the Cree Indians; and Terreeya of the Esquimaux.

The Ermine is found generally in temperate Europe, but common only in the north. The finest, that is, those with the longest and thickest fur, and of the purest and brightest colour, are imported from the high latitudes. Russia, Norway, Siberia, Lapland, furnish them abundantly. The British importation, in 1833, was 105,139; and 187,000 in 1850. In America it is found from the most northern limits to the middle districts of the United States. Ermine-skins formed part of the Canada exports in the time of Charlevoix; but they have so sunk in value, that they are said not to repay the Hudson's Bay Company the expense of collecting them, and very few are brought to this country from that quarter.

"It appears that in England generally," says Mr. Macgillivray, "the Ermine is less common than the Weasel; but in Scotland, even to the south of the Frith of Forth, it is certainly of more frequent occurrence than that species; and for one Weasel I have seen at least five or six Ermines. It frequents stoney places and thickets, among which it finds a secure retreat, as its agility enables it to outstrip even a dog in a short race, and the slimness of its body allows it to enter a very small aperture. Patches of furze, in particular, afford it perfect security, and it sometimes takes possession of a rabbit's burrow. It preys on game and and other birds, from the grouse and ptarmigan downwards, sometimes attacks poultry or sucks their eggs, and is a determined enemy to rats and moles. Young rabbits and hares frequently become victims to its rapacity, and even full-grown individuals are sometimes destroyed by it. Although in general it does not appear to hunt by scent, yet it has been seen to trace its prey like a dog, following its track with certainty. Its motions are elegant, and its appearance extremely animated. It moves by leaping or bounding, and is capable of running with great speed, although it seldom trusts itself beyond the immediate vicinity of cover. Under the excitement of pursuit however its courage is surprising, for it will attack, seize by the throat, and cling to a grouse, hare, or other animal strong enough to carry it off, and it does not hesitate on occasion to betake itself to the water. Sometimes when met with in a thicket or stoney place, it will stand and gaze upon the intruder, as if conscious of security; and, although its boldness has been exaggerated in the popular stories which have made their way into books of natural history, it cannot be denied that, in proportion to its size, it is at least as courageous as the tiger or the lion."

Mr. Bell was informed by the Rev. F. W. Hope thet the latter, while shooting in Shropshire, was attracted by the loud shrill scream of a hare which he thought had been just caught in a poacher's snare. He ran towards the spot, and there saw a hare limping off, apparently in great distress, with something attached to the side of the throat. This proved to be a stoat, and the stricken hare made its way into the brushwood with its enemy still holding on. In England it takes advantage of the galleries of the mole for its winter retreat, as well as the rabbit burrow.

Captain Lyon, R.N., saw the Ermine hunting the footsteps of mice in the north as a hound would hunt a fox, and observed their burrows in the snow, which were pushed up in the same manner as the tracks of moles in Britain. These passages ran in a serpentine direction, and near the hole or dwelling-place the circles were multiplied as if to render the approach more intricate.

The same graphic voyager gives a lively description of a captive Ermine:—"He was a fierce little fellow, and the instant he obtained daylight in his new dwelling, he flew at the bars, and shook them with the greatest fury, uttering a very shrill passionate cry, and emitting the strong musky smell which I formerly noticed. No threats or teasing could induce him to retire to the sleeping-place, and whenever he did so of his own accord, the slightest rubbing on the bars was sufficient to bring him out to the attack of his tormentors. He soon took food from the hand, but not until he had first used every exertion to reach and bite the fingers which conveyed it. This boldness gave me great hopes of being able to keep my little captive alive through the winter, but he was killed by an accident."

Sir John Richardson states that the Ermine is a bold animal, and often domesticates itself in the habitations of the fur-traders, where it may be heard the live-long night pursuing the white-footed mouse (*Mus leucopus*). He remarks that, according to Indian report, this species brings forth ten or twelve young at a time. In this country it produces about five in April or May.

In Siberia Ermines are taken in traps baited with flesh; and in Norway they are either shot with blunt arrows, or taken in traps made of two flat stones, one being propped up with a stick, to which is fastened a baited string. This the animal nibbles, when the stone falls and crushes it. Two logs of wood are used for the same purpose and in the same manner in Lapland.

M. Putorius, the Polecat, or Fitchet Weasel. Stouter in proportion than either the Common Weasel or the Ermine, and the head broader. Nose rather pointed, ears round and not conspicuous. Neck comparatively short. Tail inclining to bushy, rather more than a third of the length of the body and head. There are two kinds of fur in this species; the short is fulvous and woolly, the long is black, brownish-black, and shining. A brown colour mingled with yellow, varying according to the proportions of these two sorts of fur in the individual, is the result. There are some white marks about the mouth and ears, and the parts which are darkest in colour are the head, tail, and feet. Length of the head and body 1 foot, 5 inches, 6 lines; of the tail, 5 inches 5 lines. Such is Mr. Bell's measurement. Mr. Macgillivray makes the total length to the end of the tail 17 inches, and observes that the anal sac is usually represented as single; and he found that beneath the extremity of the rectum externally two sacs containing a yellowish fetid substance of the consistence of thick cream were present.

This is the Ffwlbard of the Welsh; Fulimart, Foumart (as well as the terms given at the head of the description) of the English. Polecat has been supposed to have been a corruption of Polish Cat; but this seems to be not much better than a guess; Foumart and Fulimart have with better reason been considered to be contractions of Foul Martin, in contradistinction to the Sweet Martin. It is the Putois of the French, Foetta and Puzzolo of the Italians, Putoro of the Spanish; Iltis, Ulk, and Buntsing, of the Germans; Bonsing of the Dutch; Iler of the Swedes, and Ilder of the Danes.

It is found throughout Europe. Pennant says that it is common in the temperate parts of Russia, but grows scarcer in Siberia, except in the desert of Baraha and beyond the lake Baïkal.

Polecat (*Mustela Putorius*).

The Polecat is most destructive to the poultry-yard and the preserve; its appetite for slaughter, which seems never to be satiated as long as any living thing remains within its reach, rendering it a most ruinous neighbour to those who rear fowls or keep up a head of game. Not only the young birds fall victims to it, but the parents also; nor are even geese or turkeys safe. We remember an instance of a hen and a whole brood of chickens being killed by one of these destroyers in a single night; and upon another occasion, seven or eight nearly full-grown turkeys. The brain and the blood seem to be the choicest portions. The bodies of the dead are carried off to its haunts, which are generally in some copse or wood near a farm or in the heart of a preserve, whence it issues on its deadly errand in the evening, generally soon after sunset, or when it grows dusk.

No 'vermin' is placed with more satisfaction upon 'the Keeper's Tree,' for none commits more havoc, if so much, among the game. Beginning with the egg, it persecutes all the game-birds through every period of life, and is a far more determined enemy than the Stoat itself to the hare and rabbit-warren. The fox, as is well known, will do much to keep down the pheasants, and especially the rabbits and hares; but even this wily and powerful invader is not so mischievous as the species of which we are treating. Where a fox will kill one, a polecat will immolate ten, to say nothing of eggs; no vertebrated animal seems to come amiss to its murderous natnre. Bewick relates that during a severe storm a Foumart was traced in the snow from the side of a rivulet to its hole at some distance from it. As it was observed to have made frequent trips, and as other marks were to be seen in the snow which could not easily be accounted for, it was thought a matter worthy of great attention. Its hole was accordingly examined, and five fine eels were discovered to be the fruit of its nocturnal excursions. The marks in the snow were made by the motion of the eels in the quadruped's mouth. In Loudon's 'Magazine' (vol. vi.) is an account of a female polecat that was hunted to her nest, which held five young ones in a comfortable bed of withered grass. From a side hole the narrator picked out forty large frogs and two toads alive, but capable of sprawling only, for the old polecat had stricken them all with palsy by a bite through the brain of each.

The nest of this species is generally made in some rabbit-burrow, in the crevice of a rock, or where the tangled herbage and brushwood overgrow loose heaps of stones, and there the female drops from four to six young in May or early in June.

The courage of the Polecat is great, and none of the tribe denominated by gamekeepers 'vermin' so severely tries the 'pluck' of a terrier; for its flexibility, unless seized in the right place and shaken to death at once, enables it to turn and fasten upon the nose of the dog, so as to make the latter not unfrequently desist from the attack.

There is good evidence that the Fitchet or Polecat will breed with the Ferret.

Inferior to the fur of the Sable or Marten, that of the Polecat is nevertheless esteemed, and a considerable importation of the skins annually comes to this conntry from the north of Europe, under the name of Fitch.

Martes (Ray).—Grinding teeth, $\frac{5-5}{6-6}$; body much elongated; feet short, with separate toes; tongue smooth.

Before we enter upon the European species of Martins, or Martens, as they are perhaps more properly termed, it will be necessary to consider the difference of opinion among zoologists, as to the point whether the Common or Beech Marten, the Pine Marten, and the Sable are three different species, or merely varieties of one.

The *Martes* seems to have been known to the ancients, though it does not appear which of the Martens was thus designated; indeed it may have been a common name for them all. Martial writes ('Ep.' x. 37):—

"Venator capta marte superbus adest."

Some indeed read 'mele' for 'marte,' and so make a badger of the capture. The annotator in the Delphin edition has crowded as much confusion as he could in his illustration of that reading, for he writes, "Legunt alii capta mele, Gallicè blaireau, chat sauvage, fouine,"—badger, wild cat, marten, for which last 'fouine' is the French term.

George Bauer, who wrote under the name of Agricola, in his book 'De Animantibus Subterraneis,' notices the three kinds of Marten first above alluded to. After writing a clear account of the Polecat, he says:—"A third kind of sylvan weasel lies in the crevices of stones and caverns, which is called *Martes* by Martial and *Marturus* by the Germans." He then gives Martial's line above quoted, and proceeds to describe the animal and its habits with much accuracy. This is the Common or Stone Marten. He then describes a fourth, the Pine Marten; and afterwards a fifth, "called by the Germans Zobel," the Sable. The skins of the last are, ho remarks, more precious than cloth of gold, and he adds that forty of the best, the usual number in one bundle, have been sold for more than a thousand pieces of gold. ('De Anim. Subt.,' folio, Basil, 1561.)

Gesner, Aldrovandus, and Jonston, did little more than copy Agricola. "They seem however," says Mr. Bennett, who has well traced up the opinions of authors upon this subject, "to have abandoned Agricola's subdivision of the second species, and to have described his first, the Stone Marten, as it was emphatically denominated by the Germans, as the Beech Marten, imputing to it a more familiar and sociable disposition, and a fondness for the neighbourhood of inhabited places." The same distinctions are adopted by Ray in his 'Synopsis Quadrupedum,' 1693; but to his description of the Sable he adds that "Dr. Tancred Robinson had seen the animal itself in the possession of Dr. Charlton. Its size was that of a Cat of Cyprus, its colour a dark tawny; the fore part of its head and its ears of a whitish ash-colour; and the bristles on its eyebrows, nose, and face, very long."

Mr. Bennett remarks in continuation that so slightly did Linnæus estimate the value of the distinctious indicated between the Pine and Beech Martens, that he uniformly treats of them as one and the same animal in all his zoological writings, from the first edition of his 'Fauna Suecica' to the twelfth of his 'Systema Naturæ.' It is only, he observes, in the last, that Linnæus for the first time intimates the existence of any difference between them. There he speaks of two varieties as known to the rustics—the Beech Marten with a white throat, and the Pine Marten with a yellow throat. The Linnæan character of the Sable is principally, Mr. Bennett adds, founded on that of Ray, and is accompanied by the sign used by Linnæus to denote that he had not seen the animal to which it is appended.

M. Lesson enumerates all three as species, under the names of—1, Marte Commun, *Mustela Martes*, Linn.; La Marte, Buff. 2, Marte Fouine, *Mustela foina*, Linn. (Gmel. ?), La Fouine, Buff. 3, Marte Zibeline, *Mustela Zibellina*, Linn.; the Sobol of the Poles and Russians; the Sabbel of the Swedes.

Mr. Bennett states that since the time of Pallas the three species have been almost universally enumerated by authors, each copying his predecessors with more or less correctness. Desmarest, he remarks, has omitted the most important characters given by Pallas for the Sable, and has, on his own authority, furnished it with a tail of two-thirds the length of its body, while that of the Pine and Beech Martens is stated to measure but little more than the half; and he says that he knows of but one instance, since Linnæus, in which the two latter animals have beeu even apparently conjoined. This occurs in Dr. Walker's 'Essay on the Scottish Mammalia.'

Mr. Bennett, in the 'Gardens and Menagerie of the Zoological Society,' gives an accouut of the specimens of Martens in the collection of the Zoological Society.—"Such," he says, "are the specimens of Martens contained in the Society's Museum. Other individuals, exhibiting similar variations in their colouring and markings, have been observed by us in various collections; but it would be useless to multiply descriptions leading to no conclusive result. If the Beech and Pine Martens of our own country be distinct, it is probable that the last-described animal may also belong to a different species from either. We do not however hesitate to declare our opinion that the true Sable of Pallas is still a stranger to our collections; and we have good reason, in the silence of authors respecting it, for believing that it is equally unknown to the zoologists of the continent. It is certainly not a little singular that an animal so highly valued and so anxiously sought after should still be a desideratum to the scientific world; but it is perhaps no less so that the opinion which has been so lightly adopted with such well-known animals as the indigenous martens, should never yet have been put to the test of direct experiment."

Mr. Bell, after speaking in terms of deserved praise of Mr. Bennett's statement, says that a deliberate consideration of these and other authorities, and a comparison of many specimens of both kinds, had hitherto failed to lead him to a conclusion at all satisfactory to his own mind; and it is only with a protest against being considered as decidedly supporting the opinion that they are essentially different, that he ventures to give them a distinctive character in his 'British Quadrupeds.' "I am not," says Mr. Bell, "the more disposed towards this opinion by the observatiou of two living specimens in the Surrey Zoological Gardens, in which the throat, though decidedly yellow, is less bright and deep in its hue than in some other specimens, and of a single one in the menagerie of the Zoological Society, also living, the throat of which, though it would be termed whitish, yet has a slight yellow tinge. The dark colour of the former and the lighter and grayer hue of the latter, with the different colour of the throat, joined to a slight difference in the form of the head, the former being proportionally a little longer, would certainly lead us to consider the former as the Yellow-Throated or Pine Marten, and the latter as the White-Throated or Beech Marten, supposing them to be distinct; but the differences are scarcely decisive, and the yellowish tinge ou the throat of the latter specimen shows an approach to the Pine Marten even in this supposed distinguishing character, which is far from offering any help towards a satisfactory solution of the difficulty."

Mr. Macgillivray notices these observations of Mr. Bell in the 'Naturalist's Library' (British Quadrupeds); and then states that the examination of individuals in different stages, and obtained in various parts of Scotland, had disclosed to him a gradation of colouring combined with a sameness of form that had satisfied him as to the indivisibility of the species. "In fact," says Mr. Macgillivray, "the Beech Marten and the Pine Marten differ less from each other as to size than individuals of the polecat, ermine, or weasel, and the differences of colour observed are not greater than in the common fox."

M. Martes, var. with the White Throat (Linn.), the Beech Marten; *M. foina*, Gmel.; *Martes Fagorum*, Ray; *M. Saxorum*, Klein. Mr. Bell describes the head of this marten as somewhat triangular; the muzzle pointed; the nose extending a little beyoud the lips; the eyes large, prominent, aud remarkably lively; the ears large, open, and rounded; the body much elongated and very flexible; the tail long, thick, and somewhat bushy; the feet rather short; the toes generally naked, but at times, probably in the winter, covered beneath with a thin soft hair. The fur, he observes, is of two sorts: the inner extremely soft, short, copious, and of a light yellowish-gray colour; the outer very long, shining, ash-coloured at the roots, brown at the extremity, but of different degrees of intensity at different parts of the body; the middle of the back, the tail, the outer parts of the legs and the feet, being darker than the other parts; the belly lighter and more gray; the throat white, but Mr. Bell states that in one instance he had seen it of a light yellowish tinge; inner surface and margin of the ears whitish. Length of head and body 1 foot 6 inches; of the tail 9 inches 6 lines.

This is the Bela Graig of the Welsh, and Stone Marten of the English. It is La Fonine of the French; Foina and Fouina of the Italians; Marta and Gibellina of the Spanish; Hauss Marder and Stein Marder of the Germans; Marter of the Dutch; Mard of the Swedes; and Maar of the Danes.

It is found in northern and temperate Europe, and western Asia.

Beech or Stone Marten (*Mustela Martes*).

This Marten is found more remote from woods, though it is often met with in them, and more frequently in mountainous and stony places, and nearer the habitations of man than the Pine Marten. It prefers the vicinity of farm-yards and homesteads, and is a ruinous visitor to them and the game-preserve. It is an expert climber, and Daniel, in his 'Rural Sports,' has figured it on a tree about to attack a hen-pheasant at perch. A very groundless notion once prevailed that this was the Pine Marten in a state of domestication. It is lively, active, and graceful in its movements. The nest of the female is constructed of herbage, straw, or grass, sometimes in the hollow of a tree, sometimes in the crevices of rocks, not unfrequently in a ruin, and occasionally in granaries or barns.

The fur of the Beech Marten is considered very far inferior to that of the Pine Marten, and is known in the trade as the skin of the Stone Marten. Many are imported from the north of Europe, and dyed to represent Sable. The comparatively poor quality of the fur however is immediately perceptible to the experienced eye, although, as is the case with most of the animals which are used for their fur, the northern skins are fuller, richer in colour, and more lustrous than those from more temperate climates.

Martes Abietum (Ray); *Mustela Martes*, Linn., the Pine Marten. Brown; throat yellow; toes naked beneath; legs longer and head smaller than in the Beech Marten.

This is the Bela Goed of the Welsh; La Marte of the French; Marta, Martura, Martora, and Martorello of the Italians; Marta of the Spanish; Feld-Marder and Wild-Marder of the Germans; Marter of the Dutch; Wawpeestan of the Cree Indians; Wawbeechins of the Algonquins; Sable of the American Fur-Dealers; and Martin of the Hudson's Bay Company's Lists.

It is found in Europe and North America.

The Pine Marten in its habits resembles the Beech Marten, but it shuns the neighbourhood of man—living in Europe in deep forests, and preying on birds and the smaller animals. The female deposits two or three young ones in a nest of moss and leaves formed in some hollow tree, when she does not take possession of that of the squirrel or the woodpecker.

Sir John Richardson states that the Pine Marten inhabits the woody districts in the northern parts of America, from the Atlantic to the Pacific, in great numbers, and that it has been observed to be particularly abundant where the trees have been killed by fire, but are still standing. "It is very rare," continues Sir John, "as Hearne has remarked, in the district lying north of Churchill River, and east of Great Slave Lake, known by the name of Chepewyan or Barren Lands. A similar district, on the Asiatic side of Behring's Straits, 25 degrees of longitude in breadth, and inhabited by the Tchutski, is described by Pennant as equally unfrequented by the marten, and for the same reason, the want of trees. The limit of its northern range in America is like that of the woods, about the 68th degree of latitude, and it is said to be found as far south as New England. Particular races of martens, distinguished by the fineness and dark colours of their fur appear to inhabit certain rocky districts. The rocky and mountainous but woody district of the Nipigon, on the north side of Lake Superior, has long been noted for its black and valuable marten-skins."

Pine-Marten (*Mustela Abietum*).

The same author gives the length of the head and body at from 18 to 20 inches, and notices a remark of the natives that the fur loses all its lustre, and consequently much of its value, upon the falling of the first shower of rain for the season. He further states that this animal preys on mice, hares, and partridges, and in summer on small birds' eggs, &c. A partridge's head, with the feathers, is, he says, the best bait for the long-traps in which it is taken. It does not reject carrion, and often destroys the hoards of meat and fish laid up by the natives, when they have accidentally left a crevice by which it can enter. When its retreat is cut off, it shows its teeth, sets up its hair, arches its back, and hisses like a cat. It will seize a dog by the nose and bite so hard, that, unless the latter is well used to the combat, it escapes. Easily tamed, it soon becomes attached to its master, but is not docile. The flesh is occasionally eaten but not prized by the Indians. The females are smaller than the males, go with young about six weeks, and produce from four to seven at a time about the end of April. According to Mr. Graham this marten is sometimes troubled with epilepsy.

The importation of Pine Martens' skins from the territories o the Hudson's Bay Company and Canada is great. Pennant relates that at one of the company's sales (in 1743) not fewer than 12,370 good skins, and 2360 damaged, were sold, and about the same time the French brought into the port of Rochelle from Canada no less than 30,325. Upwards of 100,000 skins have long been annually imported into Great Britain.

The editor of the last edition of Pennant's 'British Zoology' says that the length of a male which he saw in Suffolk was 19 inches, exclusive of the tail, which measured 10 inches; the total length of the female the same, but the tail longer in proportion to the body. The breast of the latter was of a paler yellow, and the colour extended behind the ears.

Mr. Bell, after remarking that the colour of the fur is scarcely a tangible distinction, observes that different individuals of the Beech Marten vary quite as much in this respect as the Pine Marten and the Sable: the existence of fur on the toes, which has been adduced as a character of the Sable, probably depends, he observes, on climate; and is mentioned by Pennant as having been seen by him in the Common Marten. "Never," says Mr. Bell, "having seen an undoubted whole specimen of the true Sable, I am unable to offer any satisfactory addition to our knowledge on the more important characters of the two animals; but I have found in the examination of numbers of the finest sable-skins, that the yellow patch on the throat had always an irregular outline, and that there were also small spots of the same fine colour scattered on the sides of the neck. This is a distribution of the colour which I have never observed on the Common or Pine Marten. I offer the fact however merely as one which, combined with other characters, may possibly aid in determining the question when we have fuller information on the subject."

The probability seems to be that the Beech Marten, the Pine Marten, and the Sable, do not offer sufficient differing characters to warrant their specific distinction.

Mustela Furo, Linn. (*Viverra Furo*, Sbaw), the Ferret. Yellowish, different parts being more or less white, for the long fur is partly white and the short almost entirely yellow; eyes pink. Length of head and body 14 incbes; of the tail 5 inches 6 lines. This is Le Furet of the French. It is a native of Africa, but is domesticated in Europe. It is often regarded as a domesticated variety of the Polecat.

Ferret (*Mustela Furo*).

The Ferret was well known to the ancients; and it appears that it was used by them much in the same manner as it is employed in the present day. Its use in Spain is noticed by Strabo (iii. p. 144, ed. Casaub.), and Pliny ('Nat. Hist.,' viii. 55) speaks of its services under the name of *Viverra*, in hunting rabbits, by entering their burrows and ejecting them, so that they were taken when they bolted out.

Its habits are similar to those of tho European Weasels, but more bloodthirsty. Capable of a certain degree of tameness, it seldom, if ever, becomes attached, and is a dangerous inmate unless properly secured. It has even been known to attack and cruelly lacerate an infant which had been left unguarded in its cradle, and with such ferocity that after it had been driven away the cries of the tortured child brought it from its hiding-place, eager to renew the attack.

This species, whose whiteness and red eyes may probably be the result of a long period of domestication, cannot bear cold, and should be kept warm to ensure its healthy condition. It is said to breed twice a year in a state of domestication, unless it devours its offspring, which it sometimes does, and then it has three litters. Tho gestation of the female continues six weeks, and she tben produces generally six or seven young—sometimes nine. These are blind for a month, and at the end of two more are considered fit for service.

Ferrets should be kept in tubs or small boxes; and cleanliness is very essential to their health and strength. To enter them, tbey should, when the rabbits are half grown, be sent into the burrow with a line tied round tbem and unmuzzled. When tho ferret seizes a rabbit the line should be gently pulled and the ferret drawn back, holding the rabbit in its mouth. This mode can only be practised where the burrows run comparatively straight and near the surface.

Ferrets should not be fed before they are taken to the warren, for if they are filled with food they will not hunt, but lie sleeping in tbe burrows for hours. Before they are turned in they should be muzzled or coped, there being no necessity for the inhuman practice of sewing up the ferret's mouth.

Tbe following has been recommended as the best method of 'coping':—Tie a piece of soft string round the neck of the ferret, close to the head, and leave two rather long ends. Tie another piece round the under jaw, pass it under the tongue, bring it round over the upper jaw, and there tie it, leaving tbe ends long. The moutb will tbus be kept closed. Then bring the four ends together, and tie them in one knot on the top of the head: this makes all ssfc. No pain is inflicted apparently by this operation, for the ferret thus coped hunts as eagerly as if it were unmuzzled.

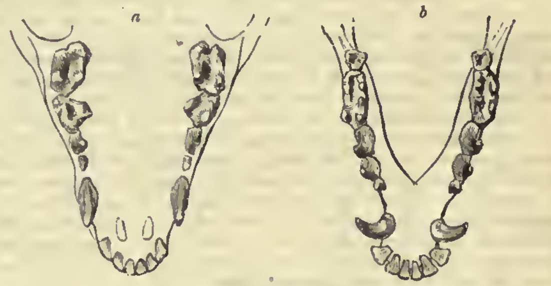
Daniel, in his 'Rural Sports,' thus describes the method of ferreting:—"The ferret is coped or muzzled, and a small bell tied round his neck; and after the holes are as silently as possible covered with purse-nets, called 'flans,' the ferret should be put in the windward side of tbe burrows, where the person should also place himself, and observe the utmost silence, otherwise the rabbits will retreat to their lower earths and be scratched to death before they will bolt. Hay nets are however chiefly used by experienced warreners, who are loth to turn ferrets into burrows, which invariably give tbe rabbits a dislike to them." The mode of using these hay nets is then described.

Mydaus.—Five toes on each foot, united up to the last phalanx by a very narrow membrane; claws, proper for digging, very large on the fore feet, moderate on the hind feet. Tail rudimentary. Pupil round; no external ear; four pectoral and two inguinal mammæ.

Dental Formula:—Incisors, $\frac{6}{6}$; Canines, $\frac{1-1}{1-1}$; False Molars, $\frac{2-2}{3-3}$; Flesh-Cutting Molars, $\frac{1-1}{1-1}$; Tuberculous Molars, $\frac{1-1}{1-1}=34$.

M. meliceps. Agreeing in size generally with the polecats of Europe and America. Eyes placed high in the head, resembling those of a hog, which animal is called to mind by the appearance of this species; eyelids rigid, well provided with minutely-bristled eyebrows; irides dark, pupil circular; ears nearly concealed by hair, but provided externally with an oblong concha surrounding tbe posterior part, and passing the lower extremity of tbe meatus auditorius, forming a small curve inward; no perceptible whiskers, a few long straggling hairs on the upper lip. Fur composed of long, delicate, closely-arranged hairs, silky at the base, and forming a warm coat. Colour blackish-brown, more or less intense on every part of the body, except the crown of the head, a streak along tbe back, and tbe extremity of the tail, which sre white, with a slight tinge of yellow, but in some individuals the streak is interrupted. The brown colour is generally lighter on the abdomen, and is subject to variations generally from grayish-brown to deep brown with a sooty tint; the last the most common. Tail scarcely half an inch long, the hairs projecting above an inch from tbe body. Limbs short and stout; feet plantigrade; claws united at the base by a thick membrane enveloping this part as a sheath: those of the fore fcet nearly double the size of the hind feet. Two glands of an oblong form, about au inch long and half an inch wide near the extremity of tbe rectum, furnished with an excretory duct nearly half an inch long, which communicates with the intestine. Fluid secreted by the glands perfectly analogous in odour to that secreted by several species of *Mephitis* in America, particularly to that of *Mephitis striata*, Fisch. Length of body aud head, from extremity of nose to root of tail, 1 foot $2\frac{3}{4}$ inches; of naked tail, half an inch; of tail, with hairy covering, 2 inches. (Horsf.)

Skull of *Mydaus meliceps* (profile). Horsfield.



Teeth of *Mydaus meliceps*.

a, upper jaw, seen from bo.ow; *b*, lower jaw, seen from above. Horsfield.

Profile of the head of *Mydaus meliceps*.

This is the Teledu of the Javanese east of Cheribon; Seng-gung of the Sunda Javanese of the mountainous districts from Cheribon to Bantam; Teleggo of the inhabitants of Sumatra; *Mephitis Javanensis* of Raffles.

Mydaus meliceps. Horsfield.

Dr. Horsfield states that this species presents a singular fact in its geographical distribution. It is, he says, exclusively confined to those mountains which have an elevation of more than 7000 feet above the level of the ocean; and on these it occurs with the same regularity as many plants. "The long-extended surface of Java," continues Dr. Horsfield, "abounding with conical points which exceed this elevation, affords many places favourable for its resort. On ascending these mountains the traveller scarcely fails to meet with our animal, which, from its peculiarities, is universally known to the inhabitants of these elevated tracts; while to those of the plains it is as strange as an animal from a foreign country. In my visits to the mountainous districts I uniformly met with it, and, as far as the information of the natives can be relied on, it is found on all the mountains. It is however more abundant on those which, after reaching a certain elevation, consist of numerous connected horizontal ridges, than on those which terminate in a defined conical peak. Of the former description are the mountain Prahu and the Tengger Hills, which are both distinctly indicated in Sir Stamford Raffles's map of Java: here I observed it in great abundance. It was less common on the mountain Gede, south of Batavia; on the mountain Ungarang, south of Semarang; and on the mountain Ijen, at the farthest eastern extremity; but I traced its range through the whole island."

Most of these mountains and ridges are cultivated for the production of wheat and European vegetables, and fruits, such as potatoes, cabbages, peaches, and strawberries, in a deep vegetable mould, where the Teledu ranges, and in its search for food injures the plantations and destroys the roots. It turns up the earth with its nose like a hog, and thus leaves vexatious traces of its nocturnal visits.

The dwelling of the animal is formed at a slight depth beneath the soil, under the roots of a large tree, where it constructs a globular chamber several feet in diameter, smooth and regular; and there is a subterraneous approach to it about 6 feet long, the external entrance to which the animal conceals with twigs and dry leaves. Here it remains hidden during the day, and at night comes forth to seek the insects and their larvæ, and common earthworms, which are its food. They are said to live in pairs, and the female produces two or three young at a birth, according to the natives.

The fetid matter, which is viscid, and which Dr. Horsfield was assured the animal could not propel beyond a distance of two feet, is very volatile, and consequently spreads to a great extent. The entire neighbourhood of a village is sometimes infected by the odour of an irritated Teledu; and it is so powerful in the immediate vicinity of the discharge as to produce syncope in some persons.

Dr. Horsfield describes the manners of this species as by no means ferocious, and states that if taken young it might, like the Badger, be easily tamed. He kept one some time in confinement: it became gentle, and never emitted its offensive smell. Dr. Horsfield carried it with him from Mount Prahu to Blederan, a village on the declivity of that hill, where the temperature was more moderate. It was tied to a small stake while the drawing was being made, and moved about quietly, burrowing the ground with its snout and feet, as if searching for food, without noticing the bystanders or making violent efforts to disengage itself. It ate voraciously of earth-worms (*Lumbrici*) which were brought to it, and held one extremity of a worm in its claws while its teeth were employed in tearing the other. After it had eaten ten or twelve it became drowsy, made a small groove in the earth, in which it placed its snout, and, having deliberately composed itself, soon slept soundly. ('Zoological Researches in Java.')

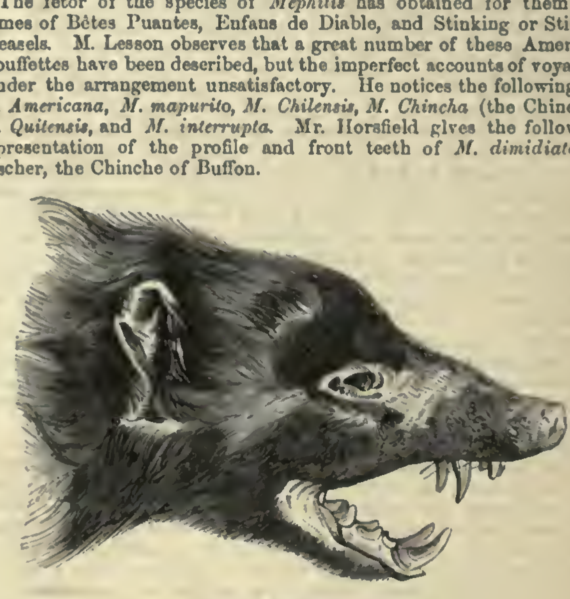
Mephitis.—Body elongate, arched. Toes separated and armed with long claws, the anterior proper for burrowing. Tail long and very bushy, or entirely null. Anal glands secreting a fetid odour.

Dental Formula:—Incisors, $\frac{6}{6}$; Canines, $\frac{1-1}{1-1}$; Molars, $\frac{3-3}{5-5} = 32$.

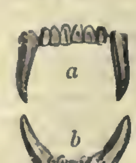
Teeth of *Mephitis* (double the natural size). F. Cuvier.

F. Cuvier gives the above cut as the dentition of *Mephitis* and *Mydaus*. The dental formula is that given by Lesson for *Mephitis*.

The fetor of the species of *Mephitis* has obtained for them the names of Bêtes Puantes, Enfans de Diable, and Stinking or Stifling Weasels. M. Lesson observes that a great number of these American Mouffettes have been described, but the imperfect accounts of voyagers render the arrangement unsatisfactory. He notices the following:—*M. Americana*, *M. mapurito*, *M. Chilensis*, *M. Chincha* (the Chinche), *M. Quitensis*, and *M. interrupta*. Mr. Horsfield gives the following representation of the profile and front teeth of *M. dimidiata* of Fischer, the Chinche of Buffon.



Profile of *Mephitis dimidiata.*



Front teeth of same. *a*, upper; *b*, lower.

M. Americana (var. *Hudsonica*), the Hudson's Bay Skunk. The following accurate description is given from the pen of Sir John

Richardson:—"The Skunk is low on its legs, with a broad fleshy body, white forehead, and the general aspect rather of a Wolverene than of a Marten; eyes small; ears short and round. A narrow white mesial line runs from the tip of the nose to the occiput, where it dilates into a broad white mark. It is again narrowed, and continues so until it passes the shoulders, when it forks, the hranches running along the sides, and becoming much hroader as they recede from each other. They approach posteriorly, and unite on the rump, becoming at the same time narrower. In some few specimens the white stripes do not unite behind, hut disappear on the flanks. The hlack dorsal space included hy the stripes is egg-shaped, the narrow end of which is towards the shoulders. The sides of the head and all the under parts are black. The hair on the body is long. The tail is covered with very long hair, and has generally two hroad longitudinal white stripes above on a black ground. Sometimes the colours of the tail are irregularly mixed; its under surface is black. The claws on the fore feet are very strong and long, heing fitted for digging, and very unlike those of martens." ('Fauna Boreali-Americana.')

This is the Seecawk of the Cree Indians.

Hudson's Bay Skunk (*Mephitis Americana*).

The author last quoted states that the Skunk is not an uncommon animal in the district it inhabits, which does not, he believes, extend to the north of 56° or 57° N. lat. It is found in the rocky and woody parts of the country, hut is still more frequent in the clumps of wood skirting the sandy plains of the Saskatchewan. Sir John Richardson had not been ablo to ascertain the southern range of this variety of Skunk, and he adds that, judging from Kalm's description, there appears to he a different one in Canada.

The Skunk lays itself up in a hole for the winter, seldom going ahroad at that season, and then for a short distance only. Mice and frogs in summer are its principal prey. It has from six to ten young at a litter, and is said to breed hut once a year.

Unlike the more agile weasels, the Skunk is slow in its motions, and consequently easily overtaken. Its defence consists of a most fetid discharge, which is described as ahsolutely intolerahle when it comes upon the nose by surprise. Lawson says:—"Polecats, or Skunks, in America are different from those in Europe. They are thicker and of a great many colours; not all alike, hut each differing from another in a particular colour. They smell like a fox, hut ten times stronger. When a dog encounters them they make urine, and he will not be sweet again in a fortnight or more. The Indians love to eat their flesh, which has no manner of ill smell, when the bladder is out. I know no use their furs are put to. They are easily brought up tame." Professor Kalm was almost suffocated by one that was chaced into a house where he slept: the very cattle bellowed through distress at the stench. Another that was killed hy a maid-servant in a cellar so overpowered her that she lay ill several days: the provisions in the place were so tainted that the owner was ohliged to throw them away. Catesby says:—"When one of them is attacked by a dog, to appear formidahle it so changes its usual form, hy bristling up its hairs and contracting its length into a round form, that it makes a very terrible appearance. This menacing hehaviour however, insufficient to deter its enemy, is seconded hy a repulse far more prevailing; for from some secret duct it emits such fetid effluviums, that the atmosphere for a large space round shall bo so infected with them that men and other animals are impatient till they are quit of it. The stench is insupportahle to some dogs, and necessitates them to let their game escape; others, by thrusting their noses into the earth, renew their attacks till they have killed it; hut rarely care to have more to do with such noisome game, which for four or five hours distracts them. The Indians notwithstanding esteem their flesh a dainty; of which I have eaten, and found it well tasted. I have known them hrought up young, made domestic, and prove tame and very active, without exercising that faculty which fear and self-preservation perhaps only prompts them to. They hide themselves in hollow trees and rocks, and are found in most of the northern continent of America. Their food is insects and wild fruit." (Carolina.) Sir John Richardson states that the noisome fluid which it discharges is of a deep-yellow colour, and contained in a small bag placed at the root of the tail. It is, he says, one of the most powerful stenches in nature; aud so durable that the spot where a Skunk has been killed will retain the taint for many days. He quotes Graham for the fact that several Indians lost their eye-sight in consequence of inflammation produced hy this fluid having heen thrown into them by the animal, which has the power of ejecting it to the distance of upwards of four feet. "I have known," says Sir John Richardson, in continuation, "a dead Skunk, thrown over the stockades of a trading post, produce instant nausea in several women in a house with closed doors upwards of a hundred yards distant. The odour has some resemblance to that of garlic, although much more disagreeable. One may however soon hecome familiarised with it; for, notwithstanding the disgust it produces at first, I have managed to skin a couple of recent specimens by recurring to the task at intervals. When care is taken not to soil the carcass with any of the strong-smelling fluid, the meat is considered hy the natives to be excellent food."

We have above adverted to the number of so-called species of *Mephitis*. Cuvier was of opinion that our knowledge did not justify us in considering them as more than varieties of a single species, and he enumerated 15 such varieties. Sir John Richardson says upon this point:—"I have now seen a considerable numher of specimens killed to the north of the Great Lakes, none of which presented any important deviation in their markings from the one principally referred to in the description. M. Desmarest remarks that the varieties (if they are to be considered as such, and not as species) are, for the most part, sufficiently uniform in the same district of country in the disposition of the stripes. The Hudson Bay variety however comes nearest to the description of the Chinche of Buffon; the *Viverra Mephitis* of Gmelin, which is said to be an inhabitant of Chili. The Fiskatta or Skunk of Kalm, which inhahits Csnada, has a white dorsal line in addition to two lateral ones." ('Fauna Boresli-Americana.')

In the museum of the Royal College of Surgeons in London, Nos. 2140 to 2144 of the 'Physiological Series' (both inclusive) present instructive preparations of the anal bags, glands, and follicles, of the Ferret; of the Zorille (*Putorius zorilla*, Cuv.); of the Marten (*Mustela Martes*); of the Javanese Skunk (*Mydaus meliceps*); and of a Skuuk. (See 'Cat.,' vol. iii. part 2.)

The following is a list of the species of *Mustelidæ* in the British Museum:—

Martes Abietum (Ray), the Pine Marten. England.
M. leucopus, the American Sable. North America.
M. Foina (Gray), the Beech Marten. Englaud.
M. melanopus, the Japanese Sable. Japan.
M. Canadensis, the Pekan, or Wood Shock. North America.
M. flavigula (Hodgson), the White-Cheeked Weasel. India.
Putorius fœtidus, the Polecat. Europe.
P. Sarmaticus (Gray), the Vomela, or Peregusna. Siheria.
Vison Lutreola, the Nurik, or Nurek Vison. North America.
Mustela vulgaris (Brisson), the Weasel. England.
M. penata (Licht.), the Black-Faced Weasel. Mexico.
M. Erminea (Linnæus), the Stoat, and Ermine. Europe and North America.
M. xanthogenys (Gray), The Yellow-Cheeked Weasel. California.
M. Sibirica (Pallas), the Chorok. Siberia.
M. Hodgsonii (Gray), Hodgson's Weasel. India.
M. Cathia (Hodgson), the Cathia. Nepaul.
M. alpina (Fischer), the Altaic Weasel. Altai Mouutains.
M. Horsfieldii (Gray), Horsfield's Weasel. India.
M. subhemachalana, the Nepaul Weasel. Nepaul.
Zorilla striata, the Zorille. Cape of Good Hope.
Galera barbara, the Tayra. Tropical America.
Grissonia vittata, the Grison, or Huron. Brazil.
Mellivora Ratel, the Ratel, or Bharsiah. Cape of Good Hope.
Gulo luscus, the Wolvereue. Europe and North America.
Helictis moschata (Gray), the Helictis. China.
H. Nipalensis, the Nepaul Helictis. Nepaul.
Mephitis varians (Gray), the Skunk. North America.
Conepatus Amazonica (C. Humboldt), the Maikel. Straits of Magalhaens.
C. Humboldtii (Gray), the Patagonian Maikel. South America.
Mydaus meliceps (F. Cuvier), the Stinkard, or Teledu. Java.
Arctonyx collaris (F. Cuvier), the Balisaur, or Sand-Bear. India.
Taxus Meles (Linnæus), the Badger. England.
Taxidea Labradoria (Waterhouse), the Brairo, or Lacyotl. Western America.
Latax cina mollis, the American Otter. North America.

Lontra Brasiliensis, the Lontra. Cayenne.
Lutra vulgaris, the Otter. England.
L. Chinensis (Gray), the Chinese Otter. China and India.
L. Californica (Gray), the Californian Otter. California.
L. aurobrunnea (Hodgson), the Golden-Brown Otter. Nepaul.
Aonyx leptonyx, the Wargul. India.
A. Delalandi (Lesson), the Gray Otter. South Africa.
Enhydra Lutris, the Kalan, or Sea Otter. California.

Fossil Mustelidæ.

Fossil remains of Weasels have been found in the Tertiary Series, in the Bone-Caves and Bone Breccias at Lunel-Vieil, Kirkdale, Puy-de-Dome, &c.

Dr. Buckland states, in his 'Reliquiæ Diluvianæ,' that a few jaws and teeth were found in Kirkdale Cave belonging to the Weasel, and that at Oreston there were marks of nibbling by the incisor and canine teeth of an animal of the size of a weasel (pointed out by Mr. Clift), showing distinctly the different effect of each individual tooth on the ulna of a wolf and the tibia of a horse. In his 'Bridgewater Treatise,' Dr. Buckland figures a weasel among the Land Mammifers of the third tertiary period.

The only fossil species named in Meyer's 'Palæologica' is *Mustela antiqua.*

MUSTELUS, a genus of Fishes. [SQUALIDÆ.]

MUTI'LLIDÆ, a family of Hymenopterous Insects corresponding to the Linnæan genus *Mutilla*. These bees belong to Latreille's division *Fossores*, and some of the species are remarkable for the power of their stings.

The females are generally destitute of wings; the males are winged. It is on this account that Latreille places them in his sub-section *Heteropyna* with the Ants. Their economy and habits however decidedly correspond with the fossorial or burrowing Sand-Wasps. This family comprises the following modern genera:—*Douglus*, *Labidus*, *Apterogyna*, *Psammotherna*, *Myrmosa*, *Myrmecodes*, and *Methoca.*

Mutilla Europæa is a British species. It is of a bluish-black colour, with the thorax red, and with three white bands across the abdomen; the male is winged. It has been taken in Coombe Wood in the neighbourhood of London.

MYA. [PYLORIDIA.]

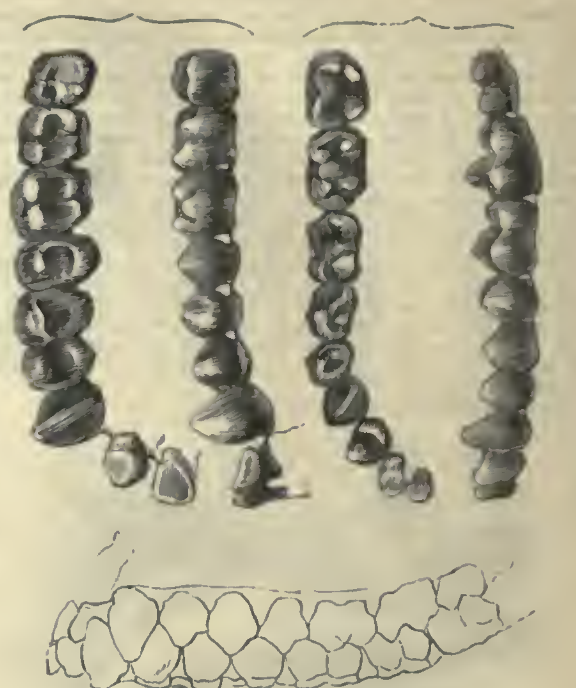
MYA'RIA, Lamarck's name for a family of Dimyarian Conchifers, consisting of the genera *Mya* and *Anatina*. [PYLORIDEA.]

MYCE'TES, Illiger's name for a genus of *Quadrumana*, consisting of the largest monkeys of America, remarkable for the powerful development of the organ of the voice. The species are, as the name implies, Howlers, and the horrible yells sent forth by these animals from the depths of the forests are described by those who have heard the mournful sounds as surpassingly distressing and unearthly. Humboldt and Bonpland heard the Araguato, one of the species, at the distance of half a league.

The genus is distinguished by a pyramidal head with the upper jaw descending much lower than the cranium, while the lower has its ascending rami very high, to afford room for the bony drum formed by a convexity of the os hyoïdes, which communicates with the larynx, and gives to the voice the enormous volume above alluded to. Humboldt gives the following as the external form of the drum in this genus.

Drum of Howling Monkey.

The tail in this genus is prehensile, and the part applied by the animal when laying hold of a branch or other body is naked below; so that such portion must have a higher sensibility of touch. F. Cuvier gives the following as the dentition of the Howling Monkeys, from the Alouate Fauve.



Teeth of Howling Monkey. F. Cuvier.

Mr. Swainson ('Classification of Quadupeds') observes that it is rather singular that F. Cuvier should not have specially noticed the remarkable size of the canine teeth in the Howlers, which he says are uncommonly large; and adds that in a specimen before him when he wrote, they are nearly six times bigger than the cutting-teeth, a structure which at once separates this group from the genus *Cebus.* Facial angle about 30 degrees.

Cuvier, in common with most other zoologists, places the genus at the head of the monkeys of the New Continent.

Dr. J. E. Gray ('Annals of Phil.,' 1825) places the form among the Anthropomorphous *Primates* in the second family (*Sariguidæ*), and as the sole genus of its first sub-family *Mycetina.*

M. Lesson arranges it between *Lagothrix* and *Cebus.*

Mr. Swainson makes *Mycetes* the first genus of the *Cebidæ*, the second family of his first order *Quadrumana.*

Mr. Ogilby observed in the summer of 1829 that two living individuals of *Mycetes seniculus* did not use the extremities of their anterior limbs for the purpose of holding objects between the finger and thumb, as is common among the *Quadrumana;* and he ascertained also, on closer examination, that the thumb, as it has generally been considered, was not in these animals opposeable to the other fingers, but originated in the same line with them. Struck with the apparent singularity of the fact, he was induced to pay particular attention to all the other animals referred by zoologists to the Quadrumanous Family to which he had access; and the continued observation of more than six years assured him that the non-opposeable character of the inner finger of the anterior extremities, which he first observed in the specimens referred to, is not confined to the genus *Mycetes*, but extends throughout the whole of the genera of the South American monkeys, individuals of all of which had been seen by him in a living state. He remarked that a true thumb existed on the anterior limbs of none of them, and that consequently they have been incorrectly referred to the *Quadrumana* by zoologists generally. [CHEIROPODA; QUADRUMANA; SIMIADÆ.]

The habits of these animals are social, and most of them have thick beards. Their deep and sonorous yells are supposed to be a call to their mates; in short, to be a hideous love-song. In their gregarious habits and howlings they may be considered as bearing some analogy to the Gibbons of the Old World [APE; HYLOBATES]; whilst their low facial angle has induced some to look upon them as representing the baboons of the ancient continent.

M. Ursinus (*Stentor Ursinus* of Geoffroy), the Araguato.

Length nearly 3 feet, without including the tail. Hair, which is longer than that of *M. seniculus* (Mono Colorado of Humboldt), of a golden red, but the beard, which is of a deeper colour than the rest, is less bushy than it is in *M. seniculus;* and the circumference of the face where the hair is red is also paler. Humboldt states that the eye, voice, and gait, denote melancholy. He saw young ones brought up in the Indian huts, which never played like the Sagoins. [JACCHUS.] Lopez de Gomara speaks of the Araguato de los Cumanenses as having the face of a man, the beard of a goat, and a grave demeanor. Fruit and the leaves of plants form their food. The females carry the young upon their shoulder. Humboldt counted above forty upon one tree, and he does not douht that upon a square league of the wild conntries frequented by them above two thousand may he found. They were in great ahundance near pools of stagnant water shaded by the *Mauritia flexuosa.* All the species are natives of South America.

Araguato (*Mycetes Ursinus*).

MYCETOCHARUS. [CISTELIDES.]

MYCETOPHAGUS, a genus of Tetramerous Xylophagous *Coleoptera.*

MYCETO'PODA, or MYCE'TOPUS, a genus of Conchiferous *Mollusca* with elongated valves, estahlished hy M. D'Orhigny, and referrihle to the family *Naiadæ* of Lamarck. M. D'Orhigny states that this genus perforates like the *Pholadæ.* [NAIADÆ; PHOLADÆ.]

MYCTERIA. [JABIRU.]

MYCTERUS, a genus of Heteromerous *Coleoptera.*

MYDAS, a genus of Dipterous Insects.

MYDAUS. [MUSTELIDÆ.]

MYGALE. [SORECIDÆ.]

MY'GALE, a genus of Spiders, the species of which have their eyes placed closely together at the antcrior extremity of the thorax. They spin their wehs in the form of tubes, in which they reside concealed in holes in the ground, or under stones, or tho hark of trees. In consequence of the representations of Madame Merian, some kinds of *Mygale* have hecome celehrated as hird-catching spiders. Mr. W. S. M'Leay has however shown that Madame Merian's drawing is not to be trusted, since the *Mygale* there figured is a suhterranean spider, and makes no net in which to entrap small hirds. The same distinguished naturalist has ohserved a spider helonging to the genus *Epeira* eating a young hird of the genus *Zosterops,* which had heen entangled in its net in a garden in Sydney, Australia. In a communication of Mr. M'Leay's, published iu the 'Annals of Natural History' for 1842, he remarks on the suhject of hird-catching spiders as follows :—"My conviction is that Madame Merian has told a wilful falsehood respecting *Mygale,* or rather has painted a falsehood; and that her followers have too hastily placed confidence in her idle tales. My conviction is that no *Mygale* can catch hirds in its net; for, as I have said in the paper printed in the 'Zoological Transactions,' it makes no geometrical net. Nay, further, I have proved that the genus *Nephila,* which lives in a geometrical net, does not catch hirds either here or in the West Indies; and moreover, I have ascertained that hirds are not the proper food of this New Holland *Epeira.*" The *Mygale Ionica,* a Grecian species, forms a very ingenious trap-door with which to close up the mouth of its tuhe.

MYGINDA. [AQUIFOLIACEÆ.]

MYIOTHERA. [MERULIDÆ.]

MYLODON. [MEGATHERIIDÆ.]

MYOPHONUS. [CORVIDÆ.]

MYOPORA'CEÆ, *Myoporads,* a natural order of Plants, distinguished from *Verbenaceæ* hy little except the ovules heing pendulous and the alhumen more ahundant. The plants referred to *Myoporaceæ* are chiefly shruhs of little interest, inhahiting the Australian regions and other parts of the southern hemisphere. The most remarkahle thing connected with them is the presence of cysts of oil in their leaves, which thence have a dotted structure.

Avicennia tomentosa, the White Mangrove, a shore plant rooting in mud, is a curious species. Brown descrihes its roots as creeping to a considerahle distance, often curved ahove the ground as much as six feet hefore they fix themselves, and throwiug up naked suckers out of the mud in great ahundance, which look like shoots of asparagus. It is used at Rio Janeiro for tanning. It exudes a kind of green aromatic resin, which is eaten hy the natives of New Zealand.

The order contains 9 genera and 42 species.

MYOPOTAMUS, a genus of Animals helonging to the order *Rodentia* and the family *Hystricidæ.* [HYSTRICIDÆ.]

MYOPTERIS. [CHEIROPTERA.]

MYOSOREX. [SORECIDÆ.]

MYOSO'TIS (from μῦς, a mouse, and ωτ, tho crude form of οὖς, an ear), a genus of Plants belonging to the natural order *Boraginaceæ.* It has a 5-parted calyx; the corolla salver-shaped, contorted in æstivation; the throat closed with scales, the limh 5-fid, ohtuse; the stamens included, with filaments very short; the style simple; the nuts smooth, externally convex, keeled within, attached hy a minute lateral spot near their hase. This genus is distinguished from all the other Boragineous genera hy the possession of a contorted æstivation of the corolla. The species are annual or perennial, rough or smoothish plants, with hlue flowers in terminal racemes, which are revolute hefore expansion. Ahout 50 species have heen descrihed, which inhabit the more temperate parts of Asia, Africa, and America, and are ahundant in Europe. Eight species are found in Great Britain.

M. palustris, Great Water Scorpion-Grass, or Forget-Me-Not, has the calyx opeu when in fruit, and shorter than the pedicel, with straight adpressed hristles; the teeth short, triangular; the limh of the corolla flat, longer than the tuhe; the lohes slightly emarginate; the puhescence of the stem spreading. It is a native throughout Europe, and also of Asia and North America. In Great Britain it is found in humid meadows, hogs, hanks of rivers, rivulets, and ditches. This plant has a large hright hlue corolla with a yellow eye. It is a heautiful plant, and when once seen will he seldom forgotten. It is prohahly on this account that it has ohtained its common name Forget-Me-Not. Amongst the young it is regarded as emhlematical of true affection. A variety is descrihed with white flowers.

The following are the remaining British species of this genus :—

M. repens, Mouse-Ear, with narrow lanceolate teeth; lohes of the corolla slightly emarginate; the puhescence of the stem spreading. Found in hoggy places.

M. cæspitosa, with narrow lanceolate teeth; the limh of the corolla equalling the tuhe; the lohes entire; the puhescence of the stem adpressed. Found in watery places.

M. suaveolens has an attenuated calyx; the limh of the corolla longer than the tuhe; the root-leaves on long stalks, pointed. Only found in Scotland on the summits of the Breadalhane Mountains.

M. sylvatica has a calyx rounded helow, deeply 5-cleft, closed when in fruit; the limh of the corolla longer than the tuhe, flat; the root-leaves hluntish. Found in shady places.

M. arvensis, Field Scorpion-Grass, has the calyx half 5-cleft; the limh of the corolla equalling the tuhe, concave. Grows in cultivated land and thickets.

M. collina has the calyx open and ventricose when in fruit. Found on dry hanks.

M. versicolor has the calyx closed and ohlong when in fruit. It has small flowers, at first pale-yellow, afterwards hlue. Found in meadows and on hanks.

None of the species are used in medicine or the arts.

(Bahington, *Manual of British Botany.*)

MYOSU'RUS (from μῦς, a mouse, and οὐρά, a tail, the seed heing seated on a long receptacle "which looks exactly like the tail of a mouse"), a genus of Plants helonging to the natural order *Ranunculaceæ.* It has a calyx of 5 sepals, prolonged into a spire at the hase; the petals 5, with a filiform tuhular claw; the capsules closely imhricated upon a long filiform receptacle, not hursting; the seed pendulous; the emhryo inverted with the radicle superior. The ouly species of this genus is *M. minimus,* which has a simple leafless single-flowered stem 2 to 5 iuches high. It has a very long receptacle, numerous carpels, and linear leaves. It grows in damp places and in fields. It is a native of Europe and America. The American plant has heen descrihed as *M. Shortii,* hut there is every reasou to helieve it is the same as the British and other European plants. (Bahington, *Manual of British Botany.*)

MYOTHERA, a genus of Dentriostal Passerine Birds, the species of which, on account of their hahits, are knowu by the name of Ant-Catchers.

MYOXUS. [MURIDÆ.]

MYRAFRA. [FRINGILLIDÆ.]

MYRIACAN'THUS, a genus of Fossil Fishes, from tho Lias of Dorsetshire. (Agassiz.)

MYRIANI'TES, a genus of Fossil *Annelida,* from the Lower Silurian Strata of Lampeter, in South Wales. (Murchisou.)

MYRIAPODA, an order of Invertehrate Animals helonging to the class *Articulata.* This order is represented hy such species as the Centipede and Gally-Worm. They may he regarded as an intermediate form between the lower and higher forms of Articulate animals. They agree with the Annulose forms in the longitudinal extension of their trunk, in the similarity of the segments from one end of the hody to the other, and in their cylindrical form. On the other hand, they possess more complete eyes than any of the Vermiform tribes, and their respiratory apparatus and the parts of their organisation are more nearly allied to Insects. Their covering is firm, and of a horny character.

The division into segments is very distinct, a flexible membrane being interposed between each pair of firm rings or plates. The legs and other appendages are inclosed in the same kind of integument, and their joints are formed in the same manner as those of the body. We find in this class however two distinct types of conformation, of which one approximates most nearly to the Vermiform tribes, and the other to that of the higher *Articulata;* in the former of which the *Iulus* (Gally-Worm) may be taken as an example. The body is generally cylindrical, or nearly so; the number of segments is considerable, and most of them bear two pairs of thread-like legs, so that the number of these members sometimes amounts to 160 pairs. The legs are very imperfectly developed, being scarcely large or strong enough to sustain the weight of the body, and their articulations being indistinct; and the animal seems rather to glide or crawl with their assistance, like a serpent or a worm, than to use them as its proper instruments of locomotion. This kind of movement is facilitated in some species by the incomplete inclosure of the body in the consolidated integument, for this merely forms plates above and below, which are connected at the sides by soft membrane; so that the trunk can be easily placed in any direction. When at rest the body is rolled up in a spiral form; so that the legs, concealed in the concavity of the spire, are protected from injury. The animals do not move with rapidity, and they chiefly feed upon decomposing organic matter. In the higher division, on the other hand, of which the *Scolopendra* (Centipede) may be taken as the type, the body is flattened, and each segment is completely inclosed in its horny envelope; the number of segments is not very great, never exceeding 22, and being sometimes as low as 12; and each segment bears a single pair of well-developed legs, on which these animals can run with considerable rapidity. Still their bodies are possessed of considerable flexibility; and they are thus enabled to wind their way with facility through very narrow and tortuous passages, in search of the insects, &c., which constitute their food. In both orders, the first segment, or head, is furnished with numerous eyes on each side, and also with a pair of jointed antennæ; the mouth is adapted for mastication, being furnished with a pair of powerful cutting jaws; and it is also provided, in the Centipede and its allies, with a pair of appendages, formed by a metamorphosis of the legs of the first segment of the body, which are adapted not merely to hold and to tear the prey, but to convey poison into the wounds thus made, this poison being ejected through a minute aperture near their points. (Carpenter.)

The alimentary canal is mostly divided into gullet, stomach, and intestine. The stomach usually presents distinct muscular walls. The circulatory organs consist of a dorsal vessel, which propels a current of blood from behind forwards, which is distributed to the body and respiratory organs. In the higher forms respiration is effected by means of tracheæ, which convey air into the interior of the body as in Insects. The nervous system is arranged in a double series of ganglia, as in most of the Articulated Tribes. They possess cephalic ganglia, which meet above the œsophagus, and form a two-lobed mass, from which nerves proceed to the eyes and antennæ. In many parts of the double series of cords the ganglia of either side unite. The muscular apparatus is very complicated, consisting of a series of distinct muscles for the movements of the segments and legs. The sexes are separate. The embryo at the period of hatching consists of but few segments, but these increase in number till it is fully grown by the subdivision of the penultimate segment. The first number of segments is eight or nine, and these go on increasing in number till there are sixty or seventy. The larva has no legs, these organs making their appearance after the first moult. During their growth these animals have a considerable power of regenerating lost portions of their body as the legs and antennæ, but this power is lost when they cease to develop.

Mr. Newport divides the *Myriapoda* into two orders—*Chilopoda* and *Chilognatha.* [CHILOPODA; CHILOGNATHA.] The following synopsis of the genera of these two orders is drawn up from the list of the specimens of *Myriapoda* in the collection of the British Museum (1844):—

Order I. *Chilopoda.*

Family 1. *Cermatiadæ.*
1. *Cermatia*, Illiger. 9 species.

Family 2. *Lithobiidæ.*
1. *Lithobius*, Leach. 9 species.
2. *Henicops*, Newport. 1 species.

Family 3. *Scolopendridæ.*
1. *Scolopendra*, Linnæus. 38 species.
2. *Cormocephalus*, Newport. 8 species.
3. *Rhombocephalus*, Newport. 2 species.
4. *Heterostoma*, Newport. 7 species.
5. *Theatops*, Newport. 1 species.
6. *Scolopocryptops*, Newport. 1 species.
7. *Cryptops*, Leach. 5 species.

Family 4. *Geophilidæ.*
1. *Scolopendrella*, Gervais. 1 species.
2. *Mecistocephalus*, Newport. 2 species.
3. *Necrophlœophagus*, Newport. 3 species.
4. *Gonibregmatus*, Newport. 1 species.
5. *Geophilus*, Leach. 6 species.

Order II. *Chilognatha.*

Family 1. *Glomeridæ.*
1. *Glomeris*, Latreille. 4 species.
2. *Zephronia*, Gray. 6 species.
3. *Sphærotherium*, Brandt. 2 species.

Family 2. *Polyxenidæ.*
1. *Polyxenus*, Latreille. 1 species.

Famil 3. *Polydesmidæ.*
1. *Fontaria*, Gray. 3 species.
2. *Polydesmus*, Latreille. 12 species.
3. *Strongylosoma*, Brandt. 2 species.
4. *Craspedosoma*, Leach. 2 species.
5. *Cambala*, Gray. 1 species.

Fam 4. *Iulidæ.*
1. *Platops*, Newport. 5 species.
2. *Iulus*, Linnæus. 12 species.
3. *Blaniulus*, Gervais. 1 species.
4. *Spirobolus*, Brandt. 9 species.
5. *Spirostreptus*, Brandt. 15 species.

(*Monograph of the Class Myriapoda, Order Chilopoda*, by George Newport; *Linnæan Transactions*, vol. xix.; Carpenter, *Principles of Comparative Physiology.*)

MYRICA (the Greek Μυρίκη), a genus of Plants the type of the natural order *Myricaceæ*. It has its flowers in catkins, which are composed of concave scales; 4 to 8 stamens. The fruit a 1-celled 1-seeded drupe, and no perianth. There are several species of this genus, which are shrubs or small trees.

M. Gale, the Sweet Gale, or Box-Myrtle, is a native of Great Britain. It has lanceolate serrate leaves, broader upwards, with a shrubby stem. It is a bushy plant, about 4 feet in height; the catkins are sessile and erect; the fruit is covered with resinous glands, and the leaves are fragrant when bruised. This plant is found on the continent of Europe, and also in North America, under the same circumstances as in Great Britain. The leaves, on distillation, yield a yellow ethereal oil, of a feeble odour, and mild taste, which after a little time becomes slightly warm. The leaves were formerly used as a remedy against the itch, and when bruised are placed amongst furs for the destruction of the moth. In decoction they are employed for the destruction of bugs and other vermin. In Sweden they are used as a substitute for hops in brewing.

M. cerifera, Wax-Myrtle, or Bay-Tree, has cuneate-lanceolate leaves, sometimes entire, but more frequently toothed, particularly towards the end, somewhat pubescent, a little paler beneath, and generally twisted or revolute in their mode of growth; has a branching half-evergreen stem, from 1 to 12 feet high. The small flower is formed by a concave rhomboidal scale, containing three or four pairs of roundish anthers, on a branched footstalk. The pistiliferous catkins which grow on a different shrub are less than half the size of the staminiferous ones, and consist of narrower scales, with each an ovate ovary, and two filiform styles. To these catkins succeed clusters or aggregations of small globular fruits, which are at first green, but finally become nearly white. They consist of a hard stony covering, which incloses a dicotyledonous seed. The hard covering is studded on its outside with small black grains, and over these is a coating of hard white wax, fitted to the grains, and giving to the surface of the fruit a granulated appearance. This plant is a native of woods in the United States of America. The bark of the root of this plant is acid and astringent; in large doses it produces vomiting, accompanied by a burning sensation in the throat. It is used as a stimulant and astringent. The wax of the fruit is collected and purified, and used for many of the purposes for which bees'-wax and candles are employed. The wax has been occasionally used in pharmacy in the same way as common bees'-wax.

The fruit of *M. sapida*, a native of Nepaul, is about the size of a cherry, and is pleasantly acid and eatable.

(Lindley, *Flora Medica;* Lindley, *Vegetable Kingdom;* Babington, *Manual of British Botany.*)

MYRICA'CEÆ, *Gallworts*, are plants constituting a very small natural order of apetalous Exogens, with separate sexes. The most essential part of their character is expressed by Endlicher in the following terms:—"Flowers unisexual. Males—Bractlets, 2; calyx, 0. Females—Hypogynous scales from 2 to 6; ovary 1-celled, with 2 styles; ovule 1, erect, orthotropous; drupe 1-seeded; seed erect; embryo without albumen; radicle superior." In general their flowers are arranged in a manner similar to those of *Betulaceæ* and *Salicaceæ*, with which latter however they seem to have no real affinity. From *Casuaraceæ*, curious Australian trees, with jointed leafless stems, like those of *Equisetum*, they are only distinguished by their erect ovule and orthotropous seeds. They are common in the temperate parts of the world, especially in North America and the Cape of Good Hope. The order embraces 3 genera and about 20 species. [COMPTONIA; MYRICA.]

Myrica arguta.

1, a male flower; 2, an ovary; 3, a drupe cut open vertically to show the erect position of the seed within it.

MYRIOPHYLLITES, a genus of Fossil Plants, from the Coal Measures. (Artis.)

MYRIOPHYLLUM (from μυρίος, numerous, and φύλλον, a leaf), a genus of Plants belonging to the natural order *Haloragaceæ*. It has monœcious flowers; a 4-parted calyx; 4 petals, fugitive, longer than the calyx in the staminiferous flowers, small and reflex or none in the pistilliferous flowers; the stamens 8, styles 4, villose; the fruit tetragonal, separable into four hard nuts. The species are floating aquatic herbs, rising above the water to blossom. The leaves are finely cut, opposite or verticillate; the flowers are small, disposed in axillary whorls or in whorled spikes, the upper leaves being almost all abortive.

M. verticillatum, Verticillate Water-Milfoil, has the flowers all axillary, whorled; the bracts pinnatifid. It is a native of Europe, in ponds, ditches, pools, and lakes, but never in running water. It is found in Great Britain, but is a rare plant.

M. spicatum, Spiked Water-Milfoil, has the flowers whorled, forming a leafless spike, the bracts small entire, the spike erect when in bud. It is a native of Europe and North America, in ditches, lakes, and pools, never in running water; it is found abundantly in Great Britain.

M. alternifolium has the spike drooping when in bud, and the fertile flowers in axillary whorls. It is found in ponds and ditches in Europe, in Great Britain rarely.

About 10 other species of this genus from various parts of the world have been described.

(Babington, *Manual of British Botany.*)

MYRIOPODA. [MYRIAPODA.]

MYRIPRISTIS. [PERCIDÆ.]

MYRISTICA, a genus of Plants, the type of the order *Myristicaceæ*. The flowers are diœcious; calyx urceolate, 3-toothed; filaments of stamens monadelphous; anthers 6 to 10, connate; ovary simple; style, none; stigma 2-lobed; pericarp fleshy, 2-valved, 1-seeded; seed enveloped in a fleshy aril.

M. officinalis, Linnæus (*M. Moschata*, Thunberg; *M. aromatica*, Roxburgh), is the Nutmeg-Tree.

This tree is a native of the Molucca Islands, especially of Banda, but cultivated in Java, Sumatra, and elsewhere in the East, and lately in Cayenne and several of the West India Islands. It yields nutmegs and mace, the best of which are produced in the first-mentioned islands. The fruit is of the size and form of a peach, and, when ripe, the fleshy part separates into two nearly equal halves, exposing the kernel surrounded by an arillus, the former being the nutmeg, the latter the mace. The arillus is red when gathered; but being sprinkled with sea-water and dried it assumes an orange-yellow colour. It has a fatty shining appearance, yet is horny and brittle. The odour is strongly aromatic; the taste aromatic, but sharp and acrid. It contains both a fixed oil (in small quantity) and a volatile oil. One pound of mace yields by distillation one ounce of the latter. The former is not an article of European commerce, and what is termed the 'expressed oil of mace' is obtained from the nutmeg, and should bear its name. An inferior mace is obtained from various species of *Myristica*, especially the *M. tomentosa* and *M. officinalis* (Martius), which is a Brazilian tree. The properties of mace are similar to those of the nutmeg.

Myristica officinalis.

1, a calyx; 2, the monadelphous stamens of a male flower; 3, the pistil of a female flower; 4, the seed of the nutmeg, enveloped in the mace or aril; 5, a vertical section of the seed, showing the ruminated albumen and the small embryo at its base.

On the removal of the mace is seen the shell, of an oval or ovate shape, and of a dark-brown colour, in which is contained the seed or nut. This is closely invested by an inner shell or coat, which dips down into the substance of the albumen of the seed, and gives it the character which is termed ruminated. Two or three gatherings of the nutmegs are made in the year, generally in July and August, in December, and in April. The third period yields the best nutmegs. The collected nuts are dried in the sun, or by the heat of a moderate fire, till the shells split: they are then sorted and dipped in lime-water, to preserve them from the attack of insects. The nuts are about an inch long, of the size of a hazel nut, but with a furrowed or sculptured surface. Those of good quality should be heavy each weighing, on an average, 90 grains. The internal aspect is marbled and of a fatty appearance. The substance is gray; but the veins, which are of a reddish-brown, consist of cellular tissue abounding in oil, and are the processes of the internal coat already mentioned. Odour agreeable, strongly aromatic. Taste warm, aromatic, oily.

Besides the fixed oil, it contains a volatile oil, lighter than water, being of the specific gravity of 0·931-47, while a spurious oil of nutmeg is only 0·871. By keeping it deposits a stearopten, or muscat-camphor, called Myristicine. The solid or fixed oil consists of steariae and elaine, with a slight portion of volatile oil intermixed. Both the fixed and volatile oils are used for medical purposes. Of the fixed there are two varieties, the English and Dutch, of which the former is the better. It occurs in pieces, wrapped in leaves of the banana, weighing about three-quarters of a pound. When cut into it has a uniformly reddish-yellow colour. The Dutch sort is in larger pieces, wrapped sometimes in leaves, sometimes in paper, and of a lighter yellow colour. Both are frequently adulterated. The volatile oil is also mixed with purified oil of turpentine. Nutmegs are frequently either digested in alcohol or distilled to abstract the volatile oil, and then passed off as fresh. Such nutmegs are lighter, and when a hot needle is inserted do not give an oily coating to it. Old, worm-eaten, or wild nutmegs should be rejected. Genuine or cultivated nutmegs are called female, to distinguish them from the male or wild nutmegs, which are the produce either of the *M. Moschata*, var. *sphenocarpa*, or of *M. tomentosa* (Thunb.). These are longer, heavier (weighing generally 110 grains), and of inferior quality. They are more apt to cause narcotic symptoms, giddiness, &c., than the true sort. The coarse strong-smelling nutmegs from Santa Fé are from the *M. Otoba*. Other species also yield nutmegs — as *M. spuria*, in the Philippines; *M. Madagascariensis* and *M. acuminata*, in Madagascar; and *M. Bicuiba*, in Brazil. Some nutmegs have little or no odour, as the *M. fatua*, but they nevertheless act powerfully on the system. *M. spuria* yields a crimson juice, which is employed in the Philippines as a substitute for dragon's-blood.

Nutmegs and mace, from the large quantity of volatile oil, are decidedly stimulant, and when used in abundance produce, by exciting the circulation, narcotic effects. In moderation they promote the appetite and assist digestion.

MYRISTICA'CEÆ, *Nutmegs*, a family of Plants belonging to the division of Diclinous Exogens. The species are tropical, fragrant, aromatic trees, with an astringent juice, alternate coriaceous simple leaves, without stipules, and diœcious flowers. Of the flowers, the males have monadelphous stamens; the females have a single 1-celled ovary, containing an erect seed; and both have for calyx a tubular coriaceous envelope, with from 2 to 4, usually 3, valvate teeth. Their fruit is a 2-valved succulent capsule, containing a single seed enveloped in an aril, and consisting of ruminated albumen, abounding in a powerful and agreeable aromatic secretion; the embryo is very small, and placed in a cavity at the base of the albumen.

The order is nearly allied to *Anonaceæ*, from which however it differs very remarkably in the total want of a corolla, and in the reduction of the number of carpels to one. To station it in the artificial division of Apetalous Exogens, as is usually done, is to violate every principle of natural classification.

The Nutmeg of the shops, which is the seed of *M. officinalis*, is the only product of the order employed officinally. [MYRISTICA.] Other species bear fruit that may be employed as a substitute, but they are all inferior to the real Oriental *Myristica*.

This order embraces 5 genera and about 35 species. The genera are, *Myristica*, *Virola*, *Knema*, *Pyrrhosa*, and *Hyalostemma*.

Virola sebifera yields a fatty oil on being heated. *Pyrrhosa tingens* yields a crimson dye, with which the natives of Amboyna stain their teeth.

MYRMECOBIUS. [MARSUPIATA.]

MYRMECOPHAGA, the genus of Edentate Animals to which the great Ant-Eater, *M. jubata*, belongs. This animal has not often been seen in Europe. Two specimens were exhibited alive in the Gardens of the Zoological Society during the summer of 1854. An account of the anatomy of this creature was given by Professor Owen to the meeting of the British Association at Liverpool, in September 1854. [ANT-EATER.]

MYRMELEON, a genus of large Neuropterous Insects, the larvæ of which are remarkable for their habit of entrapping their prey by means of pitfalls. Among the many accounts which have been published of their operations, one of the best and most recent is that given by Mr. Westwood, in the 'Magazine of Natural History' for 1838, and in his Introduction. "Some larvæ of the common species, *Myrmeleon formicaleo*" (the Ant-Lion), writes that naturalist, "which I brought alive to this country from France, afforded me ample opportunities for watching their proceedings. It is in very fine sand that the larva makes its pitfall. When placed upon the surface, it bends down the extremity of the body, and then pushing or rather dragging itself backwards by the assistance of its hind legs, but more particularly of the deflexed extremity of its body, it gradually insinuates itself into and beneath the sand, constantly throwing off the particles which fall upon, or which it shovels with its jaws or legs upon its head, by suddenly jerking them backwards,

'Ossaque post tergum magnæ jactata parentis.'

Proceeding in this manner, in a spiral direction, it gradually diminishes the diameter of its path, and by degrees throws so much of the sand away as to form a conical pit, at the bottom of which it then conceals itself, its mandibles widely extended being the only parts that appear above the surface; with these any luckless insect that may happen to fall down the hole is immediately seized and killed. When the fluids of the victim are exhausted the ant-lion, by a sudden jerk, throws the dry carcass out of the hole: should, however, the insect by chance escape the murderous jaws of its enemy, the latter immediately commences throwing up the sand, whereby not only is the hole made deeper, and its sides steeper, but the escaping insect is probably hit, and again brought down to the bottom of the pit. It is chiefly upon ants and other soft-bodied insects these larvæ feed. They are however capable of undergoing long fasts, for one of my larvæ remained from October till March without food. Previous to assuming the pupa state, the larva forms a globular cocoon of less than half an inch in diameter of fine sand, glued with silken threads spun from a slender telescopic-like spinneret, placed at the extremity of its body, and lined with fine silk. The pupa is small, not being half an inch long, inactive, and with all the limbs laid at rest upon the breast. When ready to assume the perfect state, it uses its own mandibles, which are quite unlike those of the larva and imago, to gnaw a hole through the cocoon, and pushes itself partly through the aperture in which it leaves the pupa skin. Immediately on assuming the perfect state, the abdomen is almost immediately extended to nearly three times its previous length."

MYRMICA, a genus of Insects belonging to the order *Hymenoptera*, and the family *Formicidæ*. It is one of the genera formed out of the Linnæan genus *Formica*. Unlike that genus however, it possesses a sting. The peduncle of the abdomen is composed of two knots, the antennæ are exposed; the maxillary palpi are long and 6-jointed, and the mandibles triangular. *M. rubra* is a common British species.

MYROBALANS. This is a name applied to the almond-like kernels of a nut or dried fruit looking like a plum, of which there are several sorts known in the East. They are the produce of various species of *Terminalia*, as *T. Bellerica*, *T. Chebula*, *T. citrina*, and *T. angustifolia*. They vary from the size of olives to that of gall nuts, and have a rough, bitter, and unpleasant taste. Many of the trees of this tribe, which are all natives of the tropical regions of Asia, Africa, and America, are used for tanning, and some for dyeing. They are highly valued by dyers, creating, when mixed with alum, a durable dark-brown yellow. Myrobalans fetch in the Bombay market 8*s.* to 26*s.* the Surat candy of 821 lbs. The bark and leaves of *T. Catappa* yield a black pigment, with which Indian ink is made; the seeds are eaten like almonds. A milky juice is said to flow from *T. angustifolia*, which, when dried, is fragrant, and, resembling Benzoin, is used as a kind of incense in the Catholic churches in the Mauritius. The fruit of *T. Bellerica*, and of *T. Chebula*, both useful timber-trees, indigenous to the East Indies, are used medicinally as a tonic and astringent. One hundred and seventeen cwts. of Myrobalans were shipped from Ceylon in 1845.

The annual imports of Myrobalans into Hull, amount to about 1600 cwts. The quantity which arrived at Liverpool was 185 tons in 1849, and 851 tons in 1850; 27,212 bags in 1851, and 19,946 bags in 1852; they came from Calcutta and Bombay, and are also used for dyeing yellow and black. The price in January 1853 was 6*s.* to 12*s.* per cwt. The average annual imports into the United Kingdom may be taken at 1200 tons.

Myrobalans is also the English name given by Lindley to the natural order *Combretaceæ*, which yields these fruits. [COMBRETACEÆ; EMBLICA.]

(Symonds, *Commercial Products of the Vegetable Kingdom.*)

MYROSPERMUM, a genus of Plants belonging to the natural order *Amyridaceæ*. It has a 5-toothed campanulate calyx; 5 petals, the upper one largest; stamens 10, distinct; ovary stipitate, oblong, membranous, with 2-6-ovules; legume with a winged stalk, terminating in an oblique indehiscent 1-celled 1-2-seeded samara. The species are trees with dotted leaves.

M. Peruiferum (*Myroxylon Peruiferum*, Linnæus), Balsam of Peru Tree. The stem of this plant yields the Balsam of Peru. It has a thick smooth straight trunk with a gray coarse bark, which is filled with resin. The leaves are pinnated, and marked with transparent dots; the leaflets alternate, of 2, 3, 4, or even 5 pairs, ovato-lanceolate, acute, coriaceous at the apex, somewhat emarginate, shining above, hairy on the under side; calyx campanulate; petals 5, white, the upper reflexed, broad, roundish, emarginate, the other 4 distinct, linear-lanceolate, reflexed, spreading; stamens 10, distinct, shorter than the petals; anthers mucronate; seed reniform, lying in yellow liquid balsam, which hardens into resin.

Balsam of Peru occurs in two states; one called the white, the other the black. The former results either from spontaneous exudation from the bark, or from incisions made in it; it is also found in the inside of the seed-vessel wrapping the seed. At first it is liquid, of the consistence of recent honey, of a light yellow colour, of an agreeable odour, resembling vanilla, and a somewhat acrid, bitterish, but aromatic taste. Its specific gravity is less than that of water. Heated in a platinum spoon it burns with a white smoke, which reddens litmus paper, and leaves no residual ash. It is completely soluble in alcohol, and also in ether, except some white material which separates from it. It contains much benzoic acid. By distillation with water it yields a volatile oil. By exposure to the air it hardens, and is then termed Opobalsamum Siccum, which must not be confounded with the true Opobalsamum. [BALSAMODENDRON.] Balsam of Tolu is also sometimes called Opobalsamum.

Black Balsam of Peru is stated to be procured by boiling the resinous bark of the trunk and branches of the tree. Martius conjectures that it is procured by subjecting these parts and the pods to a kind of dry distillation, or 'distillatio per descensum,' similar to that by which tar is obtained from pine-trees. This balsam has the consistence of syrup, but does not solidify with age, is scarcely tenacious, of a blackish-brown colour, and not transparent, somewhat oily to the touch, odour agreeable, balsamic, resembling vanilla, taste acrid, balsamic, bitterish, and enduring. Scarcely igniting when in contact with flame; not yielding by distillation with water any volatile oil, and not perfectly soluble even in absolute alcohol. Its chief constituents are the oil, which cannot be termed volatile, two kinds of resin, and benzoic acid.

M. Toluiferum (*Toluifera Balsamum*, Miller, *Myroxylon Toluifera*, Humboldt), Balsam of Tolu Tree. It is very like the last, and by some botanists has been regarded as a variety. The leaflets are then membranous, obovate, taper-pointed; the terminal one larger than the others. This tree yields Balsam of Tolu. It flows from incisions in the tree, and is of the consistence of a strong turpentine. It is sent to Europe in earthenware jars or in tin cases. It becomes tenacious with age, and in cold weather may be fractured, but melts again in summer, or with the warmth of the hand. It is of a yellow or brownish colour, transparent, with the taste and odour of the white Balsam of Peru. [BALSAMS, in ARTS AND SC. DIV.]

(Lindley, *Flora Medica.*)

MYROUNGA. [PHOCIDÆ.]

MYRRH. [BALSAMODENDRON.]

MYRRHIS, a genus of Plants belonging to the natural order

Umbelliferæ, and to the tribe *Scandicineæ*. It has an obsolete calyx; obcordate petals, with an inflexed point; the fruit not beaked; the carpel covered with a double membrane; the outer membrane with elevated keeled ridges hollow within, the inner one close to the seed; no vittæ. The species have leaves three times decomposed, the leaflets pinnatifid; the involucrum wanting; the involucels of many lanceolate ciliated leaves, the central flowers of the umbel staminiferous; the petals white.

M. odorata, Sweet Cicely, or Great Chervil, has the leaves downy beneath, the leaflets of the partial involucres lanceolate-acuminate. This plant has a stem 2 or 3 feet high, round, leafy, and hollow. It is a native of middle and south Europe and Asia, from Spain to Asia Minor, also of Germany, Switzerland, Austria, the south of France, and the north of Italy. In Great Britain it is found in pastures and hilly districts. This plant was formerly much used in medicine. It yields a volatile oil, which has a pleasant odour. The young leaves and seeds were used in salads, and the roots were boiled or eaten cold, or in tarts or in a variety of sauces. In Germany the seeds were added to soups, and in the north of England they are employed for polishing and perfuming old oak floors and furniture. *M. sulcatum* has hoary leaves, and is a native of Spain. Both species may be grown in any common garden soil, and propagated by seeds or division of the roots.

(Babington, *Manual of British Botany*; Burnett, *Outlines of Botany*.)

MYRSINA'CEÆ, *Ardisiads*, a natural order of Plants. They are chiefly sub-tropical plants of the Exogenous class, so nearly the same in their fructification as the species of *Primulaceæ* of northern climates, that scarcely any valid mark of distinction can be found between them. The indehiscent fruit in *Myrsinaceæ* is chiefly relied upon for the means of separating them. The general appearance of the two orders is however widely different; *Primulaceæ* consisting of herbs with no development of woody matter, while *Myrsinaceæ*, in all cases yet observed, are shrubs or trees. Many of the species have handsome foliage and gaily-coloured flowers, on which account they are frequently met with in gardens, but they are of no importance for useful purposes. *Ardisia* and *Jacquinia* are the two commonest genera. The order contains 30 genera and 320 species.

MYRTA'CEÆ, *Myrtle-Blooms*, are Polypetalous Exogens, forming a very extensive and important natural order of Plants, exclusively inhabiting warm countries, and in all cases either shrubs or trees, an herbaceous form of the order being unknown. The most northern station of the species is the south of Europe, where the common Myrtle grows apparently wild. [MYRTUS.] If this plant is taken as the type of the order, it might be said to consist of aromatic plants with opposite leaves, dotted with transparent oil-cysts, bearing icosandrous monogynous polypetalous flowers, succeeded by an inferior succulent fruit; but this is the character rather of a section of the order than of *Myrtaceæ* considered as a whole. In this division are however included nearly all the species employed for the use of man. Among the table-fruits of the tropics are—the Guava, yielded by different species of *Psidium*; the Rose-Apple and Jamrosade, produced by *Eugenia*

Psidium pomiferum.
1, a flower; 2, a stamen; 3, a transverse section of the ovary.

Malaccensis and *E. Jambos*: of spices, Cloves are the flower-buds of *Caryophyllus aromaticus*; and Allspice is the dried berries of *Eugenia Pimenta*; all which are obtained from plants belonging to the same section as the Common Myrtle: the aromatic fruits of that plant were indeed used as a spice before Cloves and Allspice became common. [EUGENIA; PSIDIUM.]

The deviations that take place from the typical structure of the order consist partly in the fruit being dry and capsular instead of fleshy and indehiscent, and partly in the organisation of the interior of the fruit being reduced to a state of great simplicity; besides which the leaves are often alternate instead of opposite. Some of the species have no corolla, and there is in many cases a very singular tendency to consolidate the floral organs of all kinds.

The species with capsular fruit are principally found in Australia, where, in the form of *Eucalyptus* and *Leptospermum*, they constitute one of the most striking features of the vegetation. [EUCALYPTUS.] These plants abound in a powerful astringent secretion, chiefly found in their bark, on which account they are found valuable for the tanner's purposes; while the aromatic principle is also abundantly secreted in other cases, as, for example, in *Melaleuca Cajeputi*, from which the green stimulating oil of the Cajeput is procured. [MELALEUCA.]

It is more particularly among these species that anomalous conditions of the floral organs occur. In *Eucalyptus* there is no corolla, and the segments of the calyx are so completely united to each other as to form a fleshy cap, thrown off by the flowers when the time arrives for extricating the stamens. In *Melaleuca*, *Calothamnus*, and several others, the stamens are united to each other by their filaments, so as to form showy, petal-like, fringed expansions; and in *Eudesmia* the petals themselves are united into a cap, thrown off upon the expansion of the flower.

The most singular form of *Myrtaceæ* is that which derives its name from an Australian plant, called *Chamælaucium*, in which the interior of the ovary contains but one cell, with from two to five ovules rising up obliquely from its base. These plants are all small heath-like shrubs, having in the majority of cases the edge of the petals prolonged into long and delicate fringes. Such plants are extremely abundant on the west coast of Australia, where they form one of the most striking characters of the Flora.

Punica Granatum, the Pomegranate-Tree, is a most anomalous form of *Myrtaceæ*, remarkable for an almost total absence of transparent dotting, and consequently of aromatic qualities; and having a fruit consisting of two whorls of carpels compacted together into an inferior ovary, the interior of which becomes altered and distended so much after the flower has fallen off, that the fruit is nothing but a collection of cavities filled with seeds, and having no apparent relation to each other. [PUNICA.]

The genus *Caryophyllus* has the following characters:—Tube of the calyx cylindrical; limb 4-parted; petals 4, adhering by their ends in a sort of calyptra; stamens distinct, arranged in 4 parcels in a quadrangular fleshy hollow near the teeth of the calyx; ovary 2-celled; ovules about 20 in each cell; berry 1-2-celled, 1-2-seeded; seeds cylindrical or half-ovate; cotyledons thick, fleshy, convex externally, sinuous in various ways internally.

C. aromaticus, the Clove-Tree, is a native of the Molucca Islands. It is a moderately-sized tree, with leaves opposite and decussate, persistent, somewhat coriaceous and shining, minutely punctuated, about 4 inches long, ovate-lanceolate, more or less acute, quite entire, pale beneath, tapering gradually at the base into a slender foot-stalk which is almost 2 inches long. The cloves of the shops are the dried compressed flower-buds of this tree.

MY'RTEA (Turton), a genus of *Mollusca*.

MYRTLE. [MYRTUS.]

MYRTLE-BLOOMS. [MYRTACEÆ.]

MYRTUS (Μύρτος), a genus of Plants, the type of the natural order *Myrtaceæ*. It has the calyx-tube somewhat globose, with the limb 5- or very rarely 4-partite; the petals 5, or very rarely 4; the stamens distinct; the berry 2- or 3-celled, somewhat globose, crowned with the segments of the calyx; several seeds in each cell, or very rarely solitary; uniform, with a bony testa; the embryo curved; cotyledons semi-cylindrical, very short, the radicle twice the length of the cotyledons. The species are shrubs with opposite quite entire pellucid dotted leaves; peduncles axillary, 1- or rarely 3-flowered.

M. communis, Common Myrtle, has solitary 1-flowered pedicels about the length of the leaves, bearing 2 linear bracteoles under the flowers; the calyx 5-cleft; the leaves ovate, lanceolate, or acute. This beautiful plant is a native of the south of Europe; it is found wild in France about Marseille, and extends from that city along the sea-coast to Genoa, and throughout Italy. In these districts it forms thickets which sometimes grow within reach of the spray of the sea. This plant has been in all ages a great favourite in Europe. It was called by the Greeks Μύρτος. Μυρσίνη is the name under which Hippocrates refers to this plant. ('Morb. Mul.,' i. 599.) Theophrastus also uses this word, and Μυρτίνη and Μυρτίς, in speaking of the Myrtle. The Romans knew this plant by the name of Myrtus. (Pliny, 12-13.) This name has been adopted in most European languages. It is Mirto in Italian and Spanish; Myrte in German; Myrter in Danish; Myrten in Swedish; Mirte in French; Mirta in Portuguese.

The leaves of the Myrtle, like the whole order, contain a volatile oil which possesses medicinal properties, and they were used as stimulants by the ancients. The buds and berries of this plant also contain volatile oil, and were used by the Romans as a spice, and are at this day in Tuscany employed as a substitute for pepper. The Tuscans also prepare a kind of wine from the Myrtle called Myrtidanum. The berries are used at the present day in Greece as a remedy in the diarrhœa of little children. The mode of administering them is to soak them in red wine. The flowers of the Myrtle have an agreeable scent, and when distilled they form the perfume sold in France under the name of Eau d'Ange. In addition to a volatile oil the Myrtle contains tannin, so that in medicine its various parts have an astringent action, and have been used for this purpose. In Greece, Italy, and the south of France, the bark is used for tanning.

The Myrtle is only a half-hardy plant in this climate, although many individuals have lived and borne our winters for above 100 years. The Myrtle appears to have been introduced into England in the 16th century. There are at the present time many fine myrtle-trees in Great Britain and Ireland. At Cobham Hall, in Kent, there are several specimens 30 feet high. In the Isle of Wight it forms the hedges of many gardens. It cannot however be relied on, but may be easily cultivated by giving it protection during the winter. Several varieties of the *Myrtus communis* are found in gardens.

M. melanocarpa ('D. C. Prod.,' iii. p. 239). Fruit blackish. This variety of Myrtle is frequent in the south of Europe and in gardens, where there are varieties of it with double flowers and variegated leaves.

M. leucocarpa ('D. C. Prod.,' iii. p. 239). Fruit white. Native of Greece and the Balearic Isles. The fruit of this is rather large, edible, with a grateful taste and smell.

The above varieties are constant, but there are others in the garden which are more variable, such as the Gold-Striped Broad-Leaved Myrtle, Broad-Leaved Jew's Myrtle, Gold-Striped-Leaved Orange-Myrtle, Silver-Striped Italian Myrtle, Striped Box-Leaved Myrtle, Silver-Striped Rosemary-Leaved Myrtle, Silver-Striped Nutmeg Myrtle, Cockscomb or Bird's-Nest Myrtle, Spotted-Leaved Myrtle.

About 40 other species of Myrtle besides those of the old genus *Myrtus*, now referred to the genera *Myrcia*, *Syzygium*, *Eugenia*, &c., have been described. [EUGENIA.] None of them yield products used in arts or medicine, and only a few of them have been cultivated.

M. tomentosa is a native of Cochin China. It is a handsome shrub, and has been found to grow well against walls in the south of England.

M. nummularia is a creeping species found at the Straits of Magalhaens; and *M. myrsinoides*, a native of the colder parts of Peru, would probably be found to be half-hardy in this climate.

(Loudon, *Arboretum Britannicum;* Fraas, *Synopsis Floræ Classicæ;* Burnett, *Outlines of Botany;* Lindley, *Flora Medica.*)

MYRTUS PIMENTO. [PIMENTO.]

MYSCA (Turton), a genus of *Mollusca.*

MYSCOLUS, a genus of Plants belonging to the natural order *Compositæ.* The young roots of *M. Hispanicus* are eaten.

MYSIS. [STOMAPODA.]

MYSTICETE. [CETACEA.]

MYSTUS, a genus of Malacopterygious Abdominal Fishes belonging to the family *Siluridæ.* They are found in the waters of Guyana.

MYTELES, a genus of Malacopterygious Abdominal Fishes belonging to the family *Salmonidæ.* One of the American species is eatable.

MYTILACEA. [MYTILIDÆ.]

MYTILIDÆ, a family of Lamellibranchiate *Mollusca.* It includes the species referred by Linnæus to the genus *Mytilus.* This genus, as it was left by the author in his last edition of the 'Systema Naturæ,' was divided into three sections. The first, 'Parasitici, unguibus affixi,' consisted of those species which are affixed by unguicular appendages to *Gorgoniæ* and other submarine bodies, both organic and inorganic, such as *Mytilus Crista Galli*, *M. Hyotis*, and *M. Frons*, which have been since restored to the genus *Ostrea.* The second, 'Plani s. compressi, ut plani appareant et subauriti,' consisted of the Pearl-Bearing Muscle (*Matrix perlarum*), under the name of *Mytilus margaritiferus*, now separated generically under the names of *Meleagrina* and *Margarita* [AVICULA; MALLEACEÆ]; and *Mytilus unguis*, a species, if it be one, not larger than the human nail. The third, 'Ventricosiusculi,' comprised not only the true *Mytili*, of which *Mytilus edulis* (the Common Muscle) may be considered as the type, but also the *M. lithophagus*, the *Modiolæ*, the true *Avicula* (*Mytilus Hirundo*), and the Fresh-Water Muscles (*Anodon*). The generic definition of this heterogeneous assemblage was *Mytilus.* The animal an ascidia (?). The shell bivalve, rough (rudis), most frequently affixed by a byssus. The hinge toothless, marked (distinctus) by an excavated longitudinal subulate line. Linnæus placed this genus between *Anomia* and *Pinna.* [MALACOLOGY.]

Cuvier makes the Mytilacés the second family of his Testaceous Acephalous Molluscs. He characterises the family as having the mantle open in front, but with a separate aperture for the excrements, adding that all these bivalves have a foot serving the purpose of creeping, or at least to draw out, direct, and fix the byssus. They are, he states, in conclusion, known under the generic name of Moules (Muscles).

This family Cuvier subdivides into—

I. The True or Marine Muscles (Moules Propres ou Moules de Mer; *Mytilus* Linn.)

In this subdivision are placed *Mytilus* (*M. edulis* and its congeners) *Modiola* (Lam.), and *Lithodomus* (Cuv.).

II. The Anodonts (*Anodontes*, Brug.), vulgarly Pond-Muscles (Moules d'Etang).

III. Les Mulètes (Univ., Brug.) commonly called the Painters Muscles, including *Hyria* and *Castalia* (Lamarck).

IV. *Cardita.* (Brug.)

V. *Cypricardia.* (Lam.)

VI. Les Coralliophages. (De Blainv.)

Venericardia he considers as differing but little from *Cardita*, and he observes that both the one and the other approach *Cardium* in general form and the direction of the ribs (côtes). He states his suspicions that this is the place for *Crassatella.*

This family is placed by Cuvier between the Ostracés and the Camacées.

The genus *Pinna* is placed by this zoologist between *Avicula* and *Arca.*

Lamarck characterised his Mytilacées as having the hinge with a sub-internal marginal linear very entire ligament, occupying a great part of the anterior border, and the shell rarely foliated. In this family he places the genera *Modiola*, *Mytilus*, and *Pinna.*

M. De Blainville thus characterises the *Mytilacea*, which he places between the *Margaritacea* and the *Arcacea* or *Polyodonta.* The genus *Avicula* among the *Margaritacea* thus immediately precedes the *Mytilacea.*

Mantle adhering towards the borders, slit throughout its inferior borders, with a distinct orifice for the anus, and an indication of the branchial orifice by the more considerable thickening of its posterior borders; a canaliculated linguiform foot, with a byssus backwards at its base; two adductor muscles, the anterior of which is very small, besides the two pair of retractor muscles of the foot.

Shell regular, equivalve, often furnished with an epidermis, or corneus, with a toothless hinge, and a linear dorsal ligament.

The genera placed in this family by M. De Blainville are *Mytilus*, with its subdivisions, and *Pinna.*

M. Rang gives the following as the characters of the family Mytilacés:—

Animal having the mantle open throughout its inferior part, and adhering towards the borders; a separate aperture behind for the excrements, forming very rarely a tube; the foot linguiform, canaliculated, and furnished with a byssus behind.

Shell rather delicate, generally with an epidermis, or corneus, equivalve, but very inequilateral; the hinge toothless; the ligament linear; anterior muscular impression very small; the posterior one rather large.

Marine (the genus *Mytilus* alone presents a species which is said to live in fresh water). ('Manuel,' &c.)

The genera arranged by M. Rang under this family are—*Mytilus*, with its subdivisions, including *Modiola*, *Lithodomus* (Cuv.), and *Pinna.*

Mr. G. B. Sowerby ('Genera'), after remarking that the Linnæan genus *Mytilus*, on account of its principal character being its want of hinge teeth, consists of several forms that are widely distinct from each other, and which have well served as the types of several Lamarckian genera, such as *Avicula*, *Modiola*, *Anodon*, and others, in connection with the present genus, which deservedly retains the name of *Mytilus*, both on account of its form and the priority of its claim, proceeds to observe that the other genera which have been united with it, but from which it appears necessary to distinguish it, because of a certain degree of general resemblance, are *Modiola* and *Lithodomus:* from *Anodon* and *Avicula*, together with Lamarck's *Meleagrina*, it is, he adds, obviously distinct; whilst one character—namely, the pointed terminal umbones—serves to distinguish it from *Modiola* and *Lithodomus.*

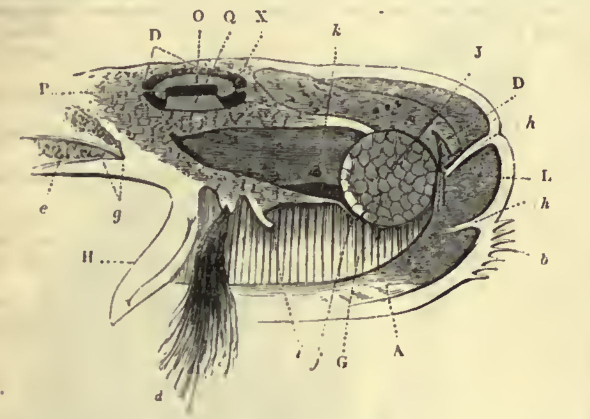
Mr. Garner, in his paper 'On the Anatomy of the Lamellibranchiate Conchifera' ('Zool. Trans.,' vol. ii.), is disposed to regard the disposition and form of the branchiæ and siphons as being of great use in the classification of those animals; and he instances *Anomia*, *Pecten*, *Arca*, *Modiola*, *Unio*, &c., as each having a particular disposition of the branchiæ, sac of the mantle, valves, siphons, &c., giving rise to particular modifications of the course of the aërating currents of water to the branchiæ. He observes, that in the genera, some of which are above mentioned, no complete division of the sac of the mantle exists; while in *Solen*, *Hiatella*, *Pholas*, &c., a different disposition takes place. With regard to the excretory system, he found the oviduct distinct from the sac in *Modiola*, *Mytilus*, *Lithodomus*, &c.; whilst in *Tellina*, *Cardium*, *Mactra*, *Pholas*, *Mya*, and most others, the ova are discharged into the excretory organs. With reference to the reproductive system, Mr. Garner remarks that the ovaries of the Lamellibranchiate *Conchifera* differ much in their situation: sometimes they form distinct parts—sometimes they are found in the foot—sometimes they are ramified in the mantle—which last disposition is present in *Modiola*, *Anomia*, *Lithodomus*, *Hiatella*, and the like.

The same author, in his 'Anatomical Classification of the Lamellibranchiata,' thus arranges the genera *Mytilus*, *Modiola*, *Pinna*, *Lithodomus*, and *Unio:*—

Mantle with a distinct anal orifice.	Foot small, byssiferous	Anterior muscle small; retractile muscles of the foot numerous; byssus large	Byssus divided to its base . . .	*Mytilus.*
			Byssus with a common corneous centre .	*Modiola.*
			Anus furnished with a long lingulate valve . . .	*Pinna.*
		Muscles equal, two pairs of retractile muscles only; byssus rudimentary . . .		*Lithodomus.*
	Foot large, uot byssiferous			*Unio* (*Cardita*, *Hyria*, &c.).

Mytilus.—This genus is abuudaut ou most rocky coasts, where the species are to be found moored hy their coarse filamentous hyssus, generally to such rocks or other suhmarine hodies as are exposed at some periods of the tide, where tides exist, and covered hy the sea at high water. Mr. G. B. Sowerhy does not think that, after heing once attached, they hahitually disengage themselves, though it appears to him probahle that, wheu disengaged hy the force of the sea, they may live for some time without heing in any manner affixed.

M. Deshayes, in the last edition of Lamarck, thus describes the animal :—Oval, elongated ; the lohes of the mantle simple or fringed, united posteriorly in a single poiut so as to form an anal siphon ; mouth rather large, furnished with two pairs of soft palps, which are pointed and fixed hy their summit ouly. Foot slender, cylindraceous, carrying at its hase and posteriorly to it a silky hyssus ; abdominal mass moderate, and on each side a pair of hranchiæ nearly equal ; two adductor muscles ; the one anterior and very small, the orher posterior, large, and rounded.



Gland of the byssus, mantle, oviduct, &c. of *Mytilus edulis.* Garner.

A, right lobe of the mantle ; D, rectum ; G, branchiæ ; H, foot ; J, posterior muscle ; L, superior tube ; O, heart ; P, ventricle ; Q, auricle ; X, pericardium ; *b*, teutacles ; *d*, hyssus ; *e*, gland of the hyssus ; *g*, retractile muscle of the foot ; *h*, valves of the mantle ; *i*, oviduct ; *j*, orifice of the excretory organ ; *k*, internal ditto.

The species are numerous, and most of them are used as food ; hut they should be eaten with caution, for serious illness and even death have ensned from a meal made on some of them. The hyssus, or heard, as it is popularly called, should be carefully cleared away, and they should be particularly avoided when cholera is about, or even when diarrhœa is prevalent.

Captain P. P. King, R.N. ('Voyages of the Adventure and Beagle,' vol. i.), mentions the Choro (*Mytilus Choros* of Molina) as among those shell-fish of the island of Chilóe which are more particularly deserving of notice. Speaking of this large muscle, Captain King says, "Molina has described the Choro of Concepçion, which is not at all different from that of Chilóe. It is often found seven or eight inches loug. The fish is as large as a goose's egg, and of a very rich flavour ; there are two kinds, one of a dark-brown and the other of a yellow colour ; but the last is most esteemed. There is also another sort, much larger than the Choro, yet equally delicate and good, the fish of which is as large as a swan's egg : it is called Cholgua ; hut as the shells seem to he of the same species, I think the distinction can only he owing to size. In Febres's 'Dictiouary of the Chileno Language,' the word Cholchua is rendered into Spanish hy 'Cascara de Choros Blancos,' or 'Shell of the White Muscle.' Cholhua, or Cholgua (the letters *g* aud *h* are indiscriminately used), must be a corruption ; for it is now used in Chilóe to distinguish the large from the small choros. The manner in which the natives of these islands, hoth Indians and descendants of foreigners, cook shell-fish is very similar to that used for haking in the South Sea Islands and on some parts of the coast of New Holland. A hole is dug in the ground, in which large smooth stones are laid, and upon them a fire is kindled. When they are sufficiently heated the ashes are cleared away, and shell-fish are heaped upon the stones, and covered first with leaves or straw and then with earth. The fish thus haked are exceedingly tender and good ; and this mode of cooking them is very superior to auy other, as they retain withiu the shells all their own juioiness."

The distribution of this genus is very wide. Few rocky coasts are without some of the species, which are all littoral. They are sometimes found affixed to crustaceaus, shells, and corals.

* *Mytili*, with a smooth shell.

Mytilus edulis, the Common Salt-Water Muscle. This species is too well known to require description : the figures will show the shape of the shell, which is strong. When freed from the epidermis and polished, the under surface of the external part of the shell is exposed, and is of a deep blue. In this state it is often offered for sale at wateriug places. The iuside of the valves is white with a dark rim.

Ova of *Mytilus edulis.* (1-18th inch focus.)

Mytilus edulis.

a, detached valve ; the animal in situ with hyssus ; the mantle slightly contracted ; *b*, valves conjoined ; animal as seen when the shell is partly forced open, with byssus.

The Common Edihle Muscle is found in extensive heds helow low-water mark, aud also at a greater depth. Rocks and stones between high-water and low-water marks are also covered with them. We once saw a lohster, which is now, we believe, in one of our museums, with its shell coated with them. The species is used largely as an article of food, and is considered rich aud sapid hy many ; hut it entirely disagrees with some coustitutions, aud, besides other derangements, has heeu known to cause hlotches, swelliugs, &c. Some cases are recorded where these and other affections have been produced by eating these muscles, whilst some who have partakeu from the same dish have escaped all evil consequences. These derangements have been attributed hy some to the byssus, hy others to the Pea-Crah [PINNOTHERIANS], a little crustacean which shelters itself, especially at particular seasons, iu the shell of the muscle, and hy others again to the muscle itself heiug in an unwholesome state or out of season. There can he little doubt that the muscle, like the oyster, aud indeed like most other edible animals, is comparatively unfit for the food of man at certain periods ; hut that the Pea-Crab has anything to do per se with the poisonous qualities of these esculents is denied hy all who have written on the suhject. When any symptoms of derangement occur after eating muscles an emetic should he taken and afterwards a dose of castor-oil. Cases of this kind are however rare. Pennant remarks, that for one who is affected by eating muscles a hundred remain uninjured.

No anatomical investigation into the condition of such specimens as prove injurious, nor chemical analysis of their composition, has

Shell of *Mytilus edulis.*

a, valves closed, with byssus; *b*, external view of one of the valves; *c*, internal view, showing the muscular impressions.

revealed the cause of the disorder; but as such casualties result mostly in summer, it is probable that some natural change is taking place in the animal, which renders it at that season unfit for food. It would therefore be prudent to use it only in the winter months. The idea that it is owing to the fish having absorbed copper is quite unfounded. The application of heat in cooking does not destroy the noxious property, as it does that of many vegetable poisons, for those which are dressed are as hurtful as those eaten raw. Neither does decay seem to be the source of the deleterious principle, since bad effects follow the use of those which are quite fresh; nor does decay decompose the poison, though most animal poisons are destroyed by putrefaction, for fatal cases have ensued from the eating of decaying muscles. The consequences have been imputed to idiosyncrasy in those who eat the muscles; but this is obviously inadequate to explain the circumstances, since in most of the instances every person (amounting in one case to thirty individuals) who tasted them suffered; and even cats and dogs, as well as human beings, died from eating them. The morbid symptoms vary, and in some of the cases are connected with inflammation of the stomach and intestines. "Two affections of this kind have been noticed; one is an eruptive disease, resembling nettle-rash, and accompanied with violent asthma; the other a comatose, or paralytic disorder, of a very peculiar description. The symptoms have usually commenced between one and two hours after eating, and rapidly attained their greatest intensity. The first symptoms were like those of violent catarrh, swelling and itching of the eyelids, and generally nettle-rash followed; and the eruption afterwards gave place to symptoms of the most urgent asthma. The swelling is not always confined to the eyelids, but has usually extended over the whole face. In several cases the eruption was preceded by asthma, lividity of the face, insensibility, and convulsive movements of the extremities; in others nausea and vomiting, followed by heat and constriction of the mouth and throat; difficulty of swallowing and speaking freely; numbness about the mouth, gradually extending to the arms, with great debility of the limbs." The abdomen is often affected with pain, increased on pressure; the functions of the kidneys disturbed, but generally increased; the bowels sometimes obstinately constipated. Epileptic symptoms, or delirium, convulsions, and coma, have appeared in the greater number of fatal cases, rather than inflammatory action.

Emetics, such as sulphate of zinc, which acts quickly, have been of service; but ether seems the most effectual means of relieving the difficulty of breathing and the other nervous symptoms.

Particular localities are celebrated as producing this muscle in perfection. "Ne fraudentur gloriâ sua littora," exclaims Pennant, "I must in justice to Lancashire add, that the finest muscles are those called Hambleton Hookers, from a village in that county. They are taken out of the sea and placed in the river Weir, within reach of the tide, where they grow very fat and delicious." In 'The Forme of Cury' (1390) is a receipt for dressing 'Muskels in Browet,' and also one for making 'Cawdel of Muskels.'

Small or seed pearls frequently occur in this species, and some years ago these were employed for medical purposes.

** *Mytili* with the shell striated longitudinally.

M. Magellanicus. Shell oblong; whitish below, purple violet above, with long thick undulated furrows; the umbones acute, and not much curved. Length varying, generally from 4 to 5 inches.

It is found in the Straits of Magalhaens, Chiloé, &c.

The flesh is well-flavoured and nutritious. The shells of old individuals, when polished, are brilliant, with a nacreous deep purple tinged with violet.

Mytilus Magellanicus, attached to a rock by its byssus.

It is not improbable that this species ministered in a degree to the woful wants of Byron and his wretched companions after the wreck of the Wager. "Having thus established," says that officer, "some sort of settlement, we had the more leisure to look about us, and to make our researches with greater accuracy than we had before, after such supplies as the most desolate coasts are seldom unfurnished with. Accordingly we soon provided ourselves with some sea-fowl, and found limpets, muscles, and other shell-fish in tolerable abundance; but this rummaging of the shore was now become extremely irksome to those who had any feeling, by the bodies of our drowned people thrown among the rocks, some of which were hideous spectacles, from the mangled condition they were in by the violent surf that drove in upon the coast. These horrors were overcome by the distresses of our people, who were even glad of the occasion of killing the gallinazo (the carrion crow of that country) while preying on these carcasses, in order to make a meal of them."

Here may be introduced the *Mytilus polymorphus* of Pallas, Gmelin, and others, thus characterised as a genus by Dr. Vanbeneden, under the name of

Dreissena.—Mantle entirely shut, presenting three apertures, one of which is furnished with a siphon. Anterior extremity of the body bifurcated and lodging in the middle of the division the transverse anterior muscle. Abdomen depressed; extremities of the branchiæ floating in their posterior half.

The shell is regular, equivalve, inequilateral, umbo with a septum in its interior. Three muscular impressions, the middle one unique and linear.

Dr. Vanbeneden thinks that the organ of the byssus, which he designates, after Poli, by the name of 'languette,' has been erroneously taken for the foot. The true foot, he observes, consists of a muscular tunic more or less thick, which covers the abdomen of the animal, and serves it as an organ of progression; whilst the organ, which always accompanies the byssus, possesses no character in common with the foot except its mobility. Instead of covering the abdomen as a muscular tunic, it forms a part of the retractor muscle, from which it cannot be separated. At the base of this organ, with which, when the byssus is torn away, the animal seems to explore the bodies in its neighbourhood, is the sheath in which the byssus is lodged.

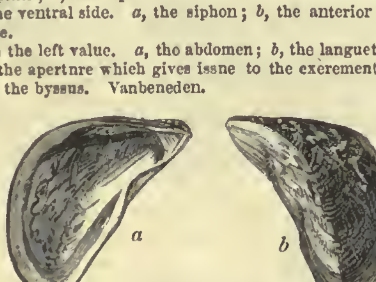
The mantle entirely envelops the animal, and forms three apertures, one of which serves for the passage of the byssus and the 'languette;' the second terminates the animal in the siphon; the third is placed on the back, and gives passage to the excrements. The aperture of the siphon is elongated many lines in respiration, and can be bent in different directions.

D. polymorpha. This appears to be the *Mytilus Wolgæ*, Chemn.; *M. Chemnitzii*, Fér.; *M. Hagenii*, De Baer; *M. lineatus* Waardenburg, and *M. Arca*, Kickx.

It inhabits seas, lakes, rivers, and marshes; all these conditions seem favourable to it. Dr. Vanbeneden gives the following localities:—the Caspian Sea, the Black Sea, and the Baltic, the Danube, the Volga, and the Rhine, where they are found in considerable quantities; the marshes of Syrmia (the Palatinate), the Canal Guillaume (Belgium), the lakes of Harlem (Holland), the Lea (our river Lea, we suppose, is meant), the Doks (the Commercial Docks, London, probably) and the neighbourhood of Edinburgh (Union Canal); so that this form extends nearly over the whole surface of Europe from 43° to 56° N. lat.; Turkey, Austria, Russia, Germany, Belgium, Holland, and England. (Vanbeneden.)

Dreissena polymorpha.

1, Animal of natural size, showing the siphon exserted, and the aperture which corresponds with the anus open; view of the back. *a*, the siphon; *b*, the posterior row of papillæ; *c*, anal aperture.
2, view of the ventral side. *a*, the siphon; *b*, the anterior row of papillæ; *c*, the languette.
3, Animal in the left valve. *a*, the abdomen; *b*, the languette in situ; *e*, the branchiæ; *d*, the aperture which gives issue to the excrements; *e*, aperture of the byssus; *f*, the byssus. Vanbeneden.



Shell of *Dreissena polymorpha.*

a, view of inside of valve, showing the septum at the umbo; *b*, the outside of valve.

Mr. J. D. C. Sowerby appears to have been the first who noticed their introduction into the Commercial Docks in the Thames, to which place he is of opinion that they had been probably brought in timber.

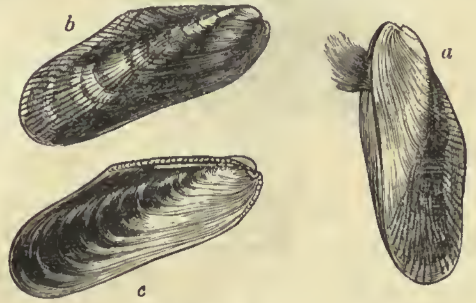
The species are found at the bottom of the water in beds, like the marine *Mytili*, agglomerated in bunches by means of their byssus. They attach themselves to stones, to piles, to other shells (*Unio* and *Anodon*), and all the bodies which are in their neighbourhood. Dr. Vanbeneden remarks, in continuation, that they probably often adhere to the keels of boats, and that it is perhaps by such means that they are dispersed over such a considerable extent.

Modiola (Lamarck).—M. Rang makes *Modiola* the third group of the genus *Mytilus*. M. Deshayes, in his inquiry whether this genus ought to be preserved, observes that the *Mytili* and *Modiolæ* much resemble each other, as all admit, but they offer some difference, the importance of which he proceeds to test. Of the animal he says nothing, their analogy being so perfect, and all their characters, internal as well as external, being so similar that it is impossible to distinguish them. The habit which certain species have of living in the stones which they pierce has not changed their organisation; and of the justice of this remark those interested in the subject may, he states, assure themselves by a comparison of the animals themselves, which are abundantly spread abroad in all seas. It is a received principle among all zoologists, he continues, that animals having the same organisation ought to make a part of the same genus; but as there are persons who attach considerable importance to certain characters in the shells, it is right to reduce it to its just value. The *Modiolæ* differ from the *Mytili* in not having pointed and terminal umbones. On assembling a great number of living and fossil species of both genera, some will be observed whose umbones, nearly terminal, are overpassed by a small very short border; others in which this border is a little more extended; and so one passes by insensible degrees from the *Mytili* to the *Modiolæ* without the possibility of determining the point where one genus ends and the other begins. If the same comparison is continued between the *Modiolæ* and the *Lithodomi* the same passage may be observed, and then, concludes M. Deshayes, the observer will be convinced, as we are, of the inutility of these genera.

M. Rang separates the group of *Mytili*, consisting of Lamarck's genus *Modiola*, into two subdivisions.

* Shell sulcated longitudinally.

M. sulcata. Shell bluish-white; epidermis yellowish; hinge-margin dentilated. It is found in the Indian seas.



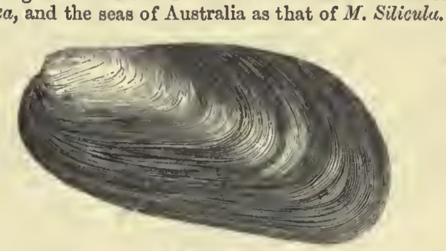
Modiola sulcata.

a, Shell closed, with byssus; *b*, outside view of valve; *c*, inside view of valve.

** Shell not sulcated longitudinally.

M. Silicula (including, according to M. Deshayes, *M. cinnamomea*). Shell marone-brown or whitish; epidermis deep marone-brown.

Lamarck gives the seas of the Mauritius as the habitat of *M. cinnamomea*, and the seas of Australia as that of *M. Silicula.*



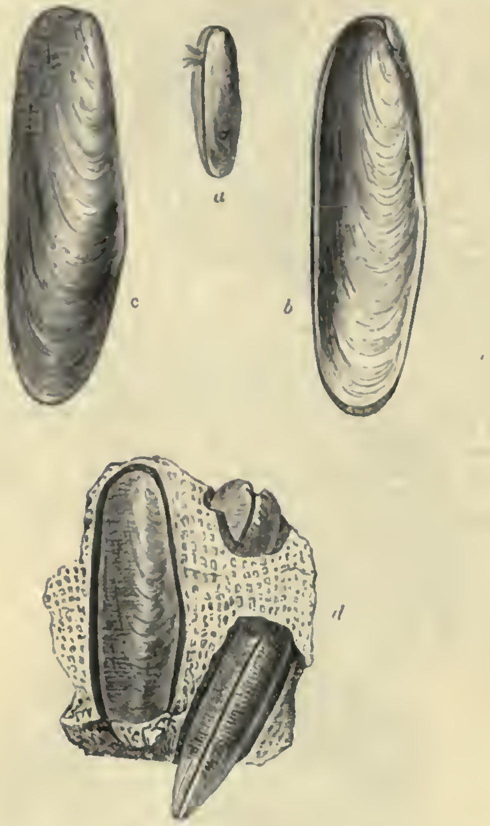
Modiola Silicula.

Lithodomus (Cuv.).—Animal oblong, very much elongated, thick, having the mantle prolonged and fringed posteriorly; anal aperture mesial; mouth furnished with very small triangular appendages; foot linguiform, canaliculated, but little developed, and carrying a byssus at its base in the early stages of the animal's life.

Shell delicate, covered with an epidermis, oblong, very much elongated, subcylindrical, rounded anteriorly, not gaping; umbo subanterior, very distinct; hinge toothless; ligament linear, for the most part internal, inserted in a narrow and elongated furrow; anterior muscular impression of considerable size.

L. Dactylus (*Modiola lithophaga*, Lam.; *Mytilus lithophagus*, Linn.).

In the early stages of life the *Lithodomi* suspend themselves to rocks and madrepores by means of their byssus; but they soon pierce those bodies in order to introduce themselves, and thus form cavities which they can never leave, in consequence of their increasing volume as they advance in age. The byssus then becomes useless, and is no longer manifested. These shells, says M. Rang, are very common in the Mediterranean and at the Antilles, where they are found in stones and masses of madrepore, and sometimes, but much more rarely, in some thick shells.



Lithodomus Dactylus.

a, Young, with byssus; *b*, full-grown, inside of valve; *c*, ditto, outside of valve; *d*, three specimens in a mass of madrepore.

This species is highly nutritious and well flavoured. Imprisoned as the animal is in the stone or madrepore, frequently with a very small opening communicating with the sea, it must obtain a plentiful supply of food, probably by means of the currents produced by the animal, for the shells are always full and the animal plump. A stew of these *Lithodomi* is described by those who have partaken of it as excellent.

With regard to the power of piercing rocks, stones, wood, &c., possessed by Lamellibranchiate animals, Mr. Garner, in a paper in the 'Philosophical Transactions,' observes that such piercing cannot in every case take place by the mechanical action of the valves, and he instances those of *Lithodomus* as not at all adapted for such an action. He also denies the possibility of the perforation being caused by a solvent fluid secreted by the animal. [LITHOPHAGIDÆ.]

Pinna (Linn.)—Animal elongated, rather thick, subtriangular; lobes of the mantle united on the dorsal border, separated throughout the rest of their extent, ordinarily ciliated on the edges; foot slender, conic, vermiform, carrying at its base a silky byssus; mouth between two lips, foliaceous within, very much elongated, and terminated by two pairs of short palps, the two palps of one side soldered nearly throughout their length; two adductor muscles, the anus terminating behind the posterior one. (Deshayes.)

Shell fibrous, horny, rather delicate, fragile, compressed, regular, equivalve, longitudinal, triangular, pointed anteriorly, rounded or truncated posteriorly; anterior umbo but little distinct; hinge linear, striate, toothless; ligament marginal, a great portion of it internal, very narrow and compact, occupying more than the anterior half of the dorsal border of the shell, in a narrow and elongated gutter; anterior muscular impression very small and entirely in the angle, posterior muscular impression very large. (Rang.)

Poli has given beautiful figures of the animal, which he calls *Chimæra*, and most elaborate details of its anatomy; and to his great work we refer the reader. There are no projecting siphons, and the conic tongue-like foot is employed by the animal to fix itself by the byssus, which is not scanty and coarse, like that of the *Mytili*, but long, fine, lustrous, and abundant; so that, though it takes no dye, it is employed in manufactures in Italy. [BYSSUS; CONCHIFERA.] The *Pinnæ* approximate more especially to the *Mytili*, but the shell of the former, with its straight umbones and its gaping opposite extremity, strongly distinguishes them. There is a tendency in their shell to divide itself into laminæ, and thus it approaches that of the *Malleacea.*

The species are generally found in deep water, but they have been taken at depths ranging from the surface to seventeen fathoms; most frequently on sandy bottoms, where they were moored by their byssus, and at no great distance from the shore. It is said that the animal sometimes fixes itself by the aid of its byssus, and sometimes removes itself by the aid of its foot. Small crustaceans, both brachyurous and macrurous, are sometimes found in their shells. Species occur nearly in all seas. Most of them are muricated when young with vaulted or subtubular spines; but as they increase in age these are worn down, and at last almost entirely disappear. We have had individuals of the great Mediterranean *Pinna* before us, gradually increasing from a very small size to nearly two feet in length. When specimens taken at wide intervals were compared, the difference was so great that they might easily have passed as distinct species, as indeed they have been described by some authors. We have seen many pearls from this *Pinna* not ill-formed and of an amber colour, but none of any considerable size.

P. Flabellum may be taken as an example of the genus. About 30 recent and 50 fossil species of this genus have been described.

Pinna Flabellum.

a, Young, with spines, and the byssus, natural size; *b*, full-grown, inside view of valve, one-fifth natural size.

Fossil Mytilidæ.

Mytilus.—Mr. G. B. Sowerby ('Genera') states that the fossil species with which he is acquainted are not numerous; they occur however, he observes, in some of the beds below the chalk as well as in most of those above it, but particularly in the crag.

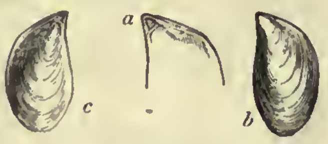
M. Deshayes, in his Tables (1833), makes the number of fossil species (tertiary) 15. *M. Chemnitzii* and *M. edulis* he states to be both living and fossil (tertiary). In the last edition of Lamarck (1836), he remarks that Brocchi mentions a fossil shell to which the latter gives the name of *M. edulis;* but M. Deshayes does not believe that this fossil is the analogue of *M. edulis*, Linn., but of another edible species very common in the Mediterranean. Of fossil species he admits 9 only in that work. Dr. Mantell notices a species in the cliff between Brighton and Rottingdean (diluvium); and another, *M. lanceolatus*, in the Shanklin sand. Professor Phillips notes a *M. cuneatus* from the inferior

Pinna Flabellum, full-grown, valves closed, outside view, with byssus, one-fifth natural size.

oolite in his list of organic remains of the Yorkshire coast. Dr. Fitton, in his 'Systematic and Stratigraphical List of Fossils' (strata below the chalk), enumerates the following species:—*M. edentulus*, *M. inæquivalvis*, *M. lanceolatus*, *M. Lyellii*, *M. prælongus*, *M. tridens*, and an undetermined species. Woodward gives 80 fossil species, principally from the Permian beds.

Dreissena.—Fossil in the modern Calcaire of Aratapak and Transylvania, in Moravia, and the environs of Vienna. (Vanbeneden.) About 10 fossil species have been described.

Here we may perhaps place *Mytilus Brardi*. The septum comes very near to that of *Dreissena*.



Mytilus Brardi.

a, Hinge and septum, enlarged; *b*, outside of valve; *c*, inside.

Modiola.—Mr. G. B. Sowerby states that the fossil species are not many. M. Deshayes, in his 'Tables,' makes the number of fossil species (tertiary) 21; and *M. barbata*, *M. discrepans*, and *M. lithophaga* (*Lithodomus*), both living and fossil (tertiary). In the last edition of Lamarck the number given is 20. Woodward gives 130 as the number of fossil species now known. They are found from the Silurian system upwards.

Lithodomus.—M. Deshayes does not mention this genus in his 'Tables,' and appears to place it under *Modiola*, a position which it occupies in Lamarck's work. M. Deshayes records *Modiola lithophaga* (var.)—*Lithodomus lithophagus*—as fossil at Paris. Mr. Lonsdale notices a *Lithodomus* in the inferior Oolite, and another in the Coral Rag. Dr. Fitton records a new species and another species, both nameless, in the Portland Stone.

Pinna.—The number of fossil species is about 50. They are chiefly from the Devonian Beds, and found in Europe, America, and Southern India.

MYTILUS. [MYTILIDÆ.]

MYXI'NE, a genus of Cartilaginous Fishes, of the order *Cyclostomi*. It is synonymous with the *Gastrobranchus* of Bloch. The *Myxine glutinosa*, or Glutinous Hag, is the type. This curious animal is shaped like an eel, and measures when full grown about one foot and a half. The head is scarcely distinguishable from the body, and is obliquely truncated in front, terminating in a large round mouth, the frame-work of which is a membranous maxillary ring, furnished above with a single tooth. The tongue is furnished on each end with two rows of strong teeth. Eight filaments surround the mouth. In the middle of its superior margin there is a single round spiracle. It has no eyes. The branchial openings are two, and are estimated at about one-fourth the length of the body, below the mesial line. The skin is naked, and very slimy. Along each side of the belly there is a row of pores, which furnish the mucous secretion. An obscure fin runs along the hinder portion of the back, is continued round the compressed tail, and beneath the anal opening, which is placed near the tail. It is of a dark bluish-brown colour above and whitish beneath. The *M. glutinosa* is not uncommon in the Scandinavian seas, and is frequently taken off the north-east coast of Britain. It enters the mouths of fishes caught in the lines of the fishermen, and eats up all the fleshy parts of their bodies, leaving only the skin and bones. It is sometimes called the Hag, and also Borer, because it is said by some that the *Myxine* pierces a small aperture in the skin, and thus makes its way into the body of the cod or other fishes which it attacks.

The very anomalous characters of this fish have at different times caused naturalists to place it in more classes than one. Thus Linnæus classed it among *Vermes*; Modeer, among *Amphibia*; and O. F. Müller among *Mollusca*. That it is a true fish, though very low down in the series, has now been placed beyond doubt. It has furnished the subject of many elaborate essays. The most valuable is the celebrated memoir on the 'Anatomy of *Myxinoideæ*,' by Professor John Müller, published in the Transactions of the Berlin Academy for 1834, illustrated by admirable anatomical drawings.

In that memoir the author proposes the following arrangement of the Cartilaginous Fishes, in which the exact position of *Myxine* and its allies in the series is well shown.

Chondroptérygia.

Skeleton cartilaginous, cranium without sutures.

Order 1. *Branchiostega.*

Family 1. *Cataphracta*.—Cartilage of the cranium and skin of the trunk covered at intervals with cartilaginous tubercles.

Sturiones. Genus 1. *Sturio.*

Family 2. *Nuda*.—Body without tubercles.

Spatulariæ. Genus 2. *Spatularia.*

Order 2. *Holocephala.*

Genus 1. *Chimæra.*

Genus 2. *Callorhyncus.*

Order 3. *Plagiostomata.*

Family 1. *Sqali*.—The branchial apertures not attached to the head.

Genus 1. *Squalus.*

Sub-Genera.

Scyllium.	*Mustelus.*	*Cestracion.*
Carcharias.	*Scymnus.*	*Spinax.*
Lamna.	*Notidanus.*	*Centrina.*
Galeus.	*Selache.*	

Genus 2. *Zygæna.*

Geuus 3. *Squatina.*

Genus 4. *Pristis.*

Family 2. *Raiæ*.—The branchial apertures attached to the head.

Genus 1. *Rhinobatus.*

Genus 2. *Torpedo.*

Genus 3. *Raia.* (Sub-Genera *Raia*, *Trygon*, and *Anacarethus.*)

Genus 4. *Propterygia.*

Genus 5. *Myliobates.* (Sub-Genera *Myliobates* and *Rhinoptera.*)

Genus 6. *Cephaloptera.*

Order 4. *Cyclostomata.*

Family 1. *Hyperoartia*, palate imperforate.

Genus 1. *Petromyzon.*

Genus 2. *Ammocœtis.*

Family 2. *Hyperotreta*, with the palate perforate. *Myxinoidea.*

Genus 1. *Myxine.*

Müller enumerates only one species, the *M. glutinosa* of the

Northern Seas. A representative species has since been made known from the Antarctic Seas.

Genus 2. *Bdellostoma*. The fishes of this genus differ from the *Myxine* in having eyes, and more than one branchial spiracle.

Müller enumerates four species as certain, viz.: *B. hexatrema* and *B. heterotrema* from the Cape of Good Hope; *Heptatrema* from the South Seas, and *Forsteri* from New Zealand. *B. Dombeyi* is regarded as doubtful.

(Yarrell, *British Fishes.*)

MYXODES, a genus of Acantbopterygious Fishes belonging to the family *Gobioda*.

MYZOMELA. [MELIPHAGIDÆ.]

N

NABALUS, a genus of Plauts belonging to the order *Asteraceæ*. Two of the species, *N. Serpentarius* and *N. albus*, are found in North America, and have, with many other plants, a repute as a remedy for rattle-snake bites. They have a milky juice in their roots, which is very bitter.

NACRE. [SHELL.]

NACRITE, a Mineral usually occurring in Mica-Slate, taking the place of the mica; so that the rock becomes a mixture of quartz and nacrite. It is also found crystallised in granite. Iu occurs in 4-sided prisms. Its hardness is 2·75. Colour silvery, or light greenish-white. Lustre pearly, silky, splendent. Translucent. Specific gravity from 2·788 to 2·793. It occurs in Wicklow, Ireland, and in North America.

A specimen from Brunswick, Maine, analysed by Dr. Thomson, gave—

Silica	64·440
Alumina . . :	28·844
Protoxide of Iron	4·428
Water	1.000
	98·712

The crystals from Wicklow contained less oxide of iron, but a considerable portion of lime and of protoxide of manganese.

NÆSA. [ISOPODA.]

NAIA, Laurenti's name for a genus of highly venomous Serpents, to which the species of *Uræus* and *Aspis* of Wagler belong.

Cuvier places the form next to the Vipers (*Vipera* of Daudin), and immediately preceding *Elaps* (Schn., part). Dr. J. E. Gray formerly made *Naiina* the second sub-family of his *Viperidæ*, *Viperina* being the first. *Naiina*, which is characterised by Dr. Gray as having the "head broad behind, with plates," is immediately succeeded by *Elaphina*, and thus the genus *Naia*, in his arrangement, stands between *Pelius* (Merrem) and *Sepidon* of the same author. ('Annals of Phil.,' 1825).

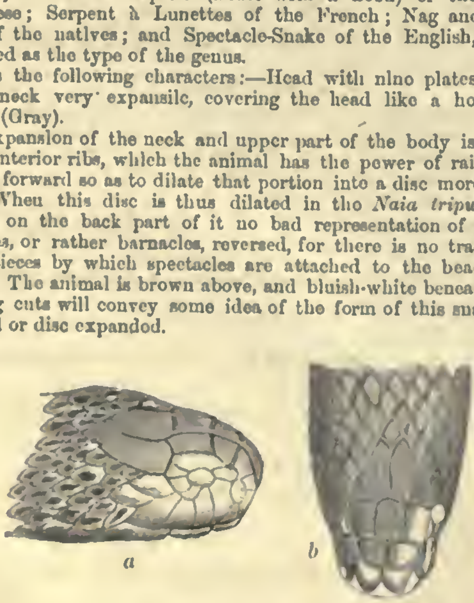
Mr. Swainson, in his 'Classification of Reptiles' ('Natural History of Fishes, Amphibians, and Reptiles,' vol. ii.), places the genus *Naia* among the *Crotalidæ*, his second family of *Ophides*, or Serpents, and arranges it between *Cerastes* and *Platurus*. He gives the following as the sub-genera :—*Naia*, *Sepidon*, and *Elaps*, and thus characterises the sub-genus *Naia* :—Neck capable of being dilated; head narrow; dorsal scales linear; tail conical; subcaudal plates arranged in two rows.

This form appears to be confined to the Old World.

The Asiatic species, *Coluber Naja* of Linnæus; *C. cæcus* of Gmelin (!); *Vipera Naja* of Daudin; *Naja tripudians* of Merrem; *N. lutescens* of Laurenti; Cobra de Capello (adder with a hood) of the Asiatic Portuguese; Serpent à Lunettes of the French; Nag and Chinta Nagoo of the natives; and Spectacle-Snake of the English, may be considered as the type of the genus.

It has the following characters :—Head with nine plates behind, broad; neck very expansile, covering the head like a hood; tail round. (Gray).

The expansion of the neck and upper part of the body is effected by the anterior ribs, which the animal has the power of raising and bringing forward so as to dilate that portion into a disc more or less large. When this disc is thus dilated in the *Naia tripudians*, it presents on the back part of it no bad representation of a pair of spectacles, or rather barnacles, reversed, for there is no trace of the lateral pieces by which spectacles are attached to the head of the wearer. The animal is brown above, and bluish-white beneath. The following cuts will convey some idea of the form of this snake, with the hood or disc expanded.

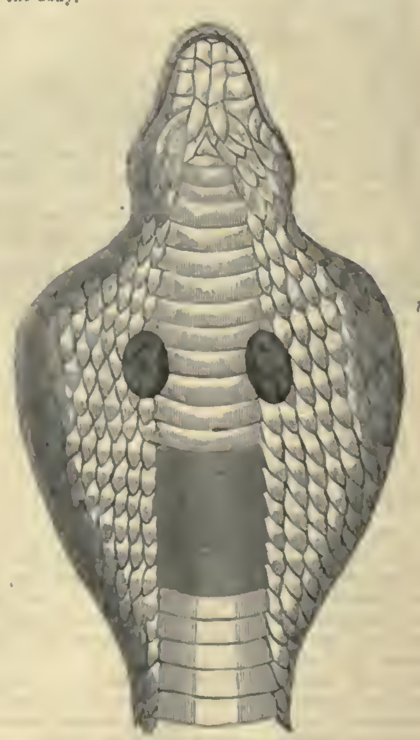


Head of *Naia*.

a, side view; *b*, seen from above.

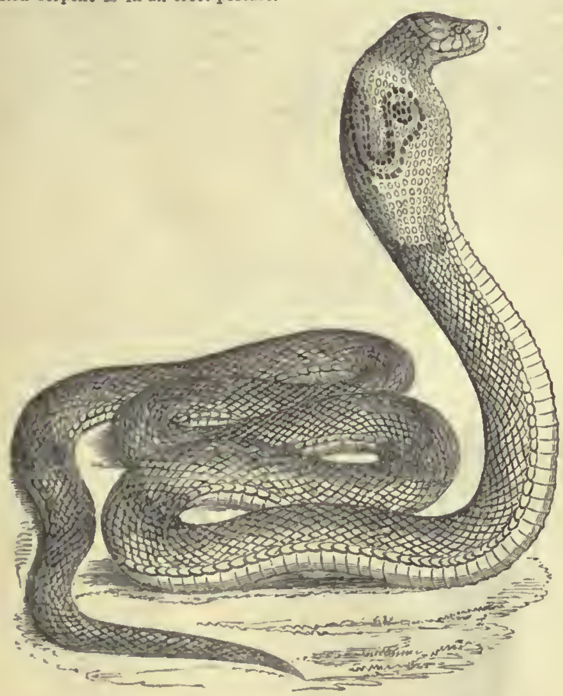
Colonel Briggs informs us that this active and deadly serpent is sometimes worshipped in temples in India, where it is pampered with

a, view of the upper side of the disc or hood expanded, with the head on the same line with the body.



b, view of the under side of the same.

c, the disc or hood seen from behind, when the anterior portion of the excited serpent is in an erect posture.



Naia tripudians, reduced, in an erect and excited state.

milk and sugar by the priests, and he notices it as a surprising instance of tbe effect of kind treatment in subduing the most irritable spirits. "The Hindus," says the Colouel, in continuation, "have a notion that the sagacity and the long-cherisbed malice of this worm are equal to that of man. I have seen them come out from tbeir holes in the temples, when a pipe bas been played to them, and feed out of the hand as tamely as any domestic animal; and it is wben in this state of docility, so opposite to their shy but impetuous nature, the common people believe that tbe Deity has condescended to adopt that form. It seems probable tbat this booded snake was the dragon of the heathen worship; and the shape of its head and its activity when in a state of excitement probably gave rise to tbe fable of its being winged."

It is pretended that the root of the *Ophiorrhiza mungos* is a specific against the bite of this serpent. The priests and jugglers however, wbo make them dance to astonish or amuse tho people, make all sure, there is little doubt, by extracting the poison-fangs.

This formidable species, or at least some species of hooded snake, according to tbe records of travellers, grows to a considerable length. Captain Percival gives the following account of its size and habits, in his 'Account of tbe Island of Ceylon,' 4to, 1805 :—

"The Cobra Capello, or Hooded Snake, is found here from six to fifteen feet long. Its bite is mortal. The natives find the herb pointed out by tbe ichneumon a remedy, if timely applied. Wben euraged and prepariug to attack, it raises its head and body to tbe heigbt of three or four feet in a spiral manner, while at the same time the remaining part of the body is coiled up to accelerate and give force to the spring. At this instant it distends from its head a membrane in the form of a hood, from which it receives its uame. This membrane lies along tbe forehead and tbe sides of the neck, and is almost imperceptible till the animal gets into a state of irritatiou and is about to attack his foe. When tbe bood is erected it completely alters the appearance of the bead, and discloses a curious streak in the shape of a pair of spectacles, and sometimes of a horse-shoe. The extension of this membrane seems intended by Providence to givo warniug to all tbose within this animal's reach that be is preparing to attack tbem. Without this signal he would be very dangerous indeed, as his motions afterwards are too rapid to be avoided. I bave more than once been an eye-witness to instances wbere the fatal bite of tbis snake was escaped from merely by the object of his vengeance timely observing his preparations. One remarkable characteristic of tbese dangerous serpents is their fondness for music. Even wheu newly caught they seem to listen witb pleasure to the notes, and even to writhe themselves into attitudes. The Indian jugglers improve greatly on this instinct, and, after taming tbem by degrees, instruct them even to keep time to their flageolet."

Tbe largest Cobra de Capello seen by Dr. Davy in Ceylon was nearly six feet long; and he adds that tbe general lengtb is between two and four feet. Tbe colour varied: those of a ligbt colour were called high-caste snakes by the natives, and those of a dark colour low-caste. "Tbo natives," says Dr. Davy, "in general rather venerate this snake than dread it. Tbey conceive that it belongs to anotber world, and that wben it appears in this it is merely as a visitor; they imagine tbat it possesses great power, that it is somewhat akin to tbe gods, and greatly superior to man. In consequence they superstitiously refrain from killing it, and always avoid it, if possible. Even when they find one in tbeir house, tbey will not kill it, but, putting it into a bag, throw it into water. Tbey believe tbat this snake has a good and generous disposition, and that it will do no barm to man, unless provoked." Dr. Davy gives a pleasing picture of the irritations and sootbings witb which tbe snake-charmers excite and allay tbe temper of this serpent. He records several instances of the operation of tbe poison, the first arising from a serpent found in a bag floating down the Kalang-ganga. It was about five feet long, and about six inches in circumference in tbe broadest part. This snake bit a hen, fixing its fangs in tbe skin covering the lower part of tbe left pectoral muscle, and keepiug its bold about two or tbree seconds, when Dr. Davy succeeded in shaking it off. Tbe hen, wbicb at first seemed to be little affected, died eigbt bours after sbe was bitten. ('An Account of the Interior of Ceylon,' &c., by John Davy, M.D., F.R.S., 4to, London, 1821.)

Several Cobras have been kept alive in the Zoological Gardens Regeut's Park. One of these creatures bit one of tbe keepers on tbe nose whilst he was playing with it. The man died iu a few hours after. The Arabs wbo accompanied the Hippopotamus had tbe power of snake-charming; and on several occasions these fearful reptiles were made to go through a variety of performances by a lad not more than 10 or 12 years old.

Tbere are several other species of *Naia*. Schlegel, in his essay on the 'Physiognomy of Serpents,' gives the following :—

N. Haje, the Aspis of antiquity. This is the snake which is most frequently operated on by tbe snake-cbarmers of Egypt, where it is found. [ASP.] It is wortby of observation with refereuce to tbe contest in the presence of Pbaraob between Moses and Aaron and the magicians of Egypt (Exodus, vii. 9-12), that it is stated, on good authority, that the modern Egyptian jugglers possess tbe power of throwing tbe *N. Haje* into a state of catalepsy, and rendering it stiff and immoveable, in otber words, changing it into a rod, by pressing the nape with the fingers.

N. Bungarus is a rare species, inbabiting the islands of Java aud Sumatra. It is tbe *Bungarus* of Daudin.

N. Bungaroides, closely resembles the last, but is smaller.

N. porphyrica inbabits tbe sandy downs of Australia.

N. Hamachates inhabits the Cape of Good Hope. *N. rhombeata* and *N. lubrica* are also Cape species.

N. Elaps is a very large snake, but its country is unknowu.

N. curta, a native of Australia.

We owe to Dr. Cantor, wbo has added so much to our knowledge of the natural bistory of Asiatic serpents, tbe introduction of a new genus of hooded snakes, *Hamadryas*, which will probably find its proper place in tbe series as a sub-genus of *Naia*.

Hamadryas (Cantor).—Head broad, sub-ovate, deplanate, with a short obtuse rostrum, covered abovo with 15 scuta; checks tumid; eyes large, prominent, pupil round; nostrils widely opened, withiu the confiue of two scuta; gape very ample, subundulated. Poisou-fangs anterior, behind which are the maxillary teeth. Neck dilatable. Body thick, smooth, imbricated with smooth scales disposed in oblique rows. Tail short, covered with scuta and scutella, its apex acute. (Cantor.)

H. ophiophagus (Cantor). Above olive-green, girt with black sagittal striæ; abdomen glaucous, marbled with black. The Hindustanee name is Sunkr Choar.

It is a native of Bengal.

Dr. Cantor thus describes the habits, the effect of the poison, and the history of this serpent :—

"The *Hamadryas*, like the *Bungarus*, *Hydrus*, and *Hydrophis*, has a few maxillary teeth behind the poison-fangs, and thus, like the latter, connects the venomous serpents with isolated poison-fangs to the harmless, which possess a complete row of maxillary teeth.

"Of the terrestrial venomous serpents, the *Bungarus* is chiefly characterised by a distribution of the teeth similar to that of the *Hamadryas*, which, also partaking of the chief characteristic of the genus *Naja*, namely, that of forming a hood or disc, constitutes an immediate link between the genera *Bungarus* and *Naja*.

"In consequence of the strong resemblance in the general appearance between the *Naja* and the *Hamadryas*, when first my attention became attracted to the latter, I thought I could refer this serpent to that genus; and it was not until I was able to examine a specimen whose poison-fangs were untouched (those of the first specimens I saw having been drawn by the natives, who are greatly afraid of this serpent), that I discovered the maxillary teeth behind the poison-fangs.

"*H. ophiophagus* differs from the *Naja tripudians* :—1, By its maxillary teeth; 2, by the strongly-developed spines on the os occipitale inferius; 3, by the integuments covering the head; 4, by the integuments covering the abdominal surface of the tail; 5, by its colour; 6, by its size. According to the natives, the *Hamadryas* feeds chiefly upon other serpents: in one I dissected I found remains of a good-sized monitor, which fact may account for its arboreal habits, as I have in Bengal, along the banks of the rivers, observed numbers of those large lizards among the branches of trees watching for birds.

"The power of abstaining from food, generally speaking, so characteristic of the Serpents, is but in a comparatively small degree possessed by this species; the most protracted starvation amounts to a period of about one month; while the *Vipera elegans*, the *Naja tripudians*, and the *Bungarus annularis*, have, without inconvenience, been confined in cages without any food for more than ten months. Two specimens of the *Hamadryas*, in my possession, were regularly fed by giving them a serpent, no matter whether venomous or not, every fortnight. As soon as this food is brought near the serpent begins to hiss loudly, and, expanding the hood, rises two or three feet; and retaining this attitude, as if to take a sure aim, watching the movements of the prey, darts upon it in the same manner as the *Naja tripudians* does. When the victim is killed by poison, and by degrees swallowed, the act is followed by a lethargic state, lasting for about twelve hours. Such of the other Indian venomous serpents, the habits of which I have had opportunity to study from life, show themselves much inclined to avoid other serpents, however ready they are to attack men or animals when provoked or driven by hunger; and I am not aware of any other of those serpents being recorded as preying upon its own kind. A short time ago however, during my sojourn at the Cape of Good Hope, I received from high authority the following fact, which throws a light upon the habits of the *Naja* of Southern Africa, one of which, when being captured, threw up the body of a *Vipera arietans* (*V. brachyurus*, Cuvier), which bore marks of having been submitted to the process of digestion.

"The *Hamadryas*, like the greater number of Indian serpents, evinces a great partiality to water. With the exception of the Tree-Serpents (*Leptophina*, Bell), they all not only drink, but also moisten the tongue, which, as this organ is not situated immediately in the cavity of the mouth, become in the serpents two different acts. Specimens of this serpent in my possession changed the skin every third or fourth month, a process which takes place in all the Indian serpents several times during the year. The *Hamadryas* is very fierce, and is always ready not only to attack but to pursue when opposed; while the *Cophias*, the *Vipera*, the *Naja*, and the *Bungarus* merely defend themselves, which done, they always retreat, provided no further provocation is offered. The natives of India assert that individuals are found upwards of 12 feet in length—a statement probably not exaggerated, as I have myself seen specimens from 8 to 10 feet in length, and from 6 to 8 inches in circumference. I have often heard it asserted that 'Cobras' (which name is naturally enough given to every hooded serpent) have been met with of an enormous size, but I strongly doubt their belonging to the genus *Naja*. Among a considerable number which have come under my observation, I never saw any exceeding 5 to 6 feet in length, while the common size is about 4 feet. Some time before I discovered the *Hamadryas*, I was favoured by J. W. Grant, Esq., of the Hon. Company's Civil Service, with an interesting description of a gigantic hooded serpent he had observed in the upper provinces, and which, he remarked, was not a *Naja*. By inspection this gentleman denied the *Hamadryas* to be identical with the above-mentioned.

"The natives describe another hooded serpent, which is said to attain a much larger size than the *Hamadryas*, and which, to conclude from the vernacular name, 'Mony Choar,' is perhaps another nearly allied species.

"The fresh poison of the *Hamadryas* is a pellucid tasteless fluid, in consistence like a thin solution of gum arabic in water; it reddens slightly litmus paper, which is also the case with the fresh poison of the *Cophias viridis*, *Vipera elegans*, *Naja tripudians*, *Bungarus annularis*, and *Bungarus cæruleus*. When kept for some time it acts much stronger upon litmus; but after being kept it loses considerably, if not entirely, its deleterious effects.

"From a series of experiments upon living animals, the effects of this poison come nearest to those produced by that of the *Naja tripudians*, although it appears to act less quickly. The shortest period within which this poison proved fatal to a fowl was fourteen minutes, whilst a dog expired in two hours eighteen minutes after being bitten. It should however be observed that the experiments were made during the cold season of the year."

NAI'ADACEÆ, otherwise called *Naiadeæ*, *Naiads*, *Naiades*, and *Fluviales*, are Aquatic Plants forming a small natural order of Endogens, remarkable for the unusual simplicity of their organisation. As they live constantly below water they require no epidermis, and therefore the leaves consist of nothing more than the mesophlœum, or central stratum of parenchyma. Their sexes are usually separate, and sometimes on different plants. Their floral envelopes are either deficient or in the form of a membranous tunic or cup, or consist of scales, to the face of which anthers or carpels adhere. The latter are either solitary or in pairs or fours, 1-seeded, 1-celled, with the ovule generally pendulous from the central suture. Their fruit is usually indehiscent and nut-like, but sometimes it is 2-valved or irregularly ruptured. The embryo has no albumen, and consists of a very large radicle, usually folded up, and containing a slender plumule lying in the cavity so formed.

These plants are inconspicuous objects, inhabiting both fresh and salt water in all parts of the world. In this country, the genera *Potamogeton*, a common inhabitant of rivers and ponds, elevating its little brown spikes of flowers above water during the time of fertilisation; *Zannichellia*, a thread-shaped plant, with minute axillary flowers, constantly submersed; and *Zostera*, or Sea-Wrack, with long narrow riband-like leaves, inhabiting æstuaries of the sea, are the most common.

This order, from which *Zosteraceæ* is now separated, contains 9 genera and 16 species. Its relations are with *Hydrocharidaceæ*, *Juncaginaceæ*, and *Algæ*. [ZOSTERACEÆ; POTAMOGETON; ZANNICHELLIA; CAULINIA.]

Zostera marina.

1, a spathe containing male and female flowers; 2, a female; 3, an anther; 4, an embryo.

NAI'ADÆ, NAI'ADES, or NAYADES, and UNIONIDÆ, a family of fresh-water Conchiferous *Mollusca*, comprising the genera *Unio*, *Hyria*, *Anodonta*, or *Anodon*, *Iridina*, *Monocondylæa*, *Mycetopus*, *Ætheria*, and *Mülleria*.—The Fresh-Water Muscles, as the members of this family are popularly called, are very closely allied to the Marine Muscles, and differ chiefly in the structure of the foot of the animal, which, in the tribe before us, is greatly developed in dimensions, and is not provided with a byssal groove. Mr. Anthony, an American conchologist, however asserts that under peculiar circumstances certain North American species do spin a byssus both in the young and adult states. As in several of the genera of *Mytilidæ* the mantle has its margins, which cannot be reflexed, freely open almost throughout, and the siphons are only indicated by a difference in the structure of the posterior borders, the shells vary greatly in form and aspect. Those of our few native species are more or less oblong and depressed; but so great is the variation among foreign species, that an American naturalist observes, there seems to be a representation of the forms of all the genera of marine bivalves in this tribe. All the *Unionidæ* are equivalve. They are covered with an epidermis which is often remarkable for brilliancy of colour, a feature also of the pearly surfaces of the insides of their valves.

The variation of the hinge is very great in this tribe, and its value, as a source of character, has been a subject of much discussion among conchologists. Some, as Mr. G. Sowerby, have gone so far as to propose the union of all the genera in one, whilst others, as Mr. Swainson, have maintained the other extreme, and not only divided the tribe into numerous genera, but have even grouped them into subfamilies. The tribe, as a group, is a very natural one; the genera are, we fear, too nearly inclined to artificial sections, and of the extreme opinions that of Mr. Sowerby approaches nearest the truth. There are however in the family a few types of character, round which a number of species seem to group themselves naturally: the sections *Unio* and *Anadon*, to which, with most authors, we refer our British species, are of this nature, and may conveniently be retained. The value of the generic divisions at best however in this tribe is not equal to that assumed by such sections in most of the other tribes we have passed in review.

The *Unionidæ* all inhabit fresh-waters; but few comparatively are found in the Old World, by far the greater number being inhabitants of America. In the United States alone there are more than two hundred species. The collections made by Major Cautley and Dr. Falconer among the Siwalik fossils would seem to indicate that during tertiary epochs the species of the Old World were more numerous than they now are. The tribe ranges far back in time. All the species are very variable, and it is extremely difficult to assign their precise diagnosis.

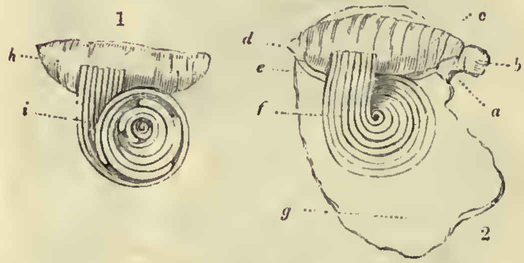
The bisexuality of the animals of this family was first, we believe, observed by Professor Bell in Europe and by Dr. Kirtland in America. The shells of the females are more ventricose than those of the males.

The distribution of the British Fresh-Water Muscles is peculiar and significant of the four species we possess. Three are members of the genus *Unio* and one of *Anodon*. The last is generally distributed through England, Scotland, and Ireland: one of the *Uniones*, that representing the section *Margaritana*, or *Alasmodon*, is partially distributed in the three countries, confining itself to the mountainous portions and the rapid streams which flow from them. The remaining two are confined to England, and abundant mainly in the south and east. On the continent the *Alasmodon* abounds in the Scandinavian rivers beyond the range of its fellows, which however have an almost universal distribution through central and southern Europe. The former species does not range south of the Alps. Taking the features of this distribution into consideration, it seems as if the *Unio margaritifera* had migrated southward from some ancient northern centre, whilst the other *Uniones* and the *Anodonta* advanced westward and northward, with unequal pace however, since only the last invaded Ireland. The fossil contents of the fresh-water tertiaries contemporaneous with or immediately preceding the period of the drift, when the greater part of the British Isles was under sea, corroborate this view, for in them we find associated together the *Unio tumidus* and *U. Pictorum* and the *Anodonta cygnea*. (Forbes and Hanley, 'History of British Mollusca.')

The North American rivers abound with this family; and Dr. Lea of Philadelphia has contributed most largely to our knowledge of the habits of these animals, and has made great additions to the species.

Dr. Lea, in his 'Preliminary Remarks,' notices Lamarck's statement that the animal of *Anodon*, which is essentially the same with that of *Unio*, is hermaphrodite, and seems viviparous; for the eggs pass into the oviduct placed along the superior branchiæ, where the young are found with their shells complete. He then tells us that he dissected a specimen of *Anodonta undulata* nearly three inches long, and found the oviducts charged with about 600,000 (as nearly as he could calculate) young shells perfectly formed, both valves being distinctly visible with the microscope. In his second volume, bearing the title of 'Observations on the Genus Unio,' &c., the same author informs us that, believing that the oviducts would present the means of discrimination in some species, he having found them to be so very different in *Unio irroratus*, his attention had been particularly addressed to these organs in the few and small species of his vicinity. Whilst engaged in this investigation, Dr. Kirtland of Poland, Ohio, informed Dr. Lea of his ability to distinguish the female and male shells of the same species, without having recourse to the included animal; and shortly afterwards Dr. Kirtland's paper on the subject appeared in the 'American Journal of Science and Arts,' vol. xxvi. Dr. Lea's attention now became more addressed to sexual characters, and he states that a very short series of examination satisfied him fully as to the establishment of the difference of sexes. The female, sustaining her very large burthen, naturally requires, he observes, more space within the valves; hence an enlargement of the posterior portion of the shell is generally found, differing in its form in various species.

The following figures, representing the oviducts of the species whose names are printed under the cuts are given by Dr. Lea.



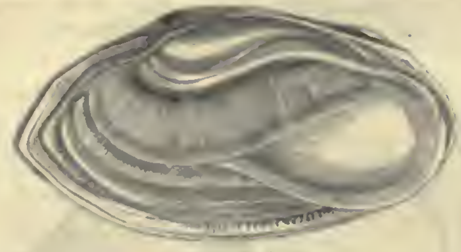
Unio irroratus.

1, soft parts, showing interior of oviduct; 2, showing exterior of oviduct, the mantle being removed; *a*, mouth; *b*, great anterior muscle; *c*, right superior branchia; *d*, great posterior muscle; *e*, inferior right branchia; *f*, right oviduct; *g*, foot; *h*, superior left branchia; *i*, interior view of oviduct; 3, 4, shell.

Unio ochraceus.

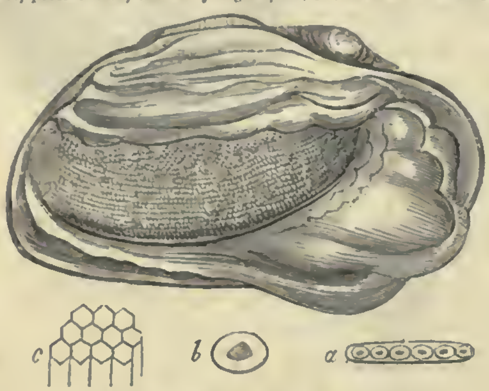
Unio cariosus.

Dr. Lea remarks that the mass of the lobes in *Anodonta undulata* differs from that of *A. fluviatilis*, in presenting a darker appearance and a very curious arrangement of the oviducts. The ova are placed in a kind of sac lying across the lobe, and presenting one end to the stomach and the other to the mantle of the animal. They lie so close together as to take the form on the exterior, like the cells of a honeycomb. This, Dr. Lea says, is of course produced by pressure. Some of these sacs, when carefully removed, were found to contain as many as twelve ova, each with a perfect living shell in it, having a brownish epidermis



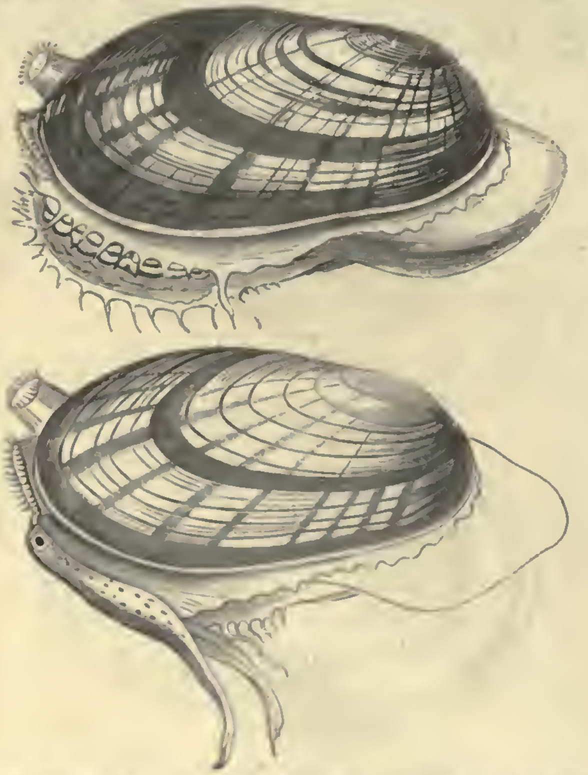
Anodonta fluviatilis.

In plate xx. (Mr. Garner's paper on the 'Lamellibranchiate Conchifera') will be found a figure of the animal from the ovarium of an *Anodonta*, as seen in the field of the microscope (⅛-inch focus); and in plate xviii. the disposition of the heart, pericardium, excretory organs, &c. of *Anodonta anatina* is shown.



Anodonta undulata, apparently ready to spawn.

a in the cut represents a sac with its ova; *b* represents the ovum with its perfect young shell included; *c* represents the honeycomb appearance, and is eight times magnified.



Two females of *Unio radiatus* as they were seen with the parts protruded as they lay at the bottom of a basin of water. Dr. Lea states that these females put on two quite different forms as regards the inferior portion of the mantle, as exhibited above.

Dr. Lea (vol. i.) states that it seems to be a matter of doubt on what these animals subsist. He says that he has strong reasons for believing that they feed on animalcules which are ever found to exist in water, and which they might separate from the constant stream which they pass from the posterior part of the shell, and which must be taken in at another part. This operation he witnessed frequently in a vessel in which he kept the *Naiadæ* for some months. If the water was not changed for twenty-four hours he uniformly found the animals quiet, but within a few minutes after it was changed they as uniformly commenced the passage of this constant stream. He adds that he cannot suppose this operation to be for the sole purpose of breathing, as there is no intermission in the stream of water, and the quantity thrown out is too great for this purpose only. He believes it to be the result of the action of the separation of the animalcules from the water.

In the Museum of the Royal College of Surgeons in London several preparations of the internal organs of the fresh-water muscle, *Anodon cygneus*, will be found.

The brilliant and variously-coloured nacre with which many of the species are lined and the extreme thickness of some of the shells are very remarkable. That pearls should be found in them will not surprise those whose attention has been drawn to their internal surface. Pennant remarks that *Mya margaritifera* of Linnæus (*Unio elongatus*) is noted for producing quantities of pearls, and formerly there were regular fisheries in many of our rivers to obtain them. As many as sixteen have been taken from one shell. The Esk and the Conway were famous in this way. The latter river in the days of Camden was noted for them. Sir Richard Wynn of Gwydir, chamberlain to Catherine, queen to Charles II., is said to have presented her majesty with a Conway pearl which is to this day honoured with a place in the regal crown. Pennant, who states this, adds, that the shells are called by the Welsh Crigen Diluw, or Deluge Shells, as if left there by the Deluge. The river Irt in Cumberland also produced them; and Sir John Hawkins, the circumnavigator, had a patent for fishing that river. Britain indeed had early acquired a reputation for its pearls; for, according to Suetonius, they were Cæsar's inducement for undertaking his British expedition. ('Jul. Cæsar,' c. 47.) This however does not seem very probable. Pliny (ix. 35) indeed speaks of the pearls of our island as small and ill-coloured, and refers to the breast-plate which Cæsar himself had brought home and dedicated to Venus Genetrix in her temple, adding that he wished it to be understood that the offering was formed of British pearls.

Ireland has produced pearls of considerable size and some value, especially in the rivers of Tyrone and Donegal. One weighed 36 carats, and was valued at 40*l*., but it was foul, and so lost much of its worth. Other single pearls were sold for 4*l*. 10*s*., and for as much as 10*l*. The last was sold a second time to Lady Glenlealy, who put it into a necklace, and refused 80*l*. for it from the Duchess of Ormond. Pennant, who quotes from the abridgment of the 'Phil. Trans.,' speaks of the last century as the time when these large Irish pearls were procured. We have seen some lately of considerable size, fair shape, and pretty good colour.

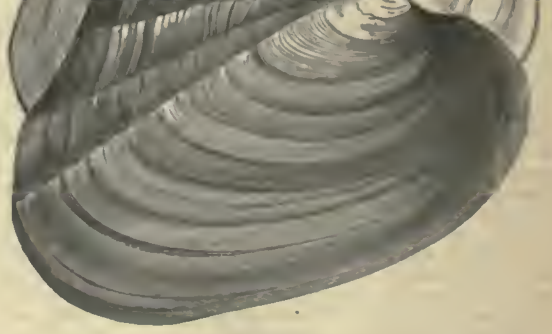
Dr. Lea, in his final arrangement, admits only two genera, *Margarita* and *Platiris*. The first of these has been preoccupied by Leach to designate a genus of Marine Conchifers. [MARGARITA.] We shall however retain the name in this article, in order to present to the reader the leading features of Dr. Lea's arrangement and the forms of the shells.

Margarita. (Lea).

I. Sub-Genus. *Unio.*—Having a Cardinal and Lateral Tooth.

* Symphynote.

Ex. *Unio alatus.*

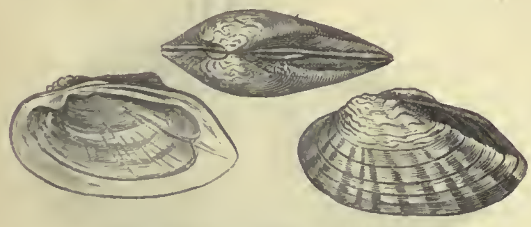


Unio alatus.

a, part of the wing of the valve broken off, showing the symphynote character reduced.

** Non-Symphynote.

Ex. *Unio Pictorum,* common in our English rivers. [CONCHIFERA.]



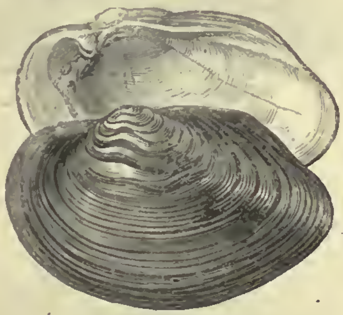
Unio Pictorum. From a young specimen.

In Mr. Garner's 'Memoir on the Anatomy of the Lamellibranchiate Conchifera' (pl. xx.) the ova of *Unio Pictorum* from the ovaries and branchiæ are represented (18th of an inch focus); also the valve of a young *Unio,* showing that its nucleus is of the same shape as the valves of the animals found in the branchiæ.

2. Sub-Genus. *Margaritana.*—Having One Tooth (Cardinal).

*** Non-Symphynote.

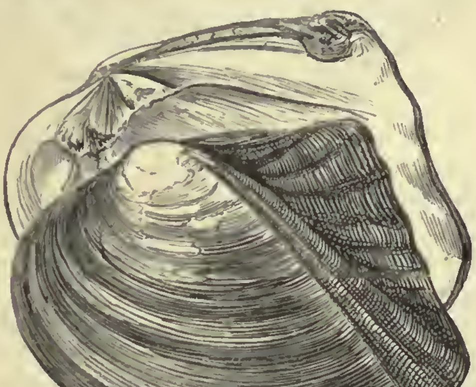
Ex. *Alasmodonta undulata.* (Say).



Alasmodonta undulata.

Symphynote.

Ex. *Alasmodonta complanata.* (Barnes.)



Alasmodonta complanata.

3. Sub-Genus. *Dipsas.*—Having a Linear Tooth under the dorsal margin.

Symphynote only.

Ex. *Dipsas plicatus.* (Leach.)

4. Sub-Genus. *Anodonta.*—Having no Teeth.

* Symphynoto.

Ex. *Symphynota magnifica.* (Lea.)

** Non-Symphynote.

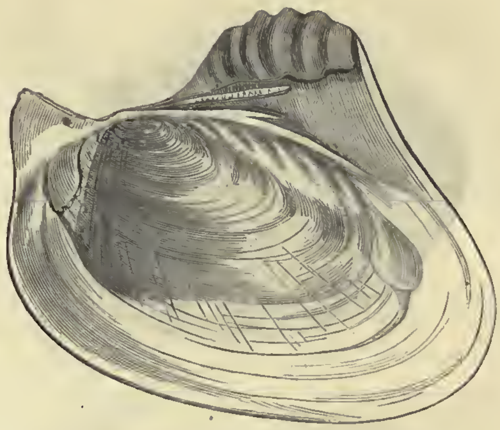
Ex. *Anodonta fluviatilis* (*Mytilus fluviatilis* of Solander, Dillwyn, &c.; *Anodonta catarracta* of Say).

Platiris. (Lea.)

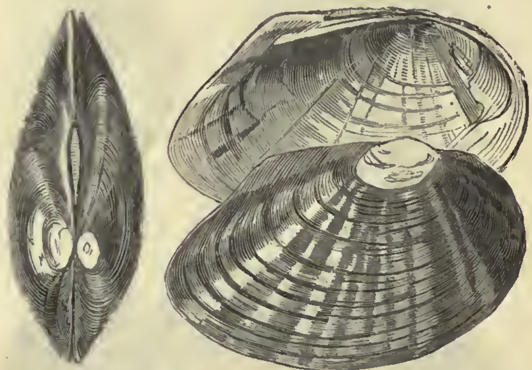
1. Sub-Genus. *Iridina.*—Having a Crenulate Dorsal Margin.

Non Symphynote.

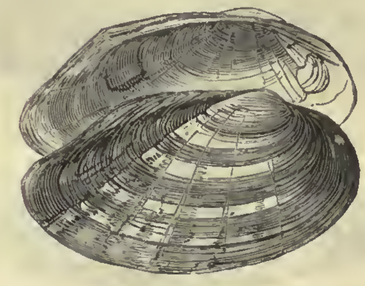
x. *Iridina exotica.* [CONCHACEA.]



Dipsas plicatus.



Symphynota magnifica.

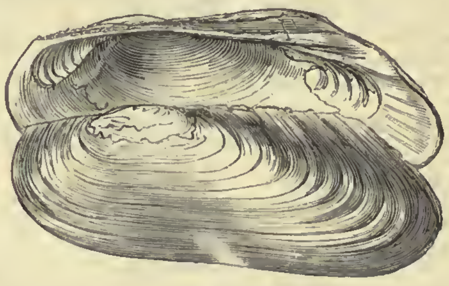


Anodonta fluviatilis.

2. Sub-Genus. *Spatha.*—Having the Dorsal Margin Non-Crenulate.

Non-Symphynote.

Ex. *Iridina Nilotica.* (Sowerby.)



Iridina Nilotica.

Plicate Shells.

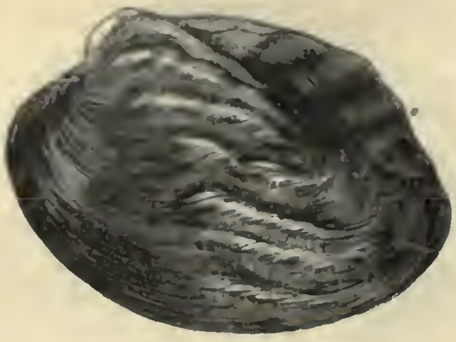
Ex. *Unio plicatus.* (Lesueur.)

Nodulous Shells.

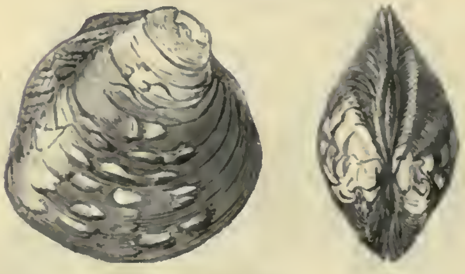
Ex. *Unio pustulosus.* (Lea.)

Smooth Shells.

Ex. *Unio complanatus* (*Unio purpureus,* Say).



Unio plicatus.



Unio pustulosus.

Unio purpureus.

Spinous Shells.

Example, *Unio spinosus* (Lea). Bartram appears to have been the first who discovered this species. He, apparently, found it in the Mississippi. See his 'Travels,' p. 431.

Dr. Lea, in his 'Tables,' enumerates 323 recent species as admitted, and 29 as unknown to him or doubtful.

Of the sub-genus *Unio* 235 recent, and 20 which he has not been able to admit as certain. (Europe, Asia, Africa, North America, South America, Australia. By far most abundant in North America.)

Margaritana, 20 admitted, 2 unknown. (Europe, North America, South America, and perhaps Africa.)

Dipsas, 2 recent. (Asia.)

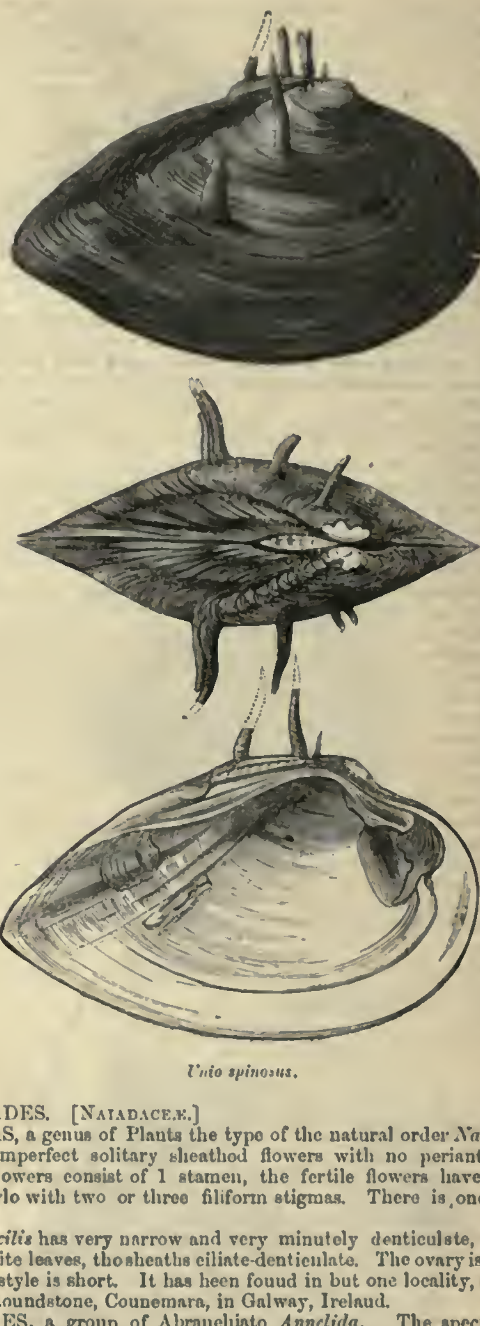
Anodonta, 58 admitted ; 7 unknown to Lea. (Europe, Asia, Africa, North America, South America, Australia.)

Iridina, 2 recent. (Africa.)

Spatha, 6 recent. (Africa, South America.)

M. Deshayes (last edition of Lamarck), after reviewing the state of the question, comes to the conclusion that all the various genera cannot form and ought not to form more than one genus, constituting singly the family of the *Naiadæ*.

Fossil Unionidæ.—The recent species of *Unio* are very numerous, amounting to 250. These are found in North and South America, Europe, Africa, Asia, and Australia. The fossil species are about 50. They are found in the Wealden and in the Tertiaries of India. The species of other genera have not yet been recognised in a fossil form.



Unio spinosus.

NAIADES. [NAIADACEÆ.]

NAIAS, a genus of Plants the type of the natural order *Naiadaceæ*. It has imperfect solitary sheathed flowers with no perianth. The barren flowers consist of 1 stamen, the fertile flowers have a single short style with two or three filiform stigmas. There is one British species.

N. flexilis has very narrow and very minutely denticulate, ternate, or opposite leaves, the sheaths ciliate-denticulate. The ovary is solitary and the style is short. It has been found in but one locality, and that is near Roundstone, Connemara, in Galway, Ireland.

NAIDES, a group of Abranchiate *Annelida*. The species have the elongated body and rings less marked than in the Earthworms. They live in holes which they bore in mud at the bottom of water, and from which they are constantly protruding their bodies. Some have black points on their heads which have been regarded as eyes. To this family belong a large number of little-studied forms of very minute fresh-water worms. The smaller ones are sometimes called Vibrios, of which the very common *Vibrio fluviatilis* of the amateur microscopist is an example. It also appears to embrace the *Stylaria* of Lamarck, the *Proto* of Oken, and the *Clymene* of Savigny. This family would repay attentive study.

NAILS, the appendages to the fingers and toes in human beings and the *Quadrumana*, and which are homologous with the claws and hoofs of the lower animals. These organs are simply an altered form of the external layer or epidermis of the skin. [SKIN.] If a portion of recently formed nail is placed under the microscope it is found to consist almost entirely of nucleated cells, which are of precisely the same character as those found in the new layers of epidermal tissue. In the older portions of the nail no very distinct structure can be seen, but if these parts are immersed in a dilute solution of caustic potash or soda, the cells will be made apparent. In the human being the nails are produced from a fold in the true skin. This fold or groove has a highly vascular surface, which is furnished with longitudinal elevated ridges, to which blood-vessels are copiously distributed, and between which the soft inner layer of the nail dips down. The nail grows by additions to its base, but as it moves upwards it receives additional matter from the portions of the skin on which it rests. M. Beau states that the rate of growth of nails is 2·5ths of a line per week, and that the growth of the nails of the toes is only 1-10th of a line per week. M. Beau states that during disease growth is not so active in the nail, and that it becomes thinner also from the absence of healthy nutrition. In this way he states that the condition of the nails may be made subservient to the diagnosis of disease. When the nail is injured, provided the skin beneath has not been destroyed, it is speedily reproduced. The nail is in every part continuous with the true epidermis, except on its projecting edge, which in the fœtus is also continuous with the epidermis. (Carpenter, *Principles of Human Physiology.*)

NAKED SEEDS. This name was applied by Linnæus to a small form of fruit which does not directly bear a style at the apex, and which has the appearance of a seed, as in the *Lamiaceæ*, to which the Sage, the Dead-Nettle, the Borage, &c., belong; such fruits are now called Spermidia by many writers. Naked seeds, strictly so named, are seeds which are fertilised by immediate contact with pollen, and which have no pericarpial covering; they are at present known only in the great class of Gymnogens, that is to say, in *Coniferæ*, *Cycadaceæ*, and *Loranthaceæ*. [SEED.]

NANDOU. [STRUTHIONIDÆ.]

NANI'NA (Gray), a genus of *Mollusca*, consisting of the phanorbicular species of *Helix*, with large umbilici, included in the sub-genus *Helicella* of De Férussac.

NANODES. [PSITTACIDÆ.]

NANOTRAGUS. [ANTILOPEÆ.]

NAPE-CRESTS, the English name for the species of Birds belonging to the genus *Chizœrhis*. [MUSOPHAGIDÆ.]

NAPHTHA is a compound of Carbon and Hydrogen, frequently found in the neighbourhood of coal-deposits, and in other parts of the earth. It contains 82·2 of carbon and 14·8 of hydrogen. It is a limpid or yellowish fluid, lighter than water, and hence called Mineral Oil. Its specific gravity is 0·7 to 0·84. It hardens and changes to the substance called Petroleum on exposure to air. It may be obtained from Petroleum by heat, which causes it to pass off in vapour.

Naphtha issues in large quantities from the earth in Persia and the Birman Empire. At Rangoon, on one of the branches of the river Irawaddy, there are upwards of 500 naphtha and petroleum wells, which afford annually 412,000 hogsheads. In the peninsula of Abcheran, on the western shore of the Caspian, naphtha rises through a marly soil in vapour, and is collected by sinking pits several yards in depth, into which the naphtha flows. There is an abundant spring near Amiana, in the Duchy of Parma. Mr. Dana says that in the United States it was formerly collected for sale by the Seneca and other Indians; the petroleum is therefore commonly called Genesee or Seneca Oil, under which name it is sold in the market.

Petroleum is used as lamp-oil in Birma, and when mixed with earth or ashes as fuel. Naphtha is used both for fuel and light by the inhabitants of Bakou, on the Caspian. The vapour is made to pass through earthen tubes, and is inflamed as it passes out, and used in cooking. The spring at Amiana is used for illuminating the city of Genoa.

Naphtha has been recently used as a medicine, and is found to be a good stimulant in some chronic diseases. It has been externally applied as a lotion in cutaneous affections. It is sometimes substituted for drying oil in making paint. It is also employed for preserving the metals of the alkalies potassium and sodium, which cannot be kept in contact with any substance containing oxygen.

The Rangoon petroleum contains the compound Paraffine. This substance has also been obtained pure in a liquid form from the coal-pits of Derbyshire. It is used for the purpose of diminishing the friction of machinery as a substitute for sperm-oil. It is now obtained artificially from coal, and also in a solid form, from which candles are made. [PARAFFINE, in ARTS AND SC. DIV.]

(Dana, *Manual of Mineralogy;* Gregory, *Handbook of Organic Chemistry.*)

NAPOLEANA. [BELVISIACEÆ.]

NAPU. [MOSCHIDÆ.]

NAPUS. [BRASSICA.]

NARCISSALES. [ENDOGENS.]

NARCISSUS, a genus of Plants belonging to the class Endogens and the natural order *Amaryllidaceæ*, among which it is known by its flowers growing upon a scape, and having a cup at their mouth; the stamens, which are opposite the sepals being longer than the others. It consists of bulbous plants principally inhabiting the warmer parts of Europe.

The following is the arrangement of the European species of this genus given in Mr. Wood's 'Tourist's Flora:'—

A. Leaves flat, linear, obtuse; tube of corolla short, obversely conical; crown campanulate, dentate.

N. Pseudonarcissus, the Daffodil. Scape 2-edged, striate; flowers nearly sessile in sheath; crown erect, nearly as long as segments of corolla; stamens equal. It is found in woods and meadows throughout Europe.

N. minor, a native of Europe.

N. incomparabilis has the scape 2-edged. It is found in France and Italy and the coasts of the Mediterranean, and is naturalised in Great Britain.

B. Leaves nearly flat; flowers hypocrateriform.

I. Scape nearly terete.

N. calathinus. Scape 2-4-flowered. A native of the Isles of Glenans and of Brittany.

N. dubius. Scape 2-6-flowered. Mediterranean and France.

N. chrysanthus. Scape 3-10-flowered. Found near Grasse, in France.

II. Scape 2-edged.

a. Crown yellow.

N. poeticus. Scape 1-flowered; petals white. It is found on open heathy fields in Norfolk and Kent, in Great Britain; it is also found in Austria and various parts of Italy.

N. radiiflorus. Scape 1-flowered; striate. It is found in Austria, Styria, and the Vallais.

N. biflorus, with linear-obtuse keeled leaves; scape compressed, 2-edged, striated, 2-flowered, crowned, very short, concave, crenate at the pale margin; the petals of a pale sulphur colour. It is found in sandy fields in the south of England, and in Ireland; also in France and Italy.

N. patulus, *N. præcox*, and *N. Tazetta*, are other European species belonging to this section.

b. Crown and petals white.

N. polyanthus. Scape slightly 2-edged, 8-20-flowered. It is found near Toulon and Nice, in stony places.

N. niveus. Scape 6-10-flowered. It is a native of France.

N. unicolor. Scape 10-15-flowered. It is found at the base of Vesuvius.

C. Leaves convoluto-setaceous.

N. serotinus. Scape 1-flowered. It is found near Palermo, on open hills.

N. cupanianus has the scape 1-7-flowered, and is found on the coasts of Corsica, Sardinia, Calabria, and Sicily.

D. Leaves semi-cylindrical and channeled.

N. lœtus has the scape 1-3-flowered. Found near Grasse, in France.

N. ochroleucus. Scape 4-8-flowered. Found in fields near Toulon.

N. odorus. Scape 1-5-flowered. It is found in the fields and olive-grounds of Lucca.

N. Jonquilla, the Jonquil. Scape 2-6-flowered. It is found in Italy. *N. intermedius* is probably a variety of this species.

N. Bulbocodium. Scape 1-flowered. A native of heaths in France.

The species, from their hardiness or gay colours, or sweet smell, have long been favourite objects of cultivation, especially the Daffodils, Jonquils, and Tazettas. A very full account of them will be found in the 'Amaryllidaceæ' of the Honourable and Reverend William Herbert, p. 292 (8vo., London, 1837), who however divides the genus into six others, after the example of Salisbury and Haworth; but as those genera are not likely to be adopted by botanists, with the exception perhaps of the genus *Corbularia*, no account need be given of them. With regard to *Corbularia*, to which the name of Hoop-Petticoat Narcissus is given, and of which five supposed species are enumerated, the peculiar form of the flower and the delicate stamens of that plant may perhaps entitle it to be regarded as a peculiar genus; the species are pretty, all yellow flowered, with the single exception of *C. cantabrica*, a little plant with white flowers found on the mountains of Biscay and the Pyrenees, but now lost in our gardens.

NARDO'STACHYS, a genus of Plants belonging to the natural order *Valerianaceæ*. The limb of the calyx is 5-parted; the lobes ovate, oblong, acute, leafy, somewhat toothed and permanent; the corolla is regular, ecalcarate, obtusely 5-lobed and bearded in the throat; there are 4 stamens, which are attached to the bottom of the corolla. The species are herbs with sweet-scented perennial roots, which are beset with erect fibres at the neck.

N. Jatamansi is a dwarf herbaceous plant with a long hairy tap-root. The stems are perennial, very short, and simply divided into a number of shaggy scaly crowns, from which the leaves are produced; the branches erect, downy, and a few inches high; leaves obovate, lanceolate, 5-ribbed, downy, those at the base acute, the upper ones obtuse; the flowers are of a pale pink colour, clustered in the axils of the upper leaves, which form a kind of involucre for them. It is a native of Nepaul, on the Himalaya Mountains, and in Delhi, Bengal, and the Deccan. This species is the true Spikenard of the ancients, and is esteemed not only as a perfume but as a stimulant medicine. Oriental writers give it as a remedy for a multitude of diseases, and it seems to be really valuable in cases of epilepsy and hysteria.

N. grandiflora has a glabrous stem, oblong glabrous leaves, with solitary terminal flowers; the capsule is downy, and the lobes of the calyx evidently denticulated. It is a native of Nepaul and Kumaon.

(Lindley, *Flora Medica.*)

NARDUS, a genus of Grasses belonging to the tribe *Rotbelliæ*. It has the spikelets in two rows on one side of the rachis of one flower; glumes absent; outer pale keeled, tapering into a subulate point; stigmas elongate, filiform, protruded at the apex of the flower.

N. stricta, the Mat-Grass, is a British species. It has the stem and leaves erect, slender, rigid; it is 5 to 8 inches in height; the spike is close; the outer pale has a short rough coriaceous often purplish awn, the inner pale is membranous. It is a native of moors and heaths.

(Babington, *Manual of British Botany.*)

NARDUS is also a name given to the plant supposed to yield Spikenard. [SPIKENARD.]

NARTHE'CIUM, a genus of Plants belonging to the natural order *Juncaceæ*. The perianth is partly coloured, of 6 linear-lanceolate persistent leaves. The filaments are woolly, and the style undivided. It has a simple obtuse stigma. The capsules pyramidal, 3-celled and 3-valved. The placenta extends only a short distance up the inner edge of the dissepiment. The seeds have a long filiform appendage at each end.

N. ossifragum, the only British species, has linear sword-shaped leaves, pedicels with one bract at the base, and another above their middle. The perianth longer than the stamens, and considerably shorter than the capsules. The flowers are bright-yellow. This species is distinguished especially by its seeds. It is found in turfy bogs.

(Babington, *Manual of British Botany.*)

NARWHAL. [CETACEA.]

NASA'LIS (Geoffroy), a remarkable genus of Monkeys established on the 'Guenon à long Nez' of Buffon, the Proboscis-Monkey of Shaw, *Simia Nasica* of Schreber, *Nasalis larvatus* of Geoffroy, the Kahau.

The enormous development of the nose in the Kahau is not dependent on bone. The nasal bones are no more elevated than they are in the rest of the *Simiadæ*, as will be perceived from the following cut of the skull of a Proboscis-Monkey in the Museum of the Zoological Society of London.

Skull of Kahau (*Simia nasalis*).

The figure given below was reduced from the drawing of a female, when newly taken from the cask of spirit in which the body was preserved: the specimen came from Borneo, and is now to be seen, but with the nose deteriorated by drying, in the Museum of that Society. It is said that the animal has the power of dilating this organ to an enormous size by inflation.

Face of Kahau (female).

Audebert gives the following view of the nose, as seen from beneath.

Nose of Kahau, seen from beneath.

The following account of this Monkey is given by Mr. Martin.

"The genus *Nasalis*, of which the 'Guenon à long Nez' of Buffon ('Suppl.,' vii.) or Proboscis-Monkey of Shaw, is the type, was founded by Geoffroy St. Hilaire in his 'Tableau des Quadrumanes,' published in the 'Annales du Muséum d'Histoire Naturelle' for 1812. In this outline of the *Simiadæ* the genera *Semnopithecus* and *Cercopithecus* are blended together under the latter title; but from this group are excluded two Monkeys, the Doue, constituting the type of the genus *Pygathrix* (*Lasiopyga* Ill.) and the 'Guenon à long Nez.' With respect to the genus *Pygathrix* or *Lasiopyga*, founded upon the alleged want of callosities, most naturalists, I believe (aware of the error committed both by Geoffroy and Illiger, in describing from an imperfect skin), have regarded it as merging into the genus *Semnopithecus*, at least provisionally, until the internal anatomy of its assumed representative be known.

"The characters of the genus *Nasalis*, formed for the reception of the 'Guenon à long Nez' (*Simia Nasica*, Schreb.; *Cercopithecus larvatus*, Wurmb), are laid down as follows:—

"'Muzzle short, forehead projecting, but little elevated; facial angle 50°; nose prominent, and extremely elongated; ears small and round. Body stout. Cheek-Pouches. Anterior hands, with four long fingers and a short thumb, ending where the index-finger begins; posterior hands very large, with fingers stout, especially the thumb. Callosities large. Tail longer than the body.'

"At a subsequent period however, in his 'Cours de l'Histoire Naturelle,' published in 1828, Geoffroy, adopting the genus *Semnopithecus*, established by F. Cuvier, places the 'Guenon à long Nez' within its limits, doubtfully, it is true, and with the acknowledgment that his genus *Nasalis* has not been generally adopted, but at the same time with a bias in its favour; for, observing that the manners of these Monkeys are those of the *Semnopitheci*, he adds, 'Cependant, il ne nous parait encore démontré que le singe nasique soit une véritable semnopitheque, et il est fort possible que lorsque l'espèce sera moins imparfaitement connue, on soit obligé de rétablir le genre *Nasalis*, dans lequel on l'isolait autrefois, mais qui n'est pas été admis par la plupart des auteurs modernes.'

"Setting aside the singular conformation of the nose, so remarkable in the *Simia nasalis*, its external characters are not different from those of the *Semnopitheci* in general; and it is to be observed that in a second species, lately added by Mr. Vigors and Dr. Horsfield, under the title of *Nasalis recurvus*, the proportions of this part of the face are much diminished, and its form also modified. This species (which though doubted by some as being distinct, is, we believe, truly so) takes an intermediate station between the *Simia nasalis* and the ordinary *Semnopitheci* with flat noses, thereby showing that the transition in this particular character is not abrupt; even were it so, an isolated point of this nature does not form a philosophical basis upon which to ground a generic distinction.

"So far I have alluded to external characters only; it remains for me to give some account of the anatomical characters of this singular Monkey, of which, as far as I can learn, modern naturalists do not appear to be aware.

"It would seem that M. Otto, who described the sacculated form of the stomach in one of the Monkeys of the genus *Semnopithecus*, is not the first observer of this peculiarity, for I find that Wurmb, in the 'Memoirs of the Society of Batavia,' notices this point in the anatomy of an individual of the *Simia nasalis*. After giving some interesting details respecting the habits and manners of the species, he proceeds as follows:—'The brain resembles that of man; the lungs are of a snow-white colour; the heart is covered with fat, and this is the only part in which fat is found. The stomach is extraordinarily large, and of an irregular form; and there is beneath the skin a sac which extends from the lower jaw to the clavicles.' Audebert (with whose work, 'Histoire des Singes,' Geoffroy St. Hilaire was well acquainted) refers to this account of Wurmb; yet Geoffroy does not, as far as I can find, advert to these points, unless indeed his statement of the presence of cheek-pouches be founded on the observation of a sac extending from the lower jaw to the clavicles; and if so, he has made a singular mistake, for the sac in question is laryngeal, and the words as they stand cannot be supposed to mean anything else. I know of no Monkey whose cheek-pouches extend beneath the skin to the clavicles; but the laryngeal sacs in the Orang and Gibbons, and also in the *Semnopitheci* themselves, are remarkable for development. It is evident however, from the silence of M. Geoffroy St. Hilaire respecting the laryngeal sacculus in the Proboscis-Monkey, that he was not aware of the real character of the structure to which Wurmb had alluded. With respect to the structure of the stomach, neither Wurmb nor M. Otto drew any general inferences from it; they described it as it presented itself in single species, and regarded it in an isolated point of view; it is, if I mistake not, to Mr. Owen that we owe its reception as an anatomical character extant throughout the *Semnopitheci*. ('Transactions of the Zoological Society.')

"The statement of Wurmb respecting the stomach and laryngeal apparatus of the Proboscis-Monkey I have lately been enabled to confirm.

"In every essential point the stomach is the same as in all the *Semnopitheci* hitherto examined: it consists of a large cardiac pouch, with a strong muscular band running as it were around it so as to divide it into two compartments, an upper and lower, slightly corrugated into sacculi; the cardiac apex of the upper pouch projects as a distinct sacculus of an oval form, and is not bifid. From this upper pouch runs a long and gradually narrowing pyloric portion, corrugated into sacculi by means of three muscular bands, of which one is continued from the band dividing the cardiac pouch into two compartments. The elongated pyloric portion sweeps around the lower cardiac pouch.

"The lungs consisted of two lobes on each side, the fissure dividing the lobes on the right side being the most complete.

"The laryngeal sac was of enormous size, and single. It extended over the whole of the throat, and advanced below the clavicles, communicating by means of a single but large opening with the larynx. This opening is on the left side, between the larynx and the os hyoides, and is capable of being closed by means of a muscle arising from the anterior apex of the os hyoides, and running down the central aspect of the trachea to the sternum. The contraction of this muscle draws the os hyoides down, so as to press upon the edge of the thyroid cartilage.

"There were no cheek-pouches, nor any traces of them.

"The teeth were much worn, but the fifth tubercle of the last molar tooth of the lower jaw was very distinct." ('Zool. Proc.,' 1837.)

Simia nasalis, the Kahau, is of a reddish-brown colour, except the light-coloured tail, lower part of the back, and some light-coloured markings on the arms. Height about 3 feet, when nearly erect. Female rather less, and destitute of the light markings on the back, &c. Nose and face darkish-brown.

Kahau (*Simia nasalis*). Audebert.

This species is a native of Borneo. Their habits are gregarious, and they are said to collect in great troops upon the trees bordering the rivers at sunrise, darting from tree to tree with great activity, sometimes springing a distance of 15 feet. Their name, Kahau, is supposed to be given to them from their continued cries, which are considered to resemble that word in their expression. Their disposition is said to be bad. M. Lesson notices a statement that the species is also a native of Cochin China; but he gives no authority for this locality.

Mr. Vigors and Dr. Horsfield, in their paper 'On the Mammalia in the Zoological Museum,' after noticing the species above described, mention another form, of which two specimens, almost equally distinguished by the extension of the nose, but having that member turned up instead of being recumbent, brought also from Borneo, are in the same collection. This is the form alluded to above by Mr. Martin, and is thus characterised by Mr. Vigors and Dr. Horsfield, under the name of *Nasalis recurvus*. It is to be remarked that they were also preserved in spirit, and consequently were not subject to the same contraction of the soft parts of the nose as might have occurred in dried skins.

It has the head, neck, shoulders, and thighs rufous above; abdomen paler; middle of the back reddish-gray; inside of arms and thighs, lower part of the back, and tail, gray; tail below, white. Size about one-third less than the Kahau.

Mr. Vigors and Dr. Horsfield observe that the general colour and markings of this animal correspond with those of the Kahau. The skin of the face however, they remark, is reddish in *N. recurvus*, where in the other species it is black. In *N. recurvus*, they add, the beard is very prominent; but in the Kahau the hairs on the chin scarcely assume the appearance of a beard.

Mr. Vigors and Dr. Horsfield state that it has been suggested that this may be the young of the Kahau; but they state that they cannot allow themselves to come to the conclusion that they are the same, with so great a disproportion of the facial angles, in the absence of some stronger grounds than mere conjecture. Its teeth, they remark, showed no signs of being otherwise than adult.

Profile of *Nasalis recurvus*.

Mr. Swainson appears to agree with Mr. Vigors and Dr. Horsfield, and Mr. Martin, in considering *N. recurvus* distinct; for he gives the number of species of *Nasalis* as two. ('Natural History and Classification of Quadrupeds.')

NASSA. [ENTOMOSTOMATA.]

NASTU'RTIUM, an old word applied to some kind of pungent herb, such as Cress. By the English of the present day it is given to the *Tropæolum majus* [TROPÆOLUM], an American annual with pungent fruit; by botanists, to the Water-Cress and plants allied to it; by the Romans it was applied to a plant resembling Mustard in its qualities.

The species now referred to the genus *Nasturtium* were formerly included under *Sisymbrium*. *Nasturtium* was separated by Brown, and is principally distinguished by the position of the cotyledons, a point of primary importance in the whole order of *Brassicaceæ*. In *Sisymbrium* the cotyledons are folded with their back upon the radicle, whilst in *Nasturtium* their edges are presented to it; in the former the cotyledons are said to be incumbent, in the latter accumbent.

N. officinale (*Sisymbrium Nasturtium*), the Common Water-Cress. In addition to the characters of the genus, this plant is known principally by the form of its leaves. The leaf is composed of from 5 to 7 leaflets, which are arranged opposite each other on a common petiole with a terminal leaflet. The leaflets are somewhat heart-shaped and slightly waved and toothed; they are succulent, and their surface is smooth. The terminal leaflet is always largest. The upper leaves do not separate into distinct leaflets, being pinnatifid with narrow segments. The petiole of the leaf does not in any manner embrace the stem. The flowers are white, and the pods, when ripe, are about an inch long. It is a native of rivulets throughout the world, and is very plentiful in Great Britain. It has a warm agreeable flavour, and has long been one of the most popular plants as a salad. It was formerly much used in medicine as a diuretic and anti-scorbutic, but its great consumption now is as an article of diet. As it frequently grows amongst plants that are not wholesome, and that bear to it a general resemblance, it would be well for every one to be acquainted with its characters. The plant most frequently mistaken for it, especially when out of flower, is the fool's water-cress. [SIUM.] From this it may be always distinguished, and in fact from all other *Umbelliferæ*, by the petioles of the leaves not forming a sheath round the stem.

The Water-Cress is cultivated to a very great extent in the neighbourhood of London. The plants are placed out in rows in the bed of a clear stream in the direction of the current, and all that is required for their successful growth is replanting occasionally and keeping the plants clear of mud and weeds; sandy and gravelly bottoms are best. "Some market-gardeners who can command only a small stream of water, grow the water-cress in beds sunk about two feet in a retentive soil, with a very gentle slope from one end to the other. Then, according to the slope and length of the bed, dams are made six inches high across it, at intervals, so that when these dams are full, the water may rise not less than three inches on all the plants included in each. The water, being turned on, will circulate from dam to dam, and the plants, if not allowed to run to flower, will afford abundance of young tops in all but the winter months." (G. Don.) Water-Cresses grown in this way have not so fine a flavour as those from natural streams.

N. sylvestre is a less common species. It is found on river banks and in wet places. It is distinguished from the last by having yellow flowers, and by its petals being twice as long as the calyx.

N. palustre is also a native of wet places. It has a fibrous root and small flowers, with the petals only as long as the calyx. The two last are also natives of Great Britain.

Other European species are *N. lippizense*, *N. pyrenaicum*, *N. anceps*, *N. amphibium*, *N. fluviatile*, *N. armoracioides*, *N. terrestre*, and *N. austriacum*.

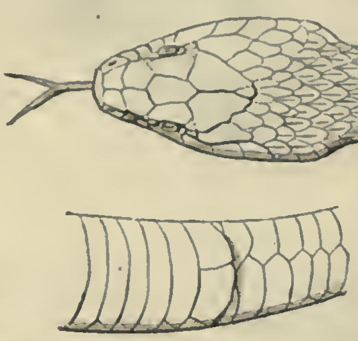
NASUA. [VIVERRIDÆ.]

NATATO'RES, Illiger's name for the Swimming-Birds—Swans Ducks, Geese, &c. [DUCKS.]

NATICA. [NERITIDÆ.]

NATRIX (Laurenti), a genus of *Colubridæ*, a family of Snakes destitute of poison-fangs, and of which the Common Snake, *N. torquata* of Ray, may be taken as an example.

The head is distinct, oblong-ovate, depressed, covered with scuta; gape wide, body very long, nearly cylindrical, slender, scales imbricated, placed in longitudinal series, lanceolate, generally carinated; abdominal shields simple, arched at the margin, caudal shields biserial. (Bell.)



Head and tail of *Natrix*. Head seen from above; tail from below.

N. torquata, Ray, Fleming, Jenyns, Bonaparte; *Coluber Natrix*, Linn., Shaw, Daudin, Turton; *Coluber torquatus*, Lacépède; *Natrix vulgaris*, Laurenti; *Tropidonotus Natrix*, Kuhl, Gray, Schlegel; Ringed Snake, Pennant; Couleuvre à Collier, Lacépède. It is the Ringelnatter of the Germans, and Tomt-Orm, Snok, and Ring-Orm of the 'Fauna Suecica.'

The Common or Ringed Snake is too well-known to require description: the female is larger than the male. Its food consists of lizards, young birds, birds' eggs, mice, and more particularly frogs. The latter are generally captured by one of the hind legs, and in that case the prey is swallowed alive, and with the lower limbs and parts foremost, the head still continuing in its proper position, and disappearing last. During the operation of deglutition the cries of the frog are very distressing, and we have delivered more than one from its enemy—unfairly perhaps, in consequence of being attracted by the cries of the sufferer. The frog evidently remains alive for some time after it has been swallowed, in the course of which the jaws of the snake are dilated, and, so to speak, dislocated in order to allow of the passage of the disproportioned body to be conveyed into the stomach. Mr. Bell, who gives in his 'British Reptiles' a very accurate and clear account of the manner in which this operation is performed and the dilatation effected, states that he has heard a frog distinctly utter its peculiar cry several minutes after it had been swallowed by the snake. The same zoologist observes that the frog is generally taken by one of the hinder extremities, because the latter is most frequently in the act of fleeing from its pursuer when taken; and in that case, the prey, according to his experience, is swallowed as we have above described; but he adds, that if the frog be taken by the middle of the body, the snake invariably turns it by several movements of the jaws, until the head is directed towards the throat of the snake, when it is swallowed head foremost. In taking lizards or birds, the snake, as far as Mr. Bell's observation goes, always swallows them head foremost. The same author gives a curious but painful description of an instance where two snakes had seized the same wretched frog, which, after a long and painful struggle, and some fighting between the snakes, was swallowed by the victor.

When the skin of the common snake has been just cast, it is a very beautiful serpent, and those who have seen it, as we have, gracefully swimming with elevated head and neck, and with the sun shining on its 'enamelled skin,' as it crossed the limpid water of some clear stream or little lake, will acknowledge its elegance and beauty. Mr. Bell has the following observations upon the subject of this change of the skin. "Snakes, like most other *Reptilia*, shed their cuticle or outer skin at greater or less intervals. It is a mistake to assign a particular period to this process; some have stated it to occur once, some twice in the summer; but I have found it to depend upon the temperature of the atmosphere, and on the state of health, and the more or less frequent feeding of the animal. I have known the skin shed four or five times during the year. It is always thrown off by reversing it; so that the transparent covering of the eyes, and that of the scales also, are always found in the exuviæ. Previously to this curious circumstance taking place, the whole cuticle becomes somewhat opaque, the eyes are dim, and the animal is evidently blind. It also becomes more or less inactive, until at length, when the skin is ready to be removed, being everywhere detached, and the new skin perfectly hard underneath, the animal bursts it at the neck, and creeping through some dense herbage, or low brushwood, leaves it attached, and comes forth in far brighter and clearer colours than before."

White and others have remarked an offensive power in this creature, that of 'stinking se defendendo,' as White describes it. He adds, "I knew a gentleman who kept a tame snake, which was in its person as sweet as any animal while in good humour and unalarmed; but as soon as a stranger or a dog or cat came came in, it fell to hissing, and filled the room with such nauseous effluvia as rendered it hardly supportable." But this offensive odour, which is expelled from certain glands, is not emitted in self-defence alone. It is also said to be the concomitant of sexual excitement.

The ringed snake is oviparous, as is the rest of the genus. The eggs, to the number of 16 or 20, are deposited in a connected chain in some dung-heap or warm situation, the connection being effected by a glutinous substance, and there left till the heat of the place or of the sun calls the young into life. Preparations illustrative of the anatomy of the Snake are to be seen in the Museum of the Royal College of Surgeons of England.

The common snake commences its hybernation in some warm hedge, under the root of a tree, or other sheltered situation, about the end of autumn; and then they coil themselves up, sometimes in numbers, till the spring again brings them forth. Many instances of tame snakes have been recorded. Mr. Bell gives the following account, showing that snakes may be made to distinguish those who caress and feed them. "I had one many years since, which knew me from all other persons; and when let out of his box would immediately come to me, and crawl under the sleeve of my coat, where he was fond of lying perfectly still, and enjoying the warmth. He was accustomed to come to my hand for a draught of milk every morning at breakfast, which he always did of his own accord, but he would fly from strangers and hiss if they meddled with him."

Common or Ringed Snake (*Natrix torquata*).

The editor of the last edition of Pennant's 'British Zoology,' the Rev. L. Jenyns, and Mr. Bell, are all of opinion that the Dumfriesshire Snake of Sowerby's 'British Miscellany' is probably an immature variety of this species. The editor of Pennant seems however to be in doubt whether it is the young of the Aberdeen Snake, *Anguis Eryx*, or of the *Natrix* here treated of. But there can, we apprehend, be hardly any doubt that the Dumfriesshire Snake is the young of *N. torquata*. The Aberdeen Snake is nothing more than the Slow-Worm or Blind-Worm. [BLIND-WORM.] Mr. Macgillivray states that he has never seen the Ringed Snake in Scotland.

Geographical Distribution.—Europe, "from Scotland and the corresponding latitude of the Continent, to Italy and Sicily." (Bell.)

With reference to the alleged inability of reptiles to live in Ireland, Mr. Bell says, "I have already mentioned the existence of *Lacerta agilis* there, and with respect to the present species, the following is the result of my inquiries. It would appear not only that the Common Snake is not indigenous to Ireland, but that several attempts to introduce it have totally failed. Mr. Ball some time since informed me of some trials of this kind." Mr. Bell then prints the following letter from Mr. Thompson, which he had recently received, and which, as Mr. Bell observes, gives a very detailed and clear account of the actual facts.

"In this order (*Ophidia*) there is not now, nor, I believe, ever was there, any species indigenous to Ireland. In the Edinburgh 'New Philosophical Journal,' for April, 1835, it is remarked: 'We have learned from good authority that a recent importation of snakes has been made into Ireland, and that at present they are multiplying rapidly within a few miles of the tomb of St. Patrick.' 'I never,' proceeds Mr. Thompson, 'heard of this circumstance until it was published, and subsequently endeavoured to ascertain its truth, by inquiring of the persons about Downpatrick (where the tomb of St. Patrick is) who are best acquainted with these subjects, not one of whom had ever heard of snakes being in the neighbourhood. Recollecting that about the year 1831, a snake (*N. torquata*), immediately after being killed at Milecross, was brought by some country-people in great consternation to my friend Dr. J. L. Drummond, I thought this might be one of those alluded to; and recently made inquiry of James Clealand, Esq. of Ruth Gael House (county Down), 25 miles distant in a direct line from Downpatrick, respecting snakes said to have been turned out by him. I was favoured by that gentleman with the following satisfactory reply:—"The report of my having introduced snakes into this country is correct. Being curious to ascertain whether the climate of Ireland was destructive to that class of reptiles, about six years ago I purchased half a dozen of them in Covent Garden market in London; they had been taken some time, and were quite tame and familiar. I turned them out in my garden; they immediately rambled away; one of them was killed at Milecross,"—that alluded to as having been brought to Mr. Drummond,—three miles distant, in about a week after its liberation; and three others were shortly afterwards killed within that distance of the place where they were turned out; and it is highly probable that the remaining two met with a similar fate, falling victims to a reward which it appears was offered for their destruction.'"

To this Mr. Bell adds, that it certainly does not appear that the failure of these attempts to introduce snakes into Ireland is to be attributed to anything connected with the climate, or other local circumstances, but rather to the prejudices of the inhabitants; nor is there reason to believe that their absence from Ireland is other than purely accidental. ('British Reptiles.') [OPHIDIA.]

NATROLITE, a Mineral belonging to the family of *Zeolites*. It occurs in right rhombic prisms, usually slender, and terminated by a short pyramid. The cleavage is perfect. It also occurs in globular, stellated, and divergent groups, consisting of delicate acicular fibres, which often terminate in acicular prismatic crystals. The colour is white, or inclining to yellow, gray, or red. The lustre is vitreous. It is transparent to transluscent. Its hardness is 4·5 to 5·5; its specific gravity is 2·14 to 2·23. It has the following composition:—

Silica	48·0
Alumina	26·5
Soda	16·2
Water	9·3
	100

It becomes opaque before the blow-pipe, and fuses to a glassy globule. It is found in amygdaloidal trap, basalt, and volcanic rocks.

Scolecite resembles Natrolite, and differs in containing lime in place of soda.

Poohnalite is a related species, from Poohna, Hindustan.

Mesole is another related species, occurring usually in impregnated globules, having a flat columnar or radiated structure, with a pearly or silky lustre.

Harringtonite, from the north of Ireland, and *Brevicite*, from Brevig, Norway, appear to be identical with *Mesole*.

Mesotype is an old species of Mineral, embracing the various forms here enumerated.

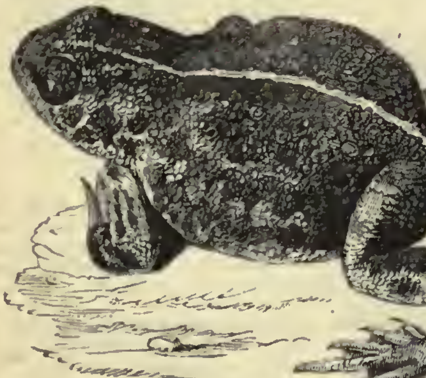
(Dana, *Mineralogy*.)

NATRON. [SODIUM.]

NATTER-JACK, or NATTER-JACK TOAD, the English name for the *Bufo Calamita* of Laurenti. Its colour is light-yellowish, inclining to brown, and clouded with dull olive; but its most distinguishing mark is the bright-yellow line running along the middle of the back. The warts or glands on the body and the large glands behind the head are reddish; the under parts yellowish spotted with black, and the legs banded with black. [BUFO.]

Mr. Bell gives the following dimensions:—

	Inches.	Lines.
Total length	2	8
Length of fore leg	1	3
Length of hinder leg	2	2



Natter-Jack Toad (*Bufo Calamita*).

NATURAL ORDERS OF PLANTS. [BOTANY; EXOGENS; ENDOGENS; ACROGENS; THALLOGENS.]

NAU'CLEA, a genus of Plants belonging to the natural order *Rubiaceæ*. It has a calyx with an oblong tube and a short truncate or 5-toothed limb; the corolla is funnel-shaped, with a slender tube, a naked throat, and 5 spreading oval oblong lobes; the anthers are inclosed, and always shorter than the lobes of the corolla; the capsules are 2-celled, sessile upon the receptacle, but gradually attenuated to the base. The seeds numerous, imbricate, winged, fixed to oblong placentæ, which are adnate to the dissepiment; the embryo is invested in a fleshy albumen. The leaves are opposite, or 3-4 in a whorl, petiolate, or sessile. The bracts wanting at the base of the head of flowers, but with linear paleæ among the flowers, which are crowded and sessile. The species are unarmed trees, rarely shrubs, and natives of India and Africa.

N. Cadamba has brachiate branches; petiolate coriaceous ovate leaves; triangular stipules; terminal solitary peduncles, usually shorter than the heads, which are globose. The flowers are orange-coloured, collected into heads about the size of a small apple; the style is white and exserted. The seeds not winged; the leaves from 5 to 10 inches long. Kudumba is the native name of this tree; it flourishes about Calcutta and Malabar, where it grows to be a very large tree, and is ornamental and very useful from the extensive shade it affords.

N. parvifolia has petiolate obovate-obtuse leaves, oval stipules, and terminal solitary peduncles; sometimes the peduncles are in triplets, when the middle one is the shortest. It is a native of the East Indies and all the coast of Coromandel, but chiefly in the mountains of the Philippines. The flowers are light yellow and globular, about the size of a plum. The wood is of a pale chestnut-colour, firm, and close-grained; it is useful for purposes where it can be kept dry, but when exposed to wet it soon decays.

N. cordifolia is prized on account of its wood, which is light and durable where it can be kept dry. It answers well for furniture.

There are 37 species of this genus enumerated, all of which are natives of the East, but do not possess any peculiar qualities which entitle them to particular notice.

The *Nauclea Gambia* of Hunter ('Linnæan Transactions,' vol. ix.) is now *Uncaria Gambia*. [UNCARIA.]

(Lindley, *Flora Medica*.)

NAUCLERUS. [FALCONIDÆ.]

NAU'CRATES, a genus of Fishes of the Mackerel Tribe, having fusiform bodies, tails keeled at the side, and two free spines before the anal fin. The *N. ductor* is popularly known as the Pilot-Fish, and is remarkable for its habit of following vessels often for many hundred miles. Mr. Crouch, in the 14th volume of the 'Linnæan Transactions,' has recorded an instance of two individuals of this species which accompanied a ship from the Mediterranean to Falmouth, where they were taken by a net. The *N. ductor* is about a foot in length, and is remarkable for the beauty of its colour, being of a silvery pale blue banded by broad and deep transverse dark blue belts.

NAU'TILIDÆ, or NAUTILA'CEA, a family of Cephalopodous *Mollusca*. According to Lamarck, they constitute the sixth family of his Polythalamous *Cephalopoda*, consisting of the genera *Discorbites, Siderolites, Polystomella, Vorticialis, Nummulites*, and *Nautilus*. To these Mr. G. B. Sowerby, Jun., adds *Simplegas* and *Endosiphonites*. In the system of M. De Blainville it is the fifth family of his *Polythalamacea*, and comprises the genera *Orbulites, Nautilus, Polystomella*, and *Lenticulina*. The genus *Nautilus* is the type of this family. [CEPHALOPODA.]

Linnæus gave the following as the generic character of *Nautilus*:—"Animal (Rumphius, 'Mus.,' t. 17, f. D) testa univalvis, isthmis perforatis concamerata, polythalamia;" and he divided the genus as follows:—

I. Spiral, rounded.

In this section he placed the species *N. Pompilius, N. Calcar, N. crispus, N. Beccarii, N. rugosus, N. umbilicatus, N. Spirula*, and *N. semilituus*. Of these, all, except *N. Pompilius* and *N. Spirula*, the latter of which is separated as a cephalopodous genus under the name of *Spirula*, are minute chambered shells, for the most part from the Adriatic Sea.

II. Elongated, sub-erect (erectiusculi).

In this section the species are *N. obliquus, N. Raphanistrum, N. Raphanus, N. Granum, N. Radicula, N. Fascia, N. Sipunculus, N. Legumen*, and *N. Orthocera*. Of these, all but *N. Orthocera* are minute, and from the Adriatic and Mediterranean. *N. Orthocera*, now established as a fossil genus of Cephalopods under the name of *Orthoceras*, though described by Linnæus as fossil, seems to have been considered by him as not without a living analogue, for he writes—"Habitat in alto pelago; Fossilis;" and he has the following observation:—"Testa frequentissima petrificata in montibus nostris calcareis, inter omnia fossilia nobis nota sæpe longissima, non dum visa immutata."

M. De Blainville thus describes the genus:—

Animal having the body rounded, and terminated behind by a tendinous or muscular filament, which attaches itself in the siphon with which the chambers of the shell are pierced; mantle open obliquely, and prolonging itself into a sort of hood above; the head provided with tentacular appendages, which are, as it were, digitated, and surrounding the aperture of the mouth.

Shell discoid, but little compressed, with the back rounded or subcarinated, umbilicated or not, but never mammellated (mameloućе); the chambers simple, invisible externally; the last deeply hollowed and pierced by one or two siphons.

The same zoologist thus divides the genus :—

A. Species not umbilicated, back rounded; aperture round, a single subcentral siphon. Ex. *N. Pompilius*, Linn.

B. Species not umbilicated, with a carinated back and angular opening. (*Angulithes*, De Montf.) Ex. *N. triangularis.*

C. Umbilicated species, with the back rounded and a single siphon. (*Oceanus*, De Montf.) Ex. *N. umbilicatus.*

D. Umbilicated species, with the back rounded and two siphons. (*Bisiphites*, De Montf.) Ex. *N. Bisiphites.*

M. Rang, under the genus *Nautilus* of Linnæus, places also *Aganides, Angulithes, Canthropes, Oceanus, Bisiphites*, and *Ammonites* of De Montfort. All De Montfort's genera, except *Oceanus* and *Ammonites*, are fossil only; the former he describes as coming from the Moluccas. It is, as far as one can judge from the figure, a very young shell, possibly the young of *N. Pompilius. Ammonites* is described as coming from the China Seas, and is apparently a species of *N. umbilicatus.* De Montfort considers it as the type of a specimen of *Ammonites* analogous to the *Ammonites*, or *Cornua Ammonis* "à cloisons unies." He further says that he possessed a superb petrification of this Ammonite a foot in diameter.

The descriptions of the animal given by De Blainville and others seem to have been taken from the figure of Rumphius. We therefore give a copy of this figure, which represents the animal in a supine position. The general form is not inaccurate, but the details are confused, and many of them incorrect, the funnel for instance, which is erroneously represented as round. That which an ordinary spectator would take for the eye is merely an opening between the digitations: the mantle is torn, and so represented as to mislead the spectator.

Animal of *Nautilus Pompilius*, from Rumphius.

The following is the description of Rumphius, and it has much more merit than his figure :—

"The fish that inhabits this shell (the *Nautilus*) is a species of *Polypus* (that is, Cephalopod; Πολύποvς, Aristotle; Poulpe, French), but of a particular aspect, moulded according to the concavity of the shell, which it does not quite fill when it holds itself retracted therein.

"The posterior part of the body fits into the bottom of the cavity, while the superior parts (which are inferior when the animal drags itself along the bottom) are flattened, but also rounded off, plaited, and of cartilaginous texture; coloured with brown or washed with red; spotted with blackish marks, which run one into another, as in the Cuttle-Fish (Veelvoet). The posterior part of the body, which presses against the shell below the convexity (kiel), and which, in its progression, becomes the superior part, is also a little cartilaginous, but not so much so as the anterior parts, which are covered with a number of cavities (wratten).

"In the middle of these parts, in front of the head, there is a considerable lump of little feet, which terminate in fleshy processes laying one over another, and which cover the mouth on each side: these processes are formed like the hand of a child. The largest, or those which are exterior, are terminated by 20 of these fingers or little feet, each as long as half a finger, as thick as a straw, round, smooth, having none of those suckers we see on the feet of the Cuttles, but a little flattened or divided at the end. The great fleshy processes are succeeded by others which are shorter and have only 16 fingers, and these are followed successively by others still shorter, which go on covering even to the mouth.

"The animal can retract or elongate these fingers at will, for they not only serve as feet to creep withal, but also as hands to seize his prey and carry it to the mouth. This mouth is armed by a very hooked beak, formed like that of a Coccatoo or a Sea-Cat (*Sepia !*). The upper beak is large, hooked, dentated on the edge; the lower beak is small, concealed, or, as it were, shut up in the upper. Both sharp, and calculated to pierce flesh (vleesch). This beak is hard as bone, and its colour of a blackish-blue, surrounded by circular lips of a white colour, fleshy or parchment-like. These are produced sometimes so as to cover entirely the beak, which at other times is almost entirely concealed by a gelatinous deposition, and by the multitude of feet which surround it, so that it cannot be seen without violent means being used.

"The eyes are placed a little low down, laterally disposed, very large, large as beans, without an inferior eyelid, pierced in the middle; but we cannot find the lens (oogappel); they are filled with dark-brown blood.

"From the hinder part of the body, to wit, that which rests upon the last partition, goes a long artery (ader) through all the partitions and through all the chambers, even unto the extremity of the spire, the middle hole to which the fish hangs fast to the shell: excepting this part the chambers are entirely empty, and it breaks readily when the fish is drawn out. Under the beak (snuit) is a half pipe (canal) of a rounded form, one side rolled over the other, of a whitish flesh, like as in the Sea-Cat (*Sepia*), and in this is concealed a sort of tongue. It is most likely the same canal as that by which the Zeekat ejects its black blood." ('Rariteit-Kamer,' book ii.)

This figure and description warmed the imagination of Denys de Montfort, who published a ludicrous representation of the supposed animal seated in its shell, and expanding its hood or sail. This has been copied by Shaw; and as it has been published by that zoologist in his 'Lectures,' we give a copy of the monster, which was meant to pass current for the inhabitant of the shell.

Supposed animal of *Nautilus Pompilius*. Denys de Montfort and Shaw

It will now be necessary to go back to the earlier authors, and to inquire whether this animal was known to them. After reading the following passages, few will hesitate to concede that it was known to the father of natural history.

Aristotle ('Hist. Nat.,' iv. 1), after well describing the different Μαλάκια (Naked Cephalopods), says :—"There are also two *Polypi* in shells; one is called by some *Nautilus*, and by others *Nauticus*. It is like the *Polypus*; but its shell resembles a hollow comb or pecten, and is not attached. This *Polypus* ordinarily feeds near the shore; sometimes it is thrown by the waves on the dry land, and the shell falling from it, it is caught, and there dies. These are small, and in form like the *Bolitænæ*" (Cephalopods probably, of the form of which

Eledone moschata is the type). "And the other," continues Aristotle, "is in a shell, like a snail; and this does not go out of its shell, but remains in it like a snail, and sometimes stretches forth its arms (or cirri, πλεκτάνας) externally."

The first of these *Polypi* is evidently the *Nautilus* or *Pompilius* of Pliny and other ancient writers; the *Argonauta* of Linnæus and the moderns. [OCTOPODA.]

The second, to which the term *Pompilius* is now exclusively applied, is as evidently the *Nautilus* of Lamarck.

Belon figured the shell of the animal, now termed *Nautilus Pompilius* (and we believe that his figure is the first that appeared) under the name of *Nautilus alter seu secundus;* but it seems clear that he was unacquainted with the soft parts. Rondeletius, apparently confounding Aristotle's two genera of *Polypi*, seems to refer the animal of the first to the shell of the second; and dwells on the impossibility of so delicate and feeble an animal dragging about so heavy a shell.

Gesner relates that 'Jo. Fauconerus,' a celebrated physician of England, formerly gave him the picture of a *Nautilus*, with a written description (by letter). This description Gesner gives; and it is not improbable that the soft parts there described may have been those of *Nautilus Pompilius* (it is clear that the shell was); but the account is so obscure and brief that there is room for doubt, though the term velum is used, which would hardly be applicable to the palmated arms or vela of the other kind.

We now return to the period which followed the publication of Rumphius's figure; and for many years no further information was obtained, though special directions were given by the French and other nations to collectors to be assiduous in procuring the soft parts. These directions were given in vain, and all was conjecture. Fragments even of molluscous animals were caught at and published as probable parts of this much-desired animal; and Messrs. Quoy and Gaimard published their 'Description d'un Fragment de Mollusque Inconnu, presumé être celui du Nautile Flamhé' (*Nautilus Pompilius*, Linn.), with figures, in the 'Annales des Sciences Naturelles' vol. XX. The materials are not sufficient to come to any safe conclusion as to the animal of which the fragment was a part, but it may now be confidently denied that it is any portion of the soft parts of *Nautilus Pompilius.* The parenchyma of the fragment indeed is said to have been identical with that of *Firola* and *Carinaria.* This fragment is preserved at Paris in the Jardin du Roi.

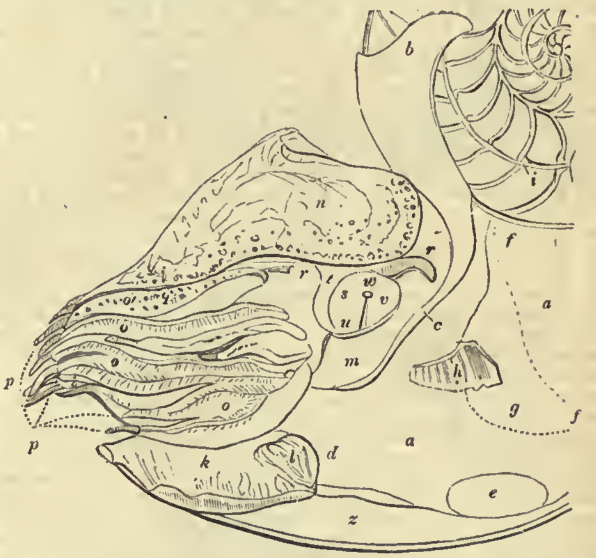
The recovery of this interesting animal was reserved for a British voyager, and its structure has been demonstrated and illustrated by Professor Owen in a most masterly manner.

Mr. George Bennett thus describes the capture of this interesting animal in his 'Wanderings in New South Wales,' &c.:—"It was on the 24th of August, 1829 (calm and fine weather, thermometer at noon 79°), in the evening, when the ship Sophia was lying at anchor in Marakini Bay, on the south-west side of the island of Erromanga, one of the New Hebrides group, Southern Pacific Ocean, that something was seen floating on the surface of the water at some distance from the ship; to many it appeared like a small dead tortoise-shell cat, which would have been such an unusual object to be seen in this part of the world, that the boat which was alongside the ship at the time was sent for the purpose of ascertaining the nature of the floating object. On approaching near it was observed to be the shell-fish commonly known by the name of the Pearly Nautilus (*Nautilus Pompilius*); it was captured and brought on board, but the shell was shattered from having been struck with the boat-hook in capturing it, as the animal was sinking when the boat approached, and had it not been so damaged it would have escaped. I extracted the fish in a perfect state, which was firmly attached to each side of the upper cavity of the shell. On being brought on board I observed it retract the tentacula still closer than before, and this was the only sensation of vitality it gave after being caught; I preserved the soft parts immediately in spirits, after making a rude pen-and-ink sketch of its form. On breaking the lower part of the shell the chambers or cavities were found filled with water. The hood has been stated by Dr. Shaw ('Lectures,' vol. ii., p. 165) as being of a pale reddish-purple colour, with deeper spots and variegations; the colour however, as it appeared in this recent specimen, was of a dark reddish-brown, in fact, resembling the colour produced by the Koka on the stained cloth of the Tongatabu natives, intermingled with white. We had fine weather; light winds and calms a day or two previous to this animal being caught." After noticing the incorrectness of Shaw's figure (which, as we have above noticed, was copied from those given by Denys de Montfort), and the greater general accuracy of that of Rumphius, he informs us that this species is called Kika, Lapia, and Krang Modang, by the natives of Amboyna; and Bia Papeda, Bia Cojin, by the Malays. Other instances are recorded by Mr. Bennett of the capture of this animal.

The specimen captured by Mr. Bennett is preserved in the Museum of the Royal College of Surgeons in London, and has produced the admirable 'Memoir on the Pearly Nautilus (*Nautilus Pompilius*, Linn.), with Illustrations of its External Form and Internal Structure,' by Professor Owen, and published by direction of the council of the college, a summary of which we shall endeavour to lay before our readers.

The external form, of which an elaborate description is given, for which we must refer our readers to the 'Memoir' itself, will be collected from the following cuts, which are reduced from Professor Owen's figures:—

Nautilus Pompilius (female), in the prone position, with its natural relation to the shell shown by a section of that part in outline. (Reduced from Owen.)



The same, with the animal as well as a part of the shell in outline, explanatory of the parts, on a larger scale. (Reduced from Owen.)

a a, the mantle; *b*, its dorsal fold, applied to the involute convexity of the shell; *c*, its free anterior margin: *d*, the orifice for the passage of the funnel; *e*, the convexity produced by the ovarian gland; *f f*, the horny girdle for the adhesion of the mantle to the shell; *g*, the horny laminæ covering the extremity of the left shell muscle; *h*, a portion of the shell which was left adhering to this muscle; *i*, the membranous tube or siphon, which traverses the testaceous tubes in the camerated portion of the shell; *k*, the funnel; *l*, the left lateral process of the funnel; *m*, the left crus or pillar of the funnel; *n*, the hood or ligamento-muscular disc that surmounts the head; *o o*, the exterior digitations on the left side; *o'*, the larger one, with a papillose surface like that of the hood; *p p*, the digitated tentacles, protruded from their sheaths; *q*, the groove which separates the hood from the papillose digitation; *r r*, the ophthalmic receptacles; *s*, the eye; *t*, its peduncle; *u*, the inferior ridge or rudimentary eyelid; *v*, the ridge running from this to *w*, the pupil; *x x*, the partitions of the chambers; *y*, the septal tubes, which give passage to the membranous siphon; *z*, the chamber of occupation. (Owen.)

Professor Owen thus concludes this part of his memoir on the anatomy of this creature:—"From what has been already said, it will be seen how considerable are the external differences between the Pearly Nautilus and the higher *Cephalopoda;* nevertheless its general plan of organisation renders its claim to rank with them indisputable;

and as its locomotive apparatus is confined to the head, the received denomination of the class remains undisturbed by its admission. The inferior or ventral pair of labial processes I consider as analogous to the superadded pedunculated arms of the Cuttle-Fish and Calamary, which also come off more internally than the shorter arms, and are approximated or united at their bases on the ventral aspect of the mouth. The other pair in *Nautilus* appear to result from a higher degree of organisation of the part analogous to the external lip in the preceding genera. The curtailed digitations are however but feeble representatives of the elongated and cotyligerous arms of the Poulp, or Cuttle-Fish; and the retractile tentacles, pedicellate eyes, and flattened disc, which, according to the testimony of Rumphius, is applied to the ground in the progressive motions of the animal, attest an obvious tendency towards the *Gasteropoda*. And while tracing these examples of affinity with the different and heretofore widely-spread groups of *Mollusca*, between which this remarkable form, I apprehend, is osculant, there may also be perceived in the whole of this singular but at the same time regular and symmetrical arrangement of the palpigerous organs about the mouth, an analogical relation to the higher *Annulosa*."

Before Professor Owen enters upon the Muscular System, which is described carefully and in detail, he notices what he aptly terms the internal skeleton or frame-work from which its principal masses take their origin. Like that of the Dibranchiate *Cephalopoda*, this skeleton, according to Professor Owen, is cartilaginous, yields readily to the knife, and in texture and semitransparency closely resembles the cartilage which constitutes the skeleton of the Skate. In *Sepia*, he observes, this cartilaginous part completely encircles the œsophagus, and on the dorsal aspect of that tube is dilated into a large cavity, which contains the brain; but in *Nautilus* the circle is incomplete behind, and the brain is protected only by its membranous sheath.

Digestive System.—The jaws are two, endowed with a vertical motion, and in form resembling a parrot's bill reversed, the upper mandible being encased in the lower when they are closed. Posteriorly they are adapted to a muscular basis, to which they owe their motions. "Thus far," continues Professor Owen, "they resemble the mandibles of the Dibranchiate *Cephalopoda;* but they are not composed entirely of horny matter, nor are they uniformly of a brown or black colour, their extremities being of a dense calcareous nature, and of a bluish-white colour; they are also less pointed at the end, and the oval margins of the lower mandible are notched and dentated." They are larger in proportion than in the Cuttle-Fish. Professor Owen proceeds to state that the calcareous extremities of both mandibles are of a hardness apparently adequate to break through the most dense crustaceous coverings, or even shells of a moderate thickness. The extremity of the upper mandible is sharp-pointed, and solid to the extent of five lines from the extremity; but in the lower one the calcareous matter is deposited on both sides of a thin layer of the black horny substance, and thus a combination of tough with dense matter is obtained, which much diminishes the liability to fracture. This mandible is also more hooked than the upper one, but is more obtuse at the end. "It seems," observes Professor Owen, "from its dentated margin, evidently intended to break through hard substances, whilst the sharp edges of the beak of the cuttle-fish better adapt it for cutting and lacerating the soft bodies of fish." In the particulars here stated the mandibles of *Nautilus* differ, as Professor Owen remarks, from those of every other known species of recent Cephalopods. The circular lip which surrounds the jaws is much deeper than in the Cuttle-Fish, and the jaws are provided with four retractor muscles, and one for protrusion. The tongue is large, and supported by an oblong horny substance. The fleshy substance is produced anteriorly, and forms three caruncles, which are very soft in texture, and beset by numerous papillæ, having all the characters of a perfect organ of taste. The anterior extremity of the horny substance is embraced by a pair of retractor muscles, which arise from the posterior margin of the lower mandible, and four delicate retractor or depressor muscles are inserted into the anterior or terminal caruncle. Behind the caruncles the dorsum of the tongue is encased with a thin layer of horny matter, from which arise four longitudinal rows of slender recurved prickles between one and two lines in length, the same in number as the labial tentacles, namely, 12. There is an analogous structure in the *Cephalopoda* and in many of the *Gasteropoda*. "The necessity of such a structure," says Professor Owen, "becomes very apparent in the Pearly Nautilus, if, as Rumphius has asserted, it creeps with the shell uppermost; since in that case the tongue, having its position reversed, would be opposed instead of being assisted by gravitation while regulating the movements of the food in the mouth. And it is worthy of remark that in the Flamingo, which turns the upper mandible to the ground while taking its food, the tongue is similarly armed with regularly-developed recurved spines, calculated, as in the Pearly Nautilus, to rake the alimentary morsels towards the fauces." [DUCKS.] Behind the horny parts the tongue again becomes soft and papillose, but the papillæ are larger and coarser. The only traces of a salivary system detected were in two broad fleshy processes projecting forward from the sides of the fauces: they were papillose, and perforated in the middle of their inner surfaces by a small aperture which led into a glandular cavity between the folds of the membrane, and from these cavities an opaque whitish substance could be expressed. In the Dibranchiate Cephalopods these glands are remarkably developed. The alimentary canal, which was filled with the fragments of Crustaceans, was everywhere connected to the parietes of the abdomen by numerous filaments; the only trace of a mesentery existed between the two last portions of the intestine, which were connected together by the ramifications of an artery and vein. Among the crustaceous fragments, portions of branchiæ, claws, and palpi were distinctly recognised, so as to leave no doubt that the greater part of them had belonged to a Brachyurous Decapod of a hirsute character, and not a swimmer. The crop, which was capacious and pyriform, was tensely filled with these fragments, and Professor Owen remarks that the capability of propelling such rude and angular particles through a narrow canal into the gizzard without rupturing the tunics of the preparatory cavity is not one of the least extraordinary examples of the powers of living matter. The gizzard very much resembles that of a fowl, as it does in *Octopus*. A globular cavity communicates with the intestine at a little distance from the pylorus, and its reception of the biliary secretion renders it in some measure analogous to a gall-bladder; but Professor Owen thinks that its chief use is probably to pour into the commencement of the intestinal canal a fluid necessary for digestion; so that, like the laminated and spiral cœcum of the higher Cephalopods, and the pyloric appendages of fish, it is essentially a simple form of pancreas. The interior of the alimentary canal, which was filled with smaller fragments of crustaceous shell, presented a few longitudinal rugæ and slight transverse puckerings. The liver is bulky, and extends on each side of the crop from the œsophagus to the gizzard. There was no trace of structure analogous to the ink-bag of the Dibranchiate Cephalopods.

Nautilus Pompilius, in the prone position, with the labial processes and tentacles, the mandibles, and the digestive organs displayed. (Reduced from Professor Owen's figure.)

a a, the hood, or upper part of the oval sheath, longitudinally divided; *b b*, the posterior lobes or angles of the hood; *c c*, the posterior concavity of the hood; *d d*, the ridge in the same; *e e e*, the cut surfaces of the above parts; *f f*, the internal surface of the oval sheath; *g g*, the external labial processes; *h h*, the external labial tentacles; *i i*, the internal labial processes; *k k*, the internal labial tentacles; *l*, the olfactory laminæ; *m*, *m*, the circular fringed lip, longitudinally divided; *n*, the superior mandible; *o*, the inferior mandible; *p*, the muscular basis on which the mandibles are fixed; *q q*, the superior pair of muscles which retract the jaws; *r r*, the semicircular muscle which protrudes the jaws, divided longitudinally; *s*, the œsophagus; *t*, the crop; *u*, the narrow canal leading to *v*, the gizzard; *w*, the intestine; *w'*, the terminal fold of intestine drawn out of its situation; *x*, the anus; *y*, the laminated pancreatic bag; *z z*, the liver; 15, a branch of the anterior aorta, which ramifies in the membrane connecting the two portions of the terminal fold of the intestine; 19, the continuation of the posterior aorta along the dorsal aspect of the crop; 20, its bifurcation at the œsophagus, to form a vascular circle corresponding to the nervous circle round that tube; 21 and 22, arteries of the crop, gizzard, &c. (Owen.)

In the Museum of the Royal College of Surgeons ('Physiological

Series,' No. 499, A.) is a preparation exhibiting the crop, gizzard, and laminated pancreatic pouch. (See the 'Catalogue,' vol. i.)

Circulating and Respiratory System.—The respiratory organs are elongated and pyramidal, and have the same laminated structure and symmetrical disposition as in the Cuttle-Fish; but they are four in number, being disposed two on either side, and each pair arising by a common peduncle from the inner surface of the mantle. "From this difference in the number of branchiæ, in addition to the other peculiarities in the structure of *Nautilus*," says Professor Owen, "the existence of at least two orders of the class *Cephalopoda* is, I imagine, demonstrated; and the denominations of these orders might conveniently be taken from the modifications of the respiratory system. Assuming therefore that it is common to the class to possess branchiæ of a laminated structure, symmetrically disposed, and concealed beneath the mantle, those genera which possess two such branchiæ will form an order under the term *Dibranchiata*, and the Pearly Nautilus and other Celphalopods with shells of an analogous formation, a second order, under the term *Tetrabranchiata*. It is in this sense that the expression 'Dibranchiate Cephalopods' has been made use of in this memoir; and to this group most of the characters of the class, as given by the immortal Cuvier in his 'Règne Animal,' exclusively appertain." [CEPHALOPODA.]

Nervous System and Organs of Sense.—This part of the system in the Pearly Nautilus is in many respects inferior to that of the Dibranchiate *Cephalopoda*, though it is analogous to it. "The part," says Professor Owen, "which corresponds to the brain of the cuttle-fish, is neither enlarged nor lobulated, nor contained in a cartilaginous receptacle; but is a simple rounded chord or commissure placed transversely above the œsophagus, and connected at its extremities to the great ganglions. These are six in number; are disposed symmetrically about the œsophagus, and, together with the central commissure, are loosely enveloped in a tough membrane, or dura mater." The double œsophageal collar is not peculiar to *Nautilus*, but is also found in other Molluscs, *Aplysia* for example; though in these latter cases the subœsophageal ganglions being more remote, the connecting filaments running to the common centre above are longer. In the Museum of the College of Surgeons a preparation (No. 1306, A, 'Physiological Series') exhibits the head and anterior or muscular part of the body of this species laid open longitudinally along the dorsal aspect, and the sides divaricated to show this part of the system. The brain, or supraœsophageal mass, will be seen to consist of a transverse chord-like ganglion, from the ends of which three nervous trunks are continued on each side. The anterior pair pass downwards and forwards by the sides of the œsophagus to unite below it, forming a ganglion on either side; these supply the digital processes and tentacles, and give off nerves to the organ of smell and the funnel. The middle and superior trunks dilate into the optic ganglions; the retina, which terminates that of the left side, is shown. The posterior chords surround the œsophagus in a manner analogous to the anterior pair, forming also two ganglionic swellings, from which the nerves of the great shell-muscles and those of the viscera are given off; the latter nerves are of small size, and are continued down by the side of the great perforated vein, and are analogous in their distribution to the sympathetic nerves and par vagum. ('Cat.,' vol. iii. part l.)

Sight.—The eye of the *Nautilus*, as might be expected from the comparative inferiority of the brain, is less complex than in the Dibranchiate Cephalopods. "Indeed," says Professor Owen, "it appears to be reduced to the simplest condition that the organ of vision can assume without departing altogether from the type which prevails throughout the higher classes. For although the light is admitted by a single orifice into a globular cavity or camera obscura, yet the parts which regulate the admission and modify the direction of the impinging rays are entirely deficient." The eyes are not situated in orbits, but are attached severally by a pedicle to the side of the head, immediately below the posterior lobes of the head. This attachment to a muscular pedicle gives great mobility to the organ, and enables the animal easily to bring it to bear on objects in a variety of directions. Professor Owen found that the contents of the globe had escaped by the pupil; but he comes to the conclusion, on satisfactory grounds, that if it had ever contained a crystalline lens, it must have been very small.

Professor Owen was unable to detect a distinct organ of hearing.

The structure of the tongue and the nerves with which it is supplied indicate a considerable development of the faculty of taste; and the numerous tentacles, soft in their texture, annulated on their surface, and well supplied with nerves, must give the animal an ample enjoyment of the sense of touch.

Generative System.—Aristotle was well aware of the distinctions of sex in the Μαλάκια; and Professor Owen remarks that the propriety with which that great zoologist classed this animal, although it was covered with a shell to which it adhered like a snail, is fully borne out by the dissection of the female, upon which he operated. The organs consist of an ovary, an oviduct, and, as in the Pectinibranchiate Gasteropods, of an accessory glandular apparatus, and are delineated in the eighth plate of Professor Owen's 'Memoir.'

With regard to the habits of the *Nautilus*, Rumphius says, "When he floats on the water be puts out his head and all his barbs (tentacles), and spreads them upon the water, with the poop (of the shell) above water: but at the bottom he creeps in the reverse position, with his boat above him, and with his head and barbs upon the ground, making a tolerably quick progress. He keeps himself chiefly upon the ground, creeping sometimes also into the nets of the fishermen; but after a storm, as the weather becomes calm, they are seen in troops floating on the water, being driven up by the agitation of the waves: whence one may infer that they congregate in troops at the bottom. The sailing however is not of long continuance; for having taken in all their tentacles, they upset their boat, and so return to the bottom." ('Rariteit-Kamer.')

Professor Owen, who quotes this passsage, observes that the extent to which the Pearly Nautilus is covered by its shell, and its close attachment to it, indicated the affinity to the Gasteropods in too strong a manner to escape the penetration of Aristotle, who, as we have seen, directly compares it in this respect to a snail; "and the general resemblance," says Professor Owen in continuation, "must have been sufficiently striking, when, with his house above him and in the supine position, he makes his way along the sand with a moderate degree of rapidity."

We here give representations of the external appearance of the shells of two species.

Shell of *Nautilus Pompilius.*

Shell of Umbilicated Nautilus (*Nautilus scrobiculatus*).

The genus *Nautilus* is thus characterised by Professor Owen. Body oblong, rounded posteriorly, terminated by a slender membranaceous tube. Head above with an ambulatory disc. Arms on each side, 19. Tentaculiferous labial appendages 4, disposed around the mouth. Tentacles (92 !) of three kinds, namely: ophthalmic, lamellose, on each side two; brachial, annulose, on each side 20; labial, annulose, on each side 24. The whole body laid up in the last chamber of a large multilocular shell, and affixed by two lateral muscles. [TETRABRANCHIATA.]

The species inhabit the seas of warm climates, especially those of Asia and Africa, and their islands, Amboyna, Zanzibar, and New Guinea; and the Pacific and Australian Oceans.

Fossil Nautilidæ.

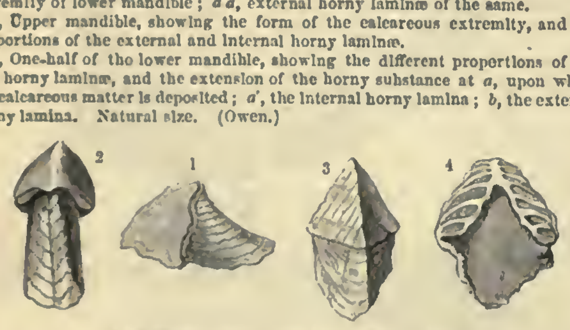
The *Rhyncholites*, formerly considered to be the beaks of birds, are now, upon unquestionable evidence, proved to be the jaws of fossil *Nautili* and *Ammonites*. Blumenbach recognised these *Rhyncholites* as being rather the mandibles of Cephalopods, differing from all recent genera then discovered; and M. D'Orbigny, who found some large ones in the same beds with the shell of a *Nautilus gigas*, suspected that those *Rhyncholites* appertained to that species.

We here give figures of the mandibles or beaks of *N. Pompilius*, the structure of which is above noticed, and some of these *Rhyncholites*.

2, Mandibles of *Nautilus Pompilius*. *a*, calcareous extremity of upper mandible; *b*, extended internal horny laminæ of the same; *c*, notched calcareous extremity of lower mandible; *d d*, external horny laminæ of the same.

3, Upper mandible, showing the form of the calcareous extremity, and the proportions of the external and internal horny laminæ.

4, One-half of the lower mandible, showing the different proportions of the two horny laminæ, and the extension of the horny substance at *a*, upon which the calcareous matter is deposited; *a'*, the internal horny lamina; *b*, the external horny lamina. Natural size. (Owen.)



Rhyncholites, upper, side, and internal views.
1, Side view (Muschelkalk of Luneville). 2, Upper view (same locality). 3, Upper view (Lias of Lyme Regis). 4, calcareous point of an under mandible (internal view), from Luneville. (Buckland).

The Oolite (Stonesfield), and the Lias of Lyme Regis and Bath, will serve as examples of the British strata wherein these beak-stones occur.

Fossil *Nautili* occur both in the Tertiary and subjacent strata. M. Deshayes ('Tables') records four fossil species (Tertiary). Dr. Mantell notices *Nautilus imperialis*, from the Arenaceous Limestone or Sandstone of Bognor; *N. elegans*, from the Chalk (Lewes); the last-named species and *N. expansus*, from the Chalk-Marl; *N. inæqualis*, from the Gault or Folkstone Marl (Folkstone); and a nameless species from the Shanklin Sand (Lower Greensand). Professor Phillips records the following in Yorkshire:—*N. lineatus* (Inferior Oolite); *N. astacoides* (Lias); *N. hexagonus* (Kelloways Rock); *N. annularis* (Lias); and others in the Speeton Clay and Brandsby Slate. Mr. Lonsdale enumerates *N. lineatus* (Lias); and *N. obesus* (Inferior Oolite from Bath). Dr. Fitton ('Strata below the Chalk') records *N. elegans*, *N. inæqualis*, *N. plicatus*, *N. radiatus*, *N. simplex*, *N. undulatus*, and an uncertain species, the first-named species from the Upper and the rest from the Lower Greensand. Sir Roderick Murchison ('Silurian System') describes and figures one species, *N. undosus*, from the Caradoc Sandstone. Altogether about 100 fossil species of the genus *Nautilus* are known. (Woodward.)

Dr. Buckland, in his 'Bridgewater Treatise,' thus concludes his observations upon the affinities of the chambered shells of Cephalopods:—

"It results from the view we have taken of the zoological affinities between living and extinct species of chambered shells, that they are all connected by one plan of organisation, each forming a link in the common chain which unites existing species with those that prevailed among the earliest conditions of life upon our globe; and all attesting the identity of the design that has effected so many similar ends through such a variety of instruments, the principle of whose construction is, in every species, fundamentally the same.

"Throughout the various living and extinct genera of chambered shells, the use of the air-chambers and siphon, to adjust the specific gravity of the animals in rising and sinking, appears to have been identical. The addition of a new transverse plate within the conical shell added a new air-chamber, larger than the preceding one, to counter-balance the increase of weight that attended the growth of the shell and body of these animals.

"These beautiful arrangements are, and ever have been, subservient to a common object, namely, the construction of hydraulic instruments of essential importance in the economy of creatures destined to move sometimes at the bottom and at other times upon or near the surface of the sea. The delicate adjustments whereby the same principle is extended through so many grades and modifications of a single type, show the uniform and constant agency of some controlling intelligence: and in searching for the origin of so much method and regularity amidst variety, the mind can only rest, when it has passed back through the subordinate series of second causes, to that great first cause, which is found in the will and power of a common Creator."

The other genera of the family *Nautilidæ* are fossil:—

Lituites has a discoidal shell; whorls close or separate; last chamber produced in a straight line; siphuncle central. It contains 15 species, which are found in the Silurian rocks of North America and Europe.

Trochoceras has a nautiloid spiral depressed shell. It contains 16 species, which are found in the Upper Silurian Rocks of Bohemia.

NAUTILOGRAPSUS. [GRAPHIDÆ.]
NAUTILUS. [NAUTILIDÆ.]
NAVEL-WORT. [COTYLEDON.]
NAVEW. [BRASSICA.]
NAVICELLA. [NERITIDÆ.]
NAVICULA. [DIATOMACEÆ.]
NAXIA. [MAIIDÆ.]
NECRONITE. [FELSPAR.]

NECROPHORUS, a genus of Coleopterous Insects belonging to the family *Silphidæ*. The antennæ are terminated by a nearly globular 4-jointed mass; the body is parallelepiped; and the maxillæ have no horny teeth. There are several species of this genus. They have obtained the name of Burying Beetles, from the peculiar instinct which they exhibit of burying the dead bodies of small animals, such as moles, mice, frogs, &c., as a receptacle for their eggs and larvæ. Their powers of perception are very strong, and it is surprising how soon they discover a dead body fitted for their purpose, round which they may be observed flying, with the elytra elevated, their dorsal surfaces being applied together. They soon creep beneath the body, and commence scratching up the earth from the sides and under the animal, which by degrees descends into the pit which is thus gradually deepened. When it has reached a sufficient depth the earth is thrown over it, and the insect deposits its eggs upon the carcass, so that the larva, when hatched, finds itself in the midst of a repast, disgusting enough, but suited to its taste. The larva is long, of a dirty-white colour, with the upper surface of the anterior segments armed with a scaly plate of a brown colour, and with small elevated points upon the hinder segments. They have also six scaly legs, and the jaws are robust. When they have attained their full size they bury themselves still deeper in the earth, where they construct an oval cell, the inner surface of which they coat with a gummy secretion. These insects, like many others which feed upon carrion, have a strong odour like musk. The habits of these insects have been especially studied by M. Gleditsch, and more recently by various persons in France, who have written upon the subject of destroying moles, and by whom various points in their economy have been elucidated.

There are a considerable number of species of this genus, some of the largest of which (*N. grandis*, Fabricius) have been observed in North America. There are seven British species, five of which are distinguished by the golden-coloured bands of the elytra. These species vary amongst themselves in the form of the thorax, the structure of the hind legs, the markings on the elytra, and the colour on the club of the antennæ. One of the most common species is the *Silpha Vespillo* (Linnæus), in which the posterior tibiæ are curved, and the trochanters furnished with a strong spine. The species vary also in length from half an inch to an inch and a third, which is the length of *N. germanicus*, the largest and rarest of the British species. (Westwood.)

NECTANDRA, a genus of Plants belonging to the natural order *Lauraceæ*. It has a 6-parted rotate calyx, deciduous segments, the three outer rather the broadest; there are 9 anthers, which are ovate, nearly sessile, with 4 cells, arranged in a curve, and distinct from the tip of the anther, the cells of the interior anthers inverted; the glands are in pairs, globose, sessile at the base of the three interior stamens next their back. The fruit is succulent, more or less immersed in the tube of the calyx, which is changed into a truncated cup. The flowers are panicled or corymbose, axillary, lax, and pretty ample.

N. cymbanum is a tree nearly 100 feet high, growing in the woods of the Orinoco, near San Fernando de Atabasso, where it is called Sassafras, and also in the ancient forests of the Rio Negro in Brazil. The branches are smooth; the leaves oblong, lanceolate, papery, and shining above; the cup is large with a double edge; the bark aromatic, bitter, and stomachic. Martius suspects that it is one of the ingredients in the famous Woorary poison of Guiana.

N. cinnamomoides has oblong leaves tapering into a fine point, acute at the base, between papery and leathery; naked, smooth, and shining above; finely downy beneath, with numerous distinct narrow costal veins. The bark has the smell and flavour of cinnamon, as which it is used in New Granada.

N. Puchury major has oblong or elliptical leaves tapering to a narrow point, smooth, reticulated, and of the same colour on either side. The cup of the fruit is very large and spongy. Martius assigned the Pichurim Bean to this plant. In the early months of the year the fruits drop from their cups to the ground, and are collected by the natives, cleaned, and dried by a gentle heat. They are prescribed in dysentery, diarrhœa, cardialgia, strangury, &c. The bark has the smell of fennel mixed with cloves.

N. Puchury minor, according to Nees, yields seeds similar in their qualities to the above. Its bark is said to resemble sassafras when fresh, but tastless and scentless when dry. According to Humboldt, it yields the sassafras nuts sold in the London shops. It is a native of the woods of Jabatinga, in the province of Rio Negro, in Brazil.

(Lindley, *Flora Medica.*)

NECTARINE. [AMYGDALUS.]

NECTARINIA. [CINNYRIDÆ.]

NECTARINIDÆ. [CINNYRIDÆ.]

NECTARY, in Botany, a term used by Linnæus to designate those appendages of the corolla which secrete honey. The term has however, since the time of Linnæus, been used in a general sense to express any organ existing in the flower between the corolla and pistil, and which could not be rightly assigned to these or the stamens. Such parts or appendages of the flower have had many other names applied to them, and some much more commonly than Nectary. A common form of appendage of the corolla is called Corona. This organ is formed at the base of the limb of the corolla, and forms sometimes an undivided cup, as in the *Narcissus*, when it is called by Haller a Scyphus. When it is separated into several parts, as in *Silene* and *Brodiæa*, it forms the Lamella of some writers. In *Stapelia* this organ forms a thick solid mass, covering the ovary and adhering to the stamens. It is here called the Orbiculus. When this appendage is accompanied with little projecting processes they are called Cornua, or horns; the upper end of these is the beak, or Rostrum, and their back, if dilated and compressed, is called Ala, or Appendix. Occasionally there is a second set of horns, which alternate with the first, and are called Ligulæ; the circular space at the top of the orbiculus is the Scutum. When the lamellæ are small and scale-like, and overarch the orifice of the tube, they are called a Fornix.

Link proposes to call all appendages which are referrible to the corolla, Paracorollæ; or, if they consist of several pieces, Parapetala; and all appendages referrible to the stamens, Parastemon. The peculiar filiform appendages of *Passiflora* he calls Paraphyses, or Parastades.

The real nature of these appendages is a point of some interest. In some instances they appear to be simple expansions of the cellular tissue and epidermis of the part on which they are seated, and in others they are evidently abortive stamens or petals. Thus the little bodies found in the claw of the petals of *Ranunculus* may be regarded as an expansion of the tissue, whilst the filamentary appendages seen in the genus *Passiflora* are evidently metamorphosed petals. The various forms of corona may be assigned to one or other of the above causes. This subject requires investigation, and it would be well if a more simple and intelligible nomenclature could be applied to these parts of the flower; for, however unimportant at first sight such organs may appear, they nevertheless constitute some of the most valuable distinctive marks for species, genera, and even orders, which the botanist possesses.

The original name (Nectary) of these appendages was applied on account of the honey which the tissues of these organs frequently secrete. They were on this account called by Meyen Compound Glands. It was supposed by Kurr that the function of these glands was vicarious, and that they only secreted honey till the fruit began to develop itself. But that the function of the nectary has no direct relation with the object of the function of the fruit, that is, the development of the seed, is proved in an experiment by Kurr himself, in which he found that the seeds of plants became perfectly maturated, although he had in the early stages of the growth of the flower removed the nectaries. As to what may be the determining cause of the secretion of sugar in these organs, any more than in other parts, no examination of their structure has hitherto pointed out. They do not however possess the power of secreting sugar and other secretions in any greater degree than the petals and other parts of the flower and fruit.

(Lindley, *Introduction to Botany;* Schleiden, *Grundzüge der Wissenschaftlichen Botanik;* Meyen, *Pflanzen Phyziologie.*)

NECTU'RUS, Rafinesque's name for a genus of *Derotremata*, placed by Cuvier between the *Axolotls* [AXOLOTL] and the *Proteii* of Laurenti. This form is the *Menobranchus* of Harlan and the *Phanerobranchus* of Fitzinger. It has the following characters:—Four toes on each foot. A row of teeth on their intermaxillaries, and another parallel but more extended on their maxillaries.

N. lateralis (*Triton lateralis* of Say; *Menobranchus lateralis* of Harlan; and *Phanerobranchus* of Fitzinger) is the species best known, and will serve for an example of the genus. It is olive, with blackish spots above, and a blackish stripe running from the muzzle just above the eye and reaching to the branchiæ, where it becomes continuous with the blackish belly, which is variegated with olive spots. The size is considerable; some say as much as two or three feet in length.

This creature is an inhabitant of the great North American lakes.

Necturus lateralis.

NEEDLE-ORE, a Mineral occurring crystallised in acicular 4- or 6-sided prisms, indistinctly terminated and longitudinally striated. Cleavage parallel to the axis of the prism. Colour, when first broken, steel-gray or blackish lead-gray, soon acquiring a yellowish tarnish. Cross fracture small-grained and uneven, with a shining metallic lustre. Hardness 2·0 to 2·5. Opaque. Specific gravity 6·125. It is found near Ekaterinburg in Siberia. The following is an analysis by Frick:—

Sulphur	11·58
Bismuth	43·20
Copper	12·10
Nickel	1·58
Tellurium	1·32
	69·78

NEEDLE-STONE, a name for the Mineral *Scolecite.* [NATROLITE.]

NEEDLE-WHIN. [GENISTA.]

NEGUNDO, a genus of Plants separated from *Acer* because of its pinnated leaves and diœcious apetalous flowers. Two species are known, one of which is a handsome hardy tree, inhabiting the United States of North America, and now common in the gardens of this country; the other is a native of Mexico, and at present but little known: it may be a mere variety of the other.

NELOCIRA. [ISOPODA.]

NELUMBIA'CEÆ, a natural order of Exogenous Plants, by some writers associated with *Nymphæaceæ*, or Water-Lilies, which they resemble in appearance and manner of life, inhabiting the fresh waters of the temperate parts of the world, and producing large polypetalous flowers with numerous stamens. But these orders differ in such important circumstances that they can hardly be regarded as plants of very close alliance, much less as members of the same order; for *Nelumbiaceæ* have no albumen, and their system of female organs is broken up into its original elements, while in *Nymphæaceæ* there is an abundance of albumen, and the female system is completely consolidated.

Nelumbiaceæ are readily known by their carpels being distinct, 1-seeded, and buried in the cavities of a large truncated fleshy receptacle, which eventually forms a broad hard bed, filled with holes, in each of which there is a single ripe nut. Notwithstanding their large flowers, these plants must be regarded as among the lowest forms of the exogenous type. The best known species is *Nelumbium speciosum*, a magnificent water-plant floating in the rivers and ditches of all the warmer parts of Asia, and also found in the Nile: its nuts are supposed to have been the sacred bean of Pythagoras; its fleshy stems are used as food by the poorer inhabitants of China. [NELUMBIUM.] The nuts of all the species are eatable and wholesome. *Nelumbium* is the only genus.

NELUMBIUM, a genus of Plants belonging to the natural order *Nymphæaceæ*, but sometimes regarded as the type of an order called *Nelumbiaceæ*. It has many distinct carpels, half-immersed in the profoundly honey-combed obconical elevated torus, each bearing a style with a solitary seed in each carpel, which is exarillate, and destitute of albumen. The flowers are large and showy, white, red, or yellow. Both leaves and flowers rise from the surface of the water.

N. speciosum, Pythagorean Bean, has a polypetalous corolla, and anthers drawn out beyond the cells into a club-shaped appendage. It is native in slow running streams and tranquil waters, in the warmer parts of Asia. The flowers are very beautiful, smelling of anise, and generally of a rose colour, seldom white. A variety of this species, Tamara, has its outer stamens sterile, dilated at the top, winged, obcordate, the appendage rising from a notch at the apex. It is a native of Malabar. The fruit resembles an instrument once used in play by the French, called Lotos, and is one of the plants supposed to be the celebrated Lotos of antiquity, formerly found in Egypt. It was known to the Greeks, and is mentioned as growing in Egypt by Herodotus (ii. 92), Theophrastus, and others. Although not now to be met with in that country, there can be no doubt as to its having actually existed there, either naturally or in a cultivated state, for these authors speak of it in clear and decisive terms, and their accounts are confirmed by the sculptures still preserved, which testify that this species, as the proper Lotos, has obtained religious reverence. It is spoken of as having been used as food by the Egyptians. Both roots and seeds are esculent, and are accounted cooling and strengthening, and to be of service in extreme thirst, diarrhœa, vomiting, &c. In China it is called Lieuwha, and the seeds and slices of the hairy root, with the kernels of apricots and walnuts, and alternate layers of ice, were frequently presented to the British ambassador and his suite, at breakfasts given by the principal mandarins. The roots are laid up by the Chinese in salt and vinegar for winter use. Thunberg says this plant is held sacred in Japan, and is considered pleasing to the deities, the images of which are frequently made sitting on its large leaves. The seeds are somewhat of the size and form of an acorn, and of a taste more delicate than that of almonds.

Nelumbium speciosum.

1, the ripe receptacle of *Nelumbium speciosum*; 2, a seed; 3, the same, with the two cotyledons so separated as to show the large plumule which they inclose.

N. luteum has a polypetalous corolla, and greatly resembles *N. speciosum* in structure. It is a native of North America, in lakes and ponds: it has been naturalised as far as Philadelphia. The flowers are yellow, and resemble a double tulip. The seeds are very agreeable to eat, and are much relished by the Indians and children.

(Don. *Dichlamydeous Plants*; Burnett, *Outlines of Botany*.)

NEMACA'NTHUS, a genus of Fossil Fishes from the Oolite and Liassic Strata. (Agassiz).

NEMALITE, a Mineral occurring in slender fibres, which are elastic, sometimes curved, and easily separated. The colour is white, with a shade of yellow. Streak white. Lustre highly silky. Opaque. Some decomposed varieties have an earthy appearance. Hardness 2·0. Specific gravity 2·353. It is found in veins at Hoboken, New Jersey, and other places in the United States. The following is its analysis by Dr. Thomsou:—

Silica	12·568
Magnesia	51·721
Peroxide of Iron	5·874
Water	29·666
	99·829

NEMATODES. [ELATERIDÆ.]

NEMATOIDEA. [ENTOZOA.]

NEMERTI'TES, a genus of Fossil *Annelida*, from the Lower Silurian Strata of Lampeter, in South Wales. (Murchison.)

NEMO'CERA, the first family of Dipterous Insects in the arrangement of Latreille, includes such species as have antennæ composed of many joints, an exserted head, a sheathed sucker, and either simple or toothed tarsal hooks. It includes the species of *Culex* and *Tipula*, the names given by naturalists to the Mosquitoes and Craneflies. These Linnæan genera are now greatly subdivided. [DIPTERA.]

NEMOICUS. [CURCULIO.]

NEMORHÆDUS, Colonel Hamilton Smith's name for the Goral Antelopes. [ANTILOPEÆ.]

NEMO'SIA, a genus of Birds established by Vieillot, and placed by Mr. Swainson in the sub-family *Tanagrinæ* in his family *Fringillidæ*. [TANAGRINÆ.]

NEOMERIS. [CETACEA.]

NEO'MERIS (Lamouroux), a group of articulated Corallines.

NEOMORPHA, a genus of Birds established by Mr. Gould on two species from New Zealand, but the specimens wanted the feet and the greater part of the wings. It has the following characters:—Bill longer than the head, compressed at the sides, arched, horny, solid, sharp at the apex, with a denticle. Nostrils open, placed in the basal furrow; carinâ mandibulæ superioris in pontem tendente. Tongue hard, slender, bristly at the apex; angles of the mouth with pendent fleshy caruncles. Total length of the largest species, 17½ inches.

NEOPHRON. [VULTURIDÆ.]

NEO'TRAGUS. [ANTILOPEÆ.]

NE'OTTIA is a name given to a brown leafless scaly plant, found in woods in this country, growing parasitically on the roots of other species. It belongs to the natural order *Orchidaceæ*, and flowers in May and June. It has a hooded perianth; a deflexed 2-lobed lip saccate at the base; the stigma transverse; rostellum flat, broad, prominent, entire, and without an appendage.

The only species is the *N. Nidus Avis*, or Bird's-Nest, so called from the appearance of the entangled fleshy fibres of the root. The whole plant is of a pale reddish-brown; the root formed of many thick fleshy fibres, from the extremities of which young plants are produced. The stem is about a foot high, with sheathing brown scales. It has no leaves. The spikes are dense, cylindrical, and many-flowered. It is the original *Neottia* of Linnæus, and is a native of Great Britain in shady woods.

Some modern botanists strangely enough apply the name of *Neottia* (itself meaning literally a nest) to plants having no entanglement of the roots that can justify the appellation, and more generally called *Spiranthes*: by those writers the true Bird's-Nest is called *Listera Nidus Avis*—a perversion of nomenclature for which there is no necessity, and which no necessity could justify. This genus gives its name to a division in the Orchidaceous order, called after it *Neottieæ*, composed of terrestrial species, especially characterised by the anther being placed at the back of the stigma, not vertically upon the end of the column, and by the pollen being pulverulent.

NEPA, a genus of Hemipterous Insects of the family *Hydrocorisæ*, the species of which are popularly known as Water-Scorpions. Their bodies terminate in two long setæ, by means of which they acquire a supply of air for respiration when immersed in the water or mud.

NEPENTHA'CEÆ, *Nepenths*, a natural order of Exogenous Plants inhabiting the damper and warmer parts of Asia, and having, in the place of leaves, large hollow bodies furnished with a lid, and containing water secreted from a peculiar glandular apparatus with which they are lined. These bodies, or pitchers, as they are called, appear at the end of a leafy tendril-like expansion of the bark, and are considered to be a hollow state of the apex of the petiole of a leaf, while the lid that closes them is regarded as the blade. Their flowers are diœcious, green or brown, apetalous, arranged in cylindrical racemes, and are succeeded by a capsular fruit filled with fine fusiform seeds, which look like very small sawdust. They are considered to be closely akin to *Aristolochiaceæ*, and also related to *Sarraceniaceæ* and *Euphorbiaceæ*. Adolph Brongniart has pointed out a resemblance between *Nepenthaceæ* and *Cytinaceæ*; but Lindley remarks that it is impossible to agree in this conclusion:—"To say uothing of the extreme dissimilarity in habit between these plants, the structure of their fruits appears to be essentially different; and the seeds of *Cytinus* being unknown, the resemblance between it and *Nepenthes* is reduced to a similarity in the arrangement of the anthers, which cannot in the present case be considered of much importance, as it in some degree depends upon the unisexuality of the flowers of both genera. A better approximation of the order has been made by Brown, who points out a relation to Birthworts (*Aristolochiaceæ*); as to which, the structure of the wood in some respects confirms his views. Like many in that order it is zoneless, although plainly exogenous; but it has this in particular to characterise it, that the system of spiral vessels is developed in a degree unknown in any other plants. Endlicher adopts the same view as does A. Brongniart, and I have formerly coincided with those botanists; but the adherent ovary of Birthworts, their highly-developed calyx, axile placentation, and bermapbrodite flowers, are serious difficulties in the way of a close contact between them and Nepenths, unless the peculiar structure of the wood, the consideration of which I for the present abandon, should lead to the final establishment of the class of Homogens, in which case Nepenths and Birthworts will be brought into contact or at least a near neighbourhood. For the present the true position of this order must be regarded as an undetermined point." Lindley places them in the Euphorbial alliance, observing that "its points of agreements are its unisexual flowers, albuminous seeds, incomplete floral envelopes, and climbing habit.

Its great disagreement consists iu its indefinite seeds aud peculiar woody structure, wbicb is however in some respects without example." ('Vegetable Kingdom.') Tbe water found in an unopened pitcber was fonnd to emit wbile boiling an odour like haked apples, and to yield minute crystals of superoxalate of potasb. There are about six species of *Nepenthes.*

Nepenthes distillatoria.

1, a male flower; 2, a female flower; 3, a vertical section of the ripe capsule; 4, a vertical section of a seed very much magnified; 5, the seeds.

NEPETA (a name used by Pliny from 'nepa,' scorpion, being supposed to be efficacious against the bite of a scorpion, or from Nepe, or Nepete, a town in Tuscany), a genus of Plants belonging to tbe natural order *Labiatæ*, and tbe trihe *Nepeteæ*. It has diverging anther-cells; a ringent corolla, the upper lip flat, straight, emarginate, or bifid; the calyx is 5-tootbed.

N. Cataria, Catmint, has stalked cordate acute leaves, deeply crenated, and clothed witb a whitish pubescence beneath; dense many-flowered whorls; smootb and glabrous nuts. The stem is from 2 to 3 feet in heigbt, downy or mealy. It is a native throughout the whole of Europe and Middle Asia, and is plentiful in Britain. The corollas are white, with a tinge of red spotted witb purple. The wbole plant has a strong smell between mint and pennyroyal. Cats are said to be fond of it, and bence it derives its name; tbey roll tbemselves on it, and tear it to pieces apparently witb mucb pleasure. Ray noticed that tbe plants he removed from the field into bis garden were always destroyed by cats unless he protected them with thorns until tbey had come into flower, but they never meddled witb plants raised from seed; bence the old saying, "If you set it the cats will eat it; if you sow it the cats won't know it." Ray accounts for this from the fact that by transplanting the leaves become bruised, and the powerful odour is exbaled which attracts tbe cats to it. It appears to act as a real aphrodisiac upon cats. Sheep are said to eat it, but all otber domestic animals refuse it.

N. Glechoma (*Glechoma hederacea*, Smith) Ground-Ivy, has uniform cordate crenate leaves, axillary stalked wborls, ovate aristate teetb, and oblong nuts with impressed dots; tbe corolla is a ligbt bluisb-gray, three times as long as the calyx. It is a native of Europe and the north of Asia, in hedges and ditches, in woods and waste places, and is plentiful in Britain. The leaves of tbe Ground-Ivy were formerly thrown into tbe vat with ale to clarify it and give it a flavour: this was called Gill-Ale, Ground-Ivy being named Gill, or Gell, and Creep-by-Ground, in some places. From tbis use of the plant, and the form of tbe leaf, it bas also the names of Ale-Hoof and Tun-Hoof; but it has gradually grown into disuse since the introductiou of hops.

N. Nepetella, Small Catmint, is an erect pubescent plant, clothed witb boary tomentum; the leaves lauceolate, crenate, rounded or cordate at tbe base, clothed with hoary tomentum or pubescence on hotb surfaces; the raccmes many-flowered, nearly simple; the bracts scarcely longer tban tbe pedicels; the calyx tububar, incurved with an oblique mouth; tbe corolla twice as long as the calyx. It is a native of the south of Europe, and is found iu Spain, Provence, Switzerland, and Italy. It is a very variable plant, especially in gardens. Many varieties bave been described.

Tbere are about 70 species of *Nepeta* known to botanists. Some of tbem have pretty blossoms, and may be cultivated iu the garden. They grow well in any garden soil, especially wben light and dry. They may be propagated by dividiug the root or by sowing the seeds.

(Kocb, *Flora Germanica*; Babington, *Manual of British Botany*; Don, *Dichlamydeous Plants*.)

NEPHELINE, or *Sommite*, is a Mineral which occurs in attacbed hexagonal prisms. Its primary form is a rbomboid. It gives indications of cleavage parallel to the planes of the prism. The fracture is conchoidal, sbining. It scratches glass. Colour white; streak tbe same. Lustre vitreous. Transparent, translucent. Specific gravity, 2·360. When a transparent fragment is put into cold nitric acid it becomes cloudy, and afterwards gelatinises. Before tbe blow-pipe tbe edges are rounded; with horax it slowly melts into a colourless transparent glass. It occurs ou Monte Somma, Vesuvius; and in tbe lava of Capo di Bore, near Rome. The following is an analysis by Arfwedson of a specimen from Vesuvius:—

Silica	44·11	
Alumina	33·73	
Soda	20·46	
		98·30

Elæolite is the name given to dingy oily-looking masses. It is found in Norway and Siberia.

Giescekite is a name for crystals from Greenland.

Cancrinite is a bluisb variety.

NEPHELIS, a genus of *Annelida.*

NEPHRITE—*Jade* or *Axe-Stone*—a Mineral which occurs iu masses. Tbe structure is compact. Its fracture is coarse, spliutery. Hardness 7·0. It is very tough. Colour dark-green and greeu of otber shades. Translucent on the edges. Specific gravity 2·9 to 3. Before the blow-pipe it wbitens, but does not fuse, but with borax it forms a transparent glass. Tbe following is an analysis by Kästner:—

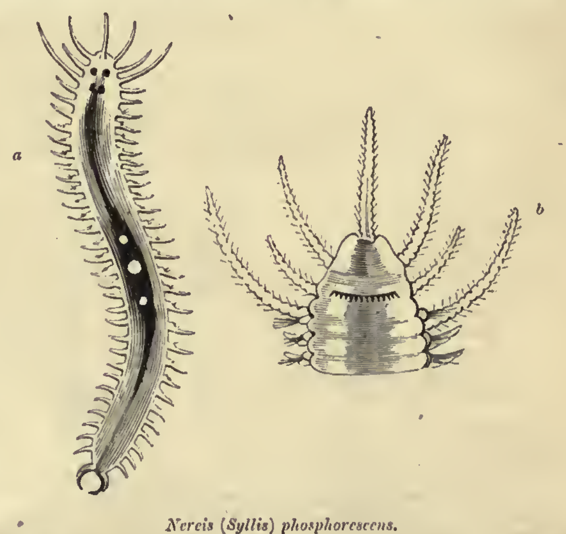
Silica	50·50	
Alumina	10·00	
Magnesia	31·00	
Oxide of Iron	5·50	
Oxide of Chromium	0·05	
Water	2·75	
		99·80

It is carved into images and worn as a charm. It was supposed to be good in diseases of tbe kidney—hence its name. It is found in New Zealand, China, and Western America.

NEPHROPS. [HOMARUS.]

NEPTÆA, a genus of Zoophytes.

NEREIS, Cuvier's name for a genus of Dorsibranchiate *Annelida*, comprehending the genus *Lycoris* of Savigny. Tentacles equal iu number are attached to the sides of the base of tbe head; a little more forward are two other biarticulated ones, and between tbem two simple ones: they have only one pair of jaws in tbeir proboscis (trompe). The branchiæ only form small laminæ on whicb a net-work



Nereis (Syllis) phosphorescens.

a, the animal (1-3rd iuch focus); *b*, head of the same (1-12th inch focus). Garner.

of vessels creeps; there are besides two tubercles to each of their feet, two bunches of filaments, a cirrhus above, and one below.

Lamarck states that the antennæ of the Nereids are in general short. The eyes, when distinct, he says, are four in number. The proboscis is large, open at its extremity, and often furnished with salient points or small tentacles. Lamarck divides them into six genera, namely, *Lycoris*, *Nephtys*, *Glycera*, *Hesione*, *Phyllodon*, and *Syllis*, principally on the ground of the presence or absence of jaws, and the modifications of the antennæ: to these he adds *Spio*.

The Nereids are widely spread, and some of the species are found in most seas. Some are found on our own coasts. [ANNELIDA.]

NEREITES, a genus of Fossil *Annelida*, from the Lower Silurian Strata of Lampeter, in South Wales. [Murchison.]

NERITA, a genus of Gasteropodous *Mollusca*, the type of the family *Neritidæ*. The genus *Nerita* has the following characters:—Shell thick, smooth, or spirally grooved; epidermis horny; outer lip thickened, and sometimes denticulated within; columella broad and flat, with its inner edge straight and toothed; operculum shelly.

N. polita has the shell thick, smooth, somewhat shining, longitudinally striated very finely, varying in colour; the spire very retuse, the lip toothed, smooth above. (Lam.)

Nerita polita, with its animal. 'Astrolabe.'

This species, according to Messrs. Quoy and Gaimard, is the most plentifully diffused of any of the genus, and is found in nearly all the seas of warm climates. It is heavy, polished, marbled, and often coloured with three red transverse bands.

The animal is of a uniform yellowish-white, with the exception of the tentacles, which are of a smoky-brown colour.

N. Ascensionis has the shell solid, transversely furrowedly ribbed, greenish-gray, spotted with white and brown: spire prominent, the apex yellow; aperture white; the lip toothed, rugous above: marked above with a yellow spot. (Lam.)

This shell is deeply striated, rugous, yellowish-gray, with circumscribed brown spots upon the parts in relief; aperture smooth, yellowish-white; peristome dotted with white and brown.

Nerita Ascensionis.
a, shell, with animal; *b*, operculum.

The animal has the foot yellow below, striated and dotted with deep-brown on the sides, so as to appear nearly black on a yellowish ground. The head, which has a very expanded hood, is striated in the same manner. The neck is violet. The tentacles are long, pointed, lively-brown, striated longitudinally with black. The eyes, placed at their base, are at the extremity of a triangular palette of yellowish-white, having a black stripe at the external border. The mantle has its contour dotted with brown. The operculum is red-brown, very much granulated, angular at the posterior border, and provided with a very projecting heel or process. It is found in the Island of Ascension. ('Astrolabe.')

END OF VOLUME III.

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