

fimbriæ, after which the tongue is retracted into the beak, and the insect swallowed by the ordinary process, as doubtless those are which are captured with the beak in flight. I do not thoroughly understand the mode by which liquids are taken up by a humming bird's tongue, though I have carefully watched the process. If syrup be presented to

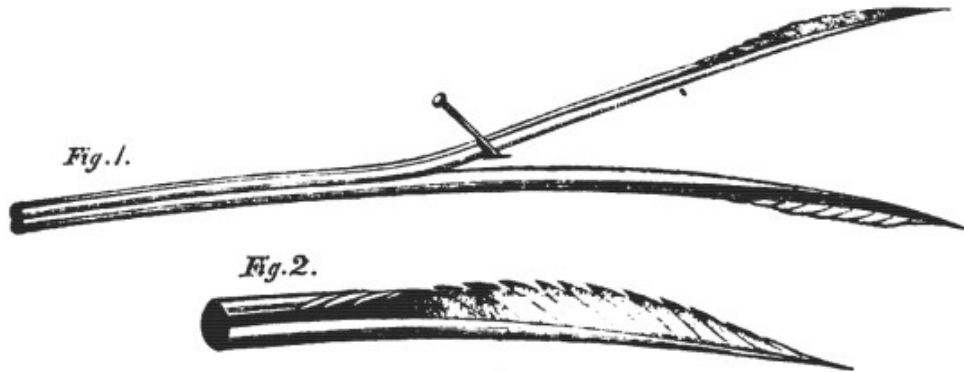


Fig. 1 represents the tongue in *Trochilus polytmus*, considerably magnified; the terminal filaments kept asunder by means of a pin.

Fig. 2. The extremity of the left filament still more magnified.

one in a quill, the tongue is protruded for about half an inch into the liquor, the beak resting in the pen, as it is held horizontal. There is a slight but rapid and constant projection and retraction of the tubes, and the liquor disappears very fast, perhaps by capillary attraction, perhaps by a sort of pumping, certainly not by licking."—*P. H. Gosse; Sandhurst, Torquay.*

Who are the Humming Bird's Relations? By
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IN your last number you have thrown down a gage of battle which I willingly take up. I beg to be allowed to say a few words in favour of the humble swift, who claims a hearing through me, his unworthy champion, to prove his undoubted, though somewhat distant, cousinship to the great and wealthy family of the Hummers; and to show that those Indian sun-birds who have so long held that honoured place in public estimation come of a different stock altogether,—very ancient and highly respectable no doubt, but still quite unworthy of the high position in which their too-partial friends have placed them.

Misled by similarity of dress and by a general resemblance in size and habits, and owing perhaps to the fact that inhabiting respectively the Eastern and Western tropics few naturalists have enjoyed a personal acquaintance with both families, and thus been enabled to detect the real and important differences hidden beneath the jewelled

robes with which Nature has alike decked them, all authors on Ornithology had placed the Trochilidæ near the Nectarinidæ and Meliphagidæ, till Prince Bonaparte, in his 'Conspectus Generum Avium,' published in 1850, separated them widely from these groups, and placed them immediately after the swifts (Cypselidæ). In 1856, in a paper on the "Natural Arrangement of Birds," published in the 'Annals of Natural History' (p. 193), I classed them as a very aberrant group of Fissirostres, and believe I was the first writer, at least in England, to give any reasons for so placing them.

Before proceeding to state what these reasons are it is necessary to make a few observations on some important principles of classification. It is now generally admitted that for the purpose of determining obscure and distant affinities we should examine those parts of an animal which have little or no direct influence on its habits and general economy. The classificatory value of an organ is in inverse proportion to its adaptability to special uses. By this means we shall penetrate the disguise of external form as adapted to similarities of food and habits, and arrive at the true and essential differences that underlie them. We thus determine that the Cetacea are not fishes, though judging from external form and habits alone we should certainly so class them, because the essential mammalian characters, which are anatomical and physiological, remain highly developed. So, though there are Marsupials which take upon themselves the exact form, habits and mode of life of Rodents or Carnivora, yet minute details of structure in the skull and skeleton, and their physiological peculiarities are universally held to separate them completely from these orders. Among birds the hornbills and the toucans may be said to have the same general form, to agree strikingly in their enormous bills, in their general habits, their food, and their mode of taking it,—yet peculiarities in the structure of the feet, of the plumage, and more particularly of the skeleton, show that they have no real affinities, the former approaching the kingfishers and the latter the cuckoos.

On the other hand we often find peculiarities of organization, which seem specially adapted to the mode of life, become diminished or altogether lost in certain aberrant species of whose affinities notwithstanding there has never been any doubt. For example, the woodpeckers are most strikingly characterised by the extensile tongue with *os hyoides* prolonged over the head, exactly as in hummers, and also by the rigid and pointed tail; but in one group (*Sasia* and *Picumnus*) the tail becomes quite soft, while the tongue remains fully developed; in another (*Meiglyptes brunneus*) the characteristic tail remains while the

prolonged *os hyoides* has entirely disappeared, and the tongue has consequently lost its peculiar extensile power; yet in both cases the characters of the sternum, the feet and the plumage show that the birds are true woodpeckers, and the food and general habits remain unaltered. In like manner the bill may undergo immense changes from the smallest size in some goatsuckers to the enormous horny mandibles of Podargus, without at all invalidating the affinities of those birds for each other; or the long feathery tongue of the toucan may differ from that of any other bird, and yet not overcome the force of the anatomical and other evidence which shows that the barbets and the cuckoos are their undoubted allies.

The skeleton, therefore, and especially the sternum, offers us an almost infallible guide in doubtful cases, as indicating deeper seated affinities than those shown by organs which are continually modified in accordance with varying conditions of existence. Another guide of this kind is furnished by the egg. This has a characteristic form and colour, and a peculiar texture of surface which runs unchanged through whole genera and families which are really related to each other, however much they may differ in outward form and habits. When, therefore, these two kinds of evidence coincide in indicating an affinity, which is in other respects doubtful, they may be considered as almost infallible. Now, in the case of the humming birds, we have this evidence. Their sternum and eggs resemble those of swifts much more than they do those of any other birds. Nor is this by any means their only likeness, for in many important points of general structure the two closely agree. If any one will take a swift of the genus *Collocalia* (the constructor of the edible nest) and also one of the eastern tree swifts (*Dendrochelidon cornatus*), he must be struck by the resemblance of these to the larger hummers in everything but the bill. The small size, the immense pectoral muscles, the short and powerful wing-bones and the enormously developed quills, are points of coincidence of great importance. The *Dendrochelidon* also makes an approach to the brilliant metallic tints of the hummers, and its long white whisker-plumes, erectile crest and immensely forked tail, remind us of some of the eccentricities of that wonderful group of birds. Here, too, we have the first quill-feather longer than all the others, a peculiarity found in no other family of Passeres but the Trochilidæ and the Cypselidæ, which further agree in having each but ten feathers in the tail. The feet also strikingly resemble each other, in both being small, with very short tarsi, short and powerful toes, with short greatly curved claws, a dilated sole, the hind toe and claw always shorter than

the others, and a great grasping power. The bill and tongue offer the sole important points of difference, but, on the principles before alluded to, they are of less importance than the points of agreement, because, being organs directly concerned in maintaining the existence of the birds, they are modified to suit the very different habits of the two families. Moreover, in a very young state, the difference is scarcely perceptible. In a pair of nestling hummers which I kept alive some days by feeding them with minute insects, which they greedily devoured, while they showed repugnance to every kind of syrup, which, therefore, probably only enters into the diet of the adult birds; I observed that the beak was short and triangular, with a very wide gape,—in fact, just the beak of a swift. I am sorry I neglected to examine the tongue of these young birds, but I have little doubt it would have been simple, or only showing a slight approach towards the tubular form. The formation of such a tongue out of one of the ordinary flat horny type is very easily conceivable. It has only to become lengthened and dilated at the margins, which gradually curl in on each side till they meet, forming a double, or rather reniform, tube. The hummer's tongue is really flat, like that of any other bird, the inrolled edges not being united at their line of contact, so that, in their fresh state, it may be flattened out into a long and very delicate ribband. The end of this tongue is fibrous, and the act of suction would no doubt secure minute flower-frequenting insects as well as pump up nectar; and that insects form the most common contents of the stomach I can assert from the examination of scores of specimens of many different species.

We will now consider what are the affinities of the Nectarinidæ, or sun-birds of the East; and at starting I will concede a point, which you, Mr. Editor, were not perhaps prepared for. I can state, from careful observation, that the tongue of the true sun-birds is really tubular, and exactly similar to that organ in the hummers, and the *os hyoides* is also partially extended over the head, so as to give some degree of extensile and retractile power. From this fact, however, I simply draw the conclusion that the structure of the tongue, though useful in confirming the affinities of genera, is not of sufficient importance to determine the relation of families when placed in opposition to other more deeply-seated anatomical and physiological characters. I can imagine how the tongue may become profoundly modified by variation and natural selection, to adapt it to some special purpose in the economy of the bird; but I cannot believe that the sternum (whose characteristic form has no immediate connection

with the habits of the species) should almost exactly resemble that of quite an unconnected family, and differ altogether from that with which it is really allied; still less that the independent evidence of the egg should confirm the same false relationship.

A further examination, too, will show us that the sun-birds are quite as sharply separated by the tubular tongue from their undoubted allies, as the hummers are from the swifts. The little birds of the genus *Diceum* have always been considered to come in the family of the sun-birds, and are undoubtedly closely allied to them, yet their tongue is short, simple, and merely split at the point. The honey-suckers of Australia and India agree closely with the sun-birds in general structure, in the form of the sternum, the shortness of wing, the length and strength of the leg (in which they both exceed most birds of their size), the large toes, the very long and powerful hind toe and claw, and in having twelve tail-feathers (in all which characters they are totally opposed to the hummers), yet the tongue is flat, of moderate length and terminating in a brush, produced by repeated splittings of the tip.

Now if the one solitary character of the retractile tubular tongue is sufficient to bring together two families so totally distinct in every other respect as the sun-birds and the hummers, it must also be held sufficient to separate them from every other family and to constitute them a distinct order of birds.

But I think I have shown that we have no reason whatever to give such importance to the modifications of the tongue. We have here, it appears to me, a most instructive example of how—when two totally distinct groups of organized beings, with some general resemblances of size and outward form, come to be specialised for a similar mode of life—Nature by means of natural selection may occasionally modify the same organ in each, in the same way, quite independently of each other.

The case of the sun-birds confirms my view of the true function of the tubular extensile tongue being primarily the capture of minute flower-frequenting insects; for those possessed of this organ and the almost equally extensible brush-tipped tongue, make insects a common part of their food, whereas the simple-tongued genera—as *Diceum*, *Phyllornis* and the American *Careba*—feed almost exclusively on soft fruits. The *Arachnotheræ*, the most highly developed of the true sun-birds, live principally on spiders and nectar, and I have often seen them fluttering in the air at flower-bunches or a sap-exuding palm,

thus imitating the action of the hummer as far as their very different organization will permit.

It is worthy of remark that the true allies of sun-birds in America, the beautiful little *Carebidæ*, which might naturally be expected to show some sort of transition to the hummers if there were any real connection between the groups, are still farther removed from them, and have never been supposed by any observer or naturalist to have the slightest affinity with them, though obtaining much of their food from flowers in a somewhat similar manner.

The sun-birds, honeysuckers and allied groups are, I believe, related intimately to the *Epimachidæ* and paradise birds, with which they agree in general internal structure, in the powerful and highly developed grasping leg, in their activity and general high organization and special adaptation to a purely arboreal existence; and this affinity is most beautifully shown in the little tufts of plumes from the breast and flanks which appear in several distinct genera of these birds (*Arachnothera*, *Nectarinia*, *Moho*, *Prothemadera* and *Ptilotis*), and which form a most constant and remarkable character in the *Paridiseas*. The wonderful *Neomorpha Gouldii* (undoubtedly allied to this great group of families), in which the bills of the two sexes differ so remarkably in length and curvature that, judging from that organ alone, they might be placed in distinct genera or even different families, tells us most plainly that here the bill has become highly variable, and must be expected to differ among birds otherwise intimately allied. A case in point is that of the *Paradiseidæ* and *Epimachidæ*, families which have been placed in distinct orders of birds owing to the difference of their bills, but which, a knowledge of their internal and external structure, their food and habits, enables us to decide are most closely related, so much so that they will probably have to form ultimately a single family.

In conclusion of this somewhat lengthy exposition I would express my firm conviction, which I trust some of your readers will share with me, that the sun-bird and the hummer have not a shadow of true affinity, the former being a specialised form of an extensive group of typical *Passeres*, the latter essentially a swift, profoundly modified for an aerial and flower-frequenting existence, but still bearing in many important peculiarities of structure the unmistakeable evidences of a common ancestry.

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