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LONGMAN, BROWN, GREEN, AND LONGMANS.

PARIS:—FRIED. KLINCKSIECK, 11 RUE DE LILLE; BAUDRY, 9 RUE DU COQ, PRES LE LOUVRE; LEIPZIG, T. O. WEIGEL.

SOLD ALSO AT THE APARTMENTS OF THE SOCIETY.

MDCCCLIV.

Mr. Woodward replied—

Sir, I beg to thank you, and the Council, for the valuable compliment you have conferred upon me. It is well known to many gentlemen now present, that I commenced life in the service of this Society, as assistant to Mr. Lonsdale, whose name is still so highly esteemed within these walls; and I enjoyed the good fortune of remaining here during the whole time of your former official connection with the Society. In the position which I have held, it has been my duty rather to assist others than to conduct investigations of my own; and I have been amply rewarded by the kind and liberal manner in which the slightest services have always been acknowledged by Fellows of this Society.

ANNIVERSARY ADDRESS OF THE PRESIDENT.

Gentlemen,—Whilst we rejoice in our continued prosperity and look forward confidently to the future progress of Geology, we must not forget, that the year just gone by has been one of mourning for science and of heavy losses by death, abroad and at home, for our Society. First in the list of the departed, who were among our eminent members, is the name of .

Leopold Von Buch. The death of this illustrious philosopher and pre-eminent geologist took place, after a few days' illness, at Berlin, in March 1853. He had attained the age of 79 years, and to the last preserved his unrivalled energy and scientific enthusiasm.

Baron Von Buch was a member of an ancient and noble Prussian family, and was a Royal Chamberlain of Prussia; knighthoods and distinctions of all kinds had been showered upon him unsought, for his merits. He was one of the eight Foreign members of the Institute of France, and a foreign or honorary fellow of almost every great scientific academy out of his own country. At home he was one of the most active members of the Berlin Academy of Sciences. Fortunate in the possession of a sufficient, if not ample income, untied by the trammels of office or routine duties, he was enabled to devote the whole of his long life to the search after scientific truth. Nobly did he fulfil his mission. Unselfish, free from envy, anxious and able to aid, he sought not only to advance science by his own exertions, but to assist by advice at all times, by purse where necessary, every younger man who worked earnestly in the same course. There is an old Jewish proverb which says, "He who seeks a name loses fame;" Leopold Von Buch scorned fame and gained it.

He was a pupil of Werner; one of the youths destined afterwards to be illustrious, who studied under the instruction of the renowned professor of Freiberg. However serious the demerits of many of the views promulgated by that distinguished teacher, his eloquence and inspiration effected mighty services for geology, through the love for the science with which it imbued his disciples. Errors vanish in the course of time—they are like unpreservable species in geolo-

gical formations,—but merits last for ever, for through them science cannot fail to advance. Von Buch was one of the first to repudiate the mistaken views of his master, but he avowedly did so by the very spirit and method of research which he had cherished and learned at the school of Freiberg.

Von Buch was only eighteen years of age when he commenced his long series of contributions to the literature of science. His first paper was "A Mineralogical Description of the Carlsbad Region," printed anonymously in 1792. Four years afterwards he produced his "Contribution to a Mineralogical Description of Landeck," and soon after a similar treatise for Silesia, accompanied by a geological map. His merits as an accurate observer and clear describer were manifested in these early productions.

In the now venerable and ever-illustrious Humboldt he found a friend and fellow-student, with a kindred mind and genius, and these two great men worked together early in life. At the close of the last century they visited the Alps and Italy in company, and there it was that Von Buch commenced those researches into the geological phænomena of volcanoes that alone would have immortalised his name. He founded a great part of what may be termed the Science of Volcanoes, and gradually divesting himself, by the legitimate process of extended observation, of Wernerian theories, worked out this most interesting section of geology in the countries most likely to enable him to solve the many problems it presents. Italy, Central France, the trap districts of Germany and Scotland, and eventually, in 1815, the Canary Islands were submitted by him to close personal inspection; with what results I need not, in this place, recall. Suffice to say, that his great work, 'The Physical Description of the Canary Islands,' will long remain an enduring monument of his labours and his generalisations. The theory of Craters of Elevation was one of the most influential of the doctrines broached by him after his careful and prolonged study of igneous phænomena.

But during the course of these peculiar studies his mind was not confined to them, and other subjects of equal importance engaged a portion of his attention with as valuable results. In 1806, whilst Europe was torn by revolutions among men, Von Buch retired to the wilds of Scandinavia, there to study the greater revolutions of Nature. During a two-years' travel in Norway, Sweden, and Lapland, his inquisitive spirit did not fail to evolve new subjects for its speculations. What he saw there forced him to abandon the belief in the necessarily primitive date of granites, and his observation of the gradual rise of the Scandinavian area and its attendant phænomena, previously only imperfectly noticed and quite misunderstood, has been a fruitful source of fresh chapters in geology. How many of the best disquisitions of our time could trace their roots to these observations of Von Buch!

The first Geological Map of Germany appeared in 1824. Von Buch's name is not appended to it, but it is known that he was the compiler and author. The impulse to local geology given by a first map, and the difficulties with which the constructor has neces-

sarily to contend, cannot be too highly appreciated. The first step, in this as in many other things, is the chief difficulty, and one apt to be underrated by those who come afterwards.

After his return from the Canaries, Switzerland,—always the favourite region with Von Buch,—again became the scene of his travels. The mode and epochs of the upheaval of mountain chains were, among other subjects, the themes of his inquiries and essays. The famous doctrines of Elie de Beaumont bear witness to the influence and suggestiveness of Von Buch's observations. His theories concerning Dolomite, though not so productive of rich results, excited general attention and caused much wholesome controversy.

Twenty-five years ago, when already past the fiftieth year of his age, Von Buch seemed to enter upon an entirely fresh career, and to take up a line of inquiry in a totally different direction from that which he had previously followed, for he commenced those brilliant palæontological researches that have secured for him a permanent fame among the cultivators of the natural history side of geology, and even among pure naturalists. I say "seemed" to enter upon this course, for the thought and study had long been working in his mind, as is evident from the essay 'On the Progress of Forms in Nature,' printed by him as early as 1806. The ideas, then conceived imperfectly, had been silently and steadily growing within him, nourished by continual observations, and in 1828 they took a definite form, when he published his observations on Ammonites, followed at intervals by his monographs upon the Goniatites, Brachiopoda, and Cystidea. There are two distinct aspects of Palæontology, a geological side and a physiological side. Cuvier was the true architect of the latter, but Von Buch erected the former. It was he who first developed the idea of the chronomorphosis of genera, the great leading principle of natural history applied to geology. He arrived at it fairly and inductively, and demonstrated it monographically and practically. He gave a grand impulse to the study of stratified rocks, an impulse only now beginning to be felt in its full force. With his usual sagacity he saw clearly its value and bearings, as is plainly indicated by his essays on comparative or geographical geology, and the latest of his numerous memoirs, those on the Cretaceous and Jurassic formations. If I am not greatly mistaken, the future progress of comparative geology will depend mainly on the following up of the palæontological doctrines that were originated by Von Buch. Viewed, too, entirely apart from their geological merits, and considered under a purely natural-history aspect, the monographs on fossils by Von Buch are most remarkable productions, both as descriptive and as philosophic essays. Not long before he died he directed his attention to fossil botany, and endeavoured to evolve guiding principles from the study of the nervation of leaves. He did not rashly enter upon this fresh subject, for botanical inquiries had long before interested him in their details, as his Scandinavian and Canarian researches testify.

Philosophers may be divided into two great natural orders, those who sow and those who reap—the originators and the demon-

strators. Von Buch was a sower. He went about the world casting the seeds of new researches and fresh ideas, wherever his prophetic spirit perceived a soil adapted for their germination. The world of science has gathered a rich harvest through his foresight. He is the only geologist who has attained an equal fame in the physical, the descriptive, and the natural history departments of his science. In all three he has been an originator and a discoverer. In every subdivision of all three he has been a suggester — a high merit in itself.

Von Buch never married. Personally he had his peculiarities and eccentricities, odd ways of his own that amused the stranger and endeared him to his many friends. Probably no geologist had ever so general an acquaintance. He went everywhere to take the measure of the workers in his favourite science, and knew them, bodily and mentally, almost all. I shall ever esteem it a good fortune to have seen him, to have received a lesson from him, and to have deserved his published commendation. Though gone from among us, his ubiquitous spirit is with us, and in the Report which I shall have to give of geological progress during the past year, I could point out the influence of his ideas at almost every step.

A short half year has passed away since among the most active and vigorous of our younger members, Hugh Edwin Strickland took a prominent part in our meetings and discussions. Healthy, earnest, and indefatigable, his life promised to be one of long services to natural science. In the best period of manhood, when experience and energy meet and work together, when well-sustained exertions in the cause of truth, and the proofs of an equal capacity for scientific learning and original research have raised our expectations and cherished our hopes, Mr. Strickland was taken from amongst us awfully and immediately, falling literally a martyr to geological science. He had been engaging, with his customary zeal, in the discussions of the Meeting of the British Association at Hull, when at the termination of the sittings he proceeded to the neighbourhood of East Retford, to examine the cuttings on the line of railway at the mouth of the Clanborough Tunnel. Intent upon his observations, note-book in hand, unhappily unaware of the danger of his position, he stepped from one line to another to avoid an approaching coal-train, just at the moment that the Great Northern passenger-train was issuing from the tunnel. Instantaneous death terminated his earthly career.

Mr. Strickland was in the forty-second year of his age. He was a native of Righton in Yorkshire, and inherited scientific tastes from his father, Mr. H. E. Strickland of Apperley, and his maternal grandfather, the eminent Dr. Edmund Cartwright. Part of his education was conducted by the late Dr. Arnold, who took a warm interest in the talents of his distinguished pupil. His training was completed at Oxford, where he studied at Oriel College, and where doubtless, under the lectures of Dr. Buckland, he acquired and ripened

those geological tastes which eventually led to his appointment as successor of his illustrious master in the Geological Chair of the University.

His acquirements in natural science were singularly diversified, embracing more or less all departments of natural history, and there are few sections of the science upon which at one time or other he did not publish observations or memoirs. His knowledge of the literature of natural history was remarkably extensive, exceeding probably that of any living naturalist; and the 'Bibliographia Zoologiæ et Geologiæ,' based on the manuscripts of Professor Agassiz, and published by the Ray Society, owes much of its value to his editorial care and unrivalled acquaintance with authors and their works. As a zoologist, the greater share of his attention was devoted to ornithology, in which department he enjoyed a world-wide fame. His work, written jointly with Dr. Melville, on extinct birds, especially the Dodo, was an application of his ornithological knowledge to geology.

Mr. Strickland's geological researches were confined to no single locality or group of formations, and his name will be ever recorded in histories of geology. In the British Islands his favourite subjects were the New Red Sandstones, Lias, and Pleistocene beds. In conjunction with Sir Roderick Murchison, he described the geology of the neighbourhood of Cheltenham, and communicated to our Transactions the well-known important memoir "On the Upper Formations of the New Red Sandstone system in Gloucestershire, Worcestershire, and Warwickshire." Many papers on the geology of various points in these counties are contained in our Journals and Proceedings. He contributed also to a knowledge of the geology of portions of Scotland and of the Isle of Man. In company with Mr. Hamilton, he travelled in the Mediterranean and Levant, and explored the geology of parts of Asia Minor, the Thracian Bosphorus, and the Island of Zante. Their joint memoirs on those countries are printed in our Transactions, and contributed materially to extend our knowledge of the structure of Eastern Europe and Western Asia. The demonstration of the existence of Palæozoic strata on the shores of the Bosphorus was one of the many fruits of this expedition.

Earnestness, energy, and simplicity were the distinguishing features of Mr. Strickland's character. He was thoroughly a man of science, and as thorough a gentleman. Fearless in his maintenance of his convictions, whether by speech or pen, his freedom from animosity and evident straightforwardness invariably converted his opponents into friends. Mr. Strickland was most happily married, but has left no family. His father-in-law, the eminent naturalist Sir William Jardine of Applegarth, has undertaken to complete the editing of the remaining volumes of the 'Bibliographia.'

One of the warmest and wisest friends of the Society, and during many years an active member of it and constant attendant at its meetings, was Charles Stokes, whose name will be long borne in mind with affection and gratitude by many geologists and naturalists. Although constantly and assiduously engaged in business, Mr. Stokes

contrived, whilst passing his days in the City and on the Stock Exchange, of which he was a most respected member, to acquire a vast amount of minute and accurate scientific information, and to pursue original, though, alas, too seldom published researches; and there was scarcely any department of the natural history sciences with which his acquaintance was not considerable. Careless of fame and brimful of benevolence, he laboured incessantly, whenever a moment of leisure permitted, to advance science by every means that lay within his power. He collected rare and interesting specimens at any cost, not for their own sakes, but to place at the disposal of any competent person who had the requisite knowledge and determination to investigate the subjects they could serve to elucidate. Before microscopic science was in fashion, he was at work encouraging the makers of microscopes, suggesting improvements, purchasing beautiful instruments, and testing their application. When lithography was in its infancy in England, he foresaw what could be done with the rising art; and, sparing no expense, found a zealous and talented ally in the late Mr. Hullmandel for experimenting on his suggestions. His knowledge of some branches of zoology and palæontology was minute and curious, as well as of parts of botany. Trilobites and Zoophytes were among his favourite subjects; upon the former he communicated valuable materials and information to the great work of Alexander Brongniart on the Fossil Crustacea; about the latter he possessed a store of novel and original information, which I fear is in great part lost with him. The subject of the fossilization of wood was one which he pursued even to the last; and only two months before his death I received a letter from him, accompanying some specimens illustrative of his views, and inquiring about others. In the 5th volume of the 2nd series of our Transactions is published a valuable paper by him on this subject, containing an explanation of the phænomena exhibited by partially silicified wood, and of the progressive steps in the process of petrifaction. In the same volume is a memoir upon "Some Species of Orthocerata," with an account of the siphon of Actinoceras and the foundation of the genus *Ormoceras*. The many curious researches concerning the Orthoceratites that have interested palæontologists of late years had their origin in his discoveries. Some time before he had made mineralogical communications to the Society. His name is constantly cited in numerous foreign treatises. But the scantiness of his writings can give no true notion of his learning and his influence on the progress of science during his time. Not an expedition started for foreign discovery, but he was in at the commencement to advise and direct the natural history arrangements. I am one of many who owe much to the sound sense and surprising knowledge of Charles Stokes. He was the Ellis of our times. I have spoken only of his scientific learning; he was as remarkable for literary, antiquarian, musical, and artistic knowledge. He died in London, deeply regretted, in the last week of December 1853, at the age of 70. His pleasant and wise presence will be missed for many a year.

Mr. Alexander Robertson, whose name as a geologist was best known to us with the affix "of Elgin," was born at Aberdeen in the year 1816, and after an education, conducted partly in England and partly in Scotland, became a pupil of Professor Syme, and studied medicine at Edinburgh. Disliking his intended profession, he soon abandoned it, and after studying science in Germany, returned to Scotland and settled in Morayshire, to pursue farming, I regret to say without success, since his death left a widow and four children unprovided for. Mr. Robertson's name is familiar to you as that of the discoverer of Freshwater beds intercalated in the Oolites of Brora. He communicated his observations on this subject to our Society, and subsequently (May 1846) a longer memoir "On the Wealden Beds of Brora, Sutherlandshire, with Remarks on the Relations of the Wealden Strata and Stonesfield Slate to the rest of the Jurassic System, and on the Marine Contemporary of the Wealden Strata above the Portland Stone;" an essay remarkable for its thoughtful and suggestive character. In this paper he pleaded forcibly for Sir Roderick Murchison's view of the Oolitic relations of the Wealden; some recent discoveries have in great part supported the argument maintained by Mr. Robertson.

Mr. Henry William Taylor was well known to the Members of our Society for his fine collection of Chalk fossils, which he spared neither time nor expense to bring together.

I shall not venture, Gentlemen, in the following Address to discuss fully and in all its details any one subject, in the manner so admirably and usefully done by my immediate predecessor, but follow the plan pursued by not a few of the distinguished men who have filled this Chair, of presenting to you in brief a summary of the leading features of geological progress during the year just passed, and a commentary on the aspects and aspirations of our science as manifested and indicated by the more salient labours of geologists during 1853. To do this thoroughly would require more leisure and a greater command of foreign languages than, unfortunately, I possess; but without professing to furnish a complete report, I hope to be useful by indicating the merits of that which has principally been done during the period I have had the distinguished honour of filling your presidency. If I claim the privilege of occasional criticism and difference of opinion, the responsibility of objections must fall entirely on myself, and if, through inadvertence, I commit injustice, by passing unnoticed any essay of merit and consequence, I trust on a future occasion to rectify the mistake and to render the acknowledgement that is due.

That the greater part of my report will take cognizance of Geology under its palæontological aspects, is a circumstance not dependent on my own predilections or peculiar line of study; it so happens that the majority of important papers published during the past year have been more or less of this character, and some of the most valuable of recent contributions to our science concern principally the natural

history department of Geology. The economics of the science have, it is true, received more than their usual share of attention, gold and coal forming the themes of not a few volumes and essays. But geology, properly so called, of a scientific character, is thinly diffused through auriferous treatises, although a great deal is often written in them about geology,—in the sense however of *round about* it. Descriptive Geology is constantly progressing, although the number of memoirs in this department has not been great during 1853. Knowing how much is in progress in this most important section of the science, we cannot regard the deficiency in the number of publications upon it as any indication of halting. The same remark may be made on the section of Geological Dynamics. Mineralogy, under its geological aspects is making decided progress in France and in America, but, to our shame be it said, continues to be neglected in England. There are numerous cultivators of it, it is true, for its own sake, learned and able mineralogists, who however, on this side of the Tweed at least, do not often put the results of their observations into print. In Scotland and in Ireland the pens of the mineralogists are much more active, and the investigation of mineral species ardently pursued, though not to the extent that we find these inquiries followed in Germany and the United States.

In the course of study of the many lately-published memoirs from which the materials of my Address are derived, the question of the meaning of the difference and contrast that are evident when we compare the faunas and floras of the more ancient or palæozoic with those of later epochs, has, in consequence of fresh accumulation of relevant facts, forced itself vividly upon my attention. It is a subject that, in common with most geologists, I have often earnestly thought over, and more than once published opinions upon. It has been the originator of not a few theories and speculations, not one of which can be said to have borne the test of searching inquiry into facts. Yet I think I am not wrong in saying, that a belief is as strongly impressed as ever on the minds of geologists who take interest in the philosophy of their science, that some law lies at the foundation of this difference. If I venture to add one speculation more, although its predecessors have either subsided into azoic oblivion, or linger, retaining but a weak hold upon our minds, I do so in the hope that there is a vitality in my offspring, which may enable it, when it becomes developed, though as yet only a suggestion, to endure; and I ask your indulgence for introducing it on this occasion, on the plea that it owes its birth to reflections arising out of this discourse.

The publication of the first volume of M. Barrande's great work on the Silurian System of Bohemia is a leading event of the geological year just completed, and from its importance commands our first attention. The researches, the results of which are embodied in this elaborate and beautiful treatise, were commenced twenty years ago, but have been more especially prosecuted during the last thirteen years. From time to time we have had more or less detailed notices of the fruits of M. Barrande's assiduous labours, but could

scarcely judge of their minuteness and importance until he commenced to send them forth in full. He now takes his place definitely in the foremost rank of geologists and palæontologists. He combines in a remarkable degree both qualifications,—no small advantage when the wide general views and the classification of great formations, such as are dealt with by this eminent man, have to be fully considered and put forth with ample arguments. Division of labour is good for the accumulation of sound and abundant materials, but experience has shown in both geology and the other sciences, that the greatest advances are to be made by combinations of kinds of knowledge in those who deal with the greater problems. M. Barrande has done well, it seems to me, by pursuing assiduously the double course he has chosen. The main body of the purely geological portion of his work he proposes to publish when the palæontological details, which constitute most of the evidence upon which his views are founded, have been laid before the geological world in all their completeness. The task he has before him in this respect is a laborious one; no less than the detailed description and critical investigation of some 1200 species of fossils,—for such is the number that has rewarded his search in Bohemia. The natural history and principal part of his first volume, a bulky work in itself, is devoted to the order of Trilobites. It is prefaced, however, by a general outline of the geology of Bohemia, which first deserves our notice, both on account of the interest it must present to British geologists dealing with palæozoic strata, and also because of certain original and peculiar views put forth in it.

The Silurian formation of the centre of Bohemia constitutes a well defined basin of an elongated oval shape, the great axis of which is directed nearly N.E. and S.W., and has a length of about 20 German geographical miles with a maximum breadth of 10. It is from 55 to 60 miles in circumference. Towards the N.E. and N. a small portion is bounded by the Trias, the Quader-sandstone, the Planer-kalk, or by the Carboniferous formation. Elsewhere, for two-thirds of its margin, granite or primordial crystalline rocks, such as gneiss and mica-slate, constitute its base and its boundary. A few small carboniferous basins are sprinkled over the Silurian surface, as well as a few isolated outliers of cretaceous beds. The dip in the two halves of the basin, the one to the N.E. and the other to the S.E. of the chief diameter, is towards the principal axis. The beds ordinarily lie at an angle of from 30° to 45°, often 70°, and are not unfrequently vertical.

M. Barrande distinguishes eight stages of strata to which he assigns a Silurian age; four of them he regards as Lower Silurian, and four as Upper Silurian. Of his Lower Silurian stages the two lowermost are azoic, the distinctions between them being founded on mineral characters, the first being composed of crystalline rocks, and the second of clay-slates and conglomerates, similar to the fossiliferous Silurian above them, but wholly void of organic remains. They are rich in lead mines. These azoic stages pass into each other, and the upper section passes gradually into the fossiliferous beds above.

The third stage of his Lower Silurian, and the first of his fossiliferous horizons, includes his "Schiste protozoique," and attains a thickness of 1200 feet. It contains no beds of limestone. The fauna of this section is very peculiar; it is composed almost totally of Trilobites, the other fossils being a Pteropod, some Cystideæ, and an Orthis. These constitute an assemblage upon which he lays great stress and designates *primordial*. All its species, without exception, are peculiar to itself, and of the Trilobites, all the genera are so, with the exception of *Agnostus*. The peculiar genera are either low and rudimentary types, or members of the Olenoid or Calymenoid families; not typical or highly developed forms. They are *Paradoxides*, *Conocephalus*, *Ellipsocephalus*, *Sao*, *Arionellus*, *Hydrocephalus*, and *Agnostus*. Of the first of these genera there are no fewer than twelve species, some of them exceedingly prolific. These primordial Trilobites have a peculiar facies of their own, dependent on the multiplication of their thoracic segments, and the diminution of their caudal shield or pygidium. M. Barrande compares this primordial fauna of Bohemia with certain fossiliferous assemblages similarly placed at the base of the fossiliferous Silurians in Wales, Norway, and Sweden, in which last country, indeed, the peculiarities of its fossils long ago attracted the attention of naturalists and the notice of Linnæus.

The isolation of this primordial zone, as distinguished from the mass of the Lower Silurian, is chiefly maintained by the grouping in it of the Olenoid family of Trilobites, almost to the exclusion of all others. It is not quite certain that more than one of the genera of Trilobites distinctive of this zone are found in any higher beds. The exception is *Agnostus*, the lowest and most rudimentary type of its tribe. Yet even this has its metropolis in the primordial zone, and sends but a few stragglers into the division immediately above. The same, or a very similar distribution, has been observed of late years by Angelin, who during 1852 commenced illustrating the fauna of the Swedish rocks.

In Wales the existence of this primordial fauna has been clearly made out. The rocks which contain it are those designated by Professor Sedgwick, who recognized their importance, as the "Lingula beds," a name adopted by the Geological Survey. Fossils were first I believe, found in them by Mr. Davis, who discovered the *Lingula*, from which they received this name. They have been thoroughly examined by my colleagues of the Geological Survey, and are stated in the *resumé* on the Lower Palæozoics of N. Wales, communicated by Professor Ramsay to the Society last April, to be about 7000 feet thick. Their importance has been fully recognized for some time by the surveyors, and the additional evidence accumulated last autumn by Mr. Salter goes to support the stress laid upon them by M. Barrande. In the prosecution of the search, a further result has been obtained in the way of a subdivision of the group, and a palæontological distinction of importance has been indicated. They prove capable of division into two well-marked sections, viz. a lower, of which *Agnostus* (probably the identical species described from the alum

slates of Sweden), an *Olenus*, and *Conocephalus* occur along with the characteristic *Lingulæ* of the deposit; and an upper, where the same genera are accompanied by a few Brachiopoda and Bryozoa, as in Bohemia. But whereas in the latter country no passage can be shown of this fauna into the Silurian stage above, in Wales a palæontological passage from the Lingula beds into the Bala or Llandeilo group appears to be indicated. This is marked by the association in the upper part of the igneous series of two large species of *Olenus* with *Agnostus* and *Lingulæ*, and with types unquestionably characteristic of the Llandeilo beds, such as *Asaphus*, *Calymene*, and *Ogygia*, and Graptolites of species undistinguishable from those of the Llandeilo flags.

The interesting memoir of Dale Owen leaves no doubt upon the equivalence to these beds of the Potsdam sandstone of North America, in which Trilobites of the Paradoxides type are mingled with the Lingulæ, so characteristic of this formation.

The demonstration of this important zone of life, the earliest as yet distinctly traced, is a great step in Palæozoic Geology, one firmly established during the past year.

The extinction of the primordial fauna in Bohemia is attributed by M. Barrande to the effects of the igneous eruptions manifested by the masses of porphyries interposed between his lowest fossiliferous and the succeeding stage. The destroying influence of trappean eruptions are more than once laid stress upon by him. Similar phænomena appear to have terminated the Lingula-flag epoch in the Welsh area; volcanic outbursts, as remarked by Professor Ramsay, "in consequence of which great ashy deposits were found interstratified with ordinary muddy sediment, and here and there associated with thick beds of felspathic lava." But these outbursts do not always appear to have had so decided an influence upon the faunas of ancient seas, for, in the instance of Wales, the great eruptions that occurred during the epoch of the deposition of the succeeding Bala beds did not materially affect the population of the oceanic area in which they broke out. For my part I am strongly inclined to think that the influence of volcanic outbursts upon life through the destructive agency of the products of eruptions has often been overrated. Igneous overflows, showers of ashes, and exhalations of deleterious vapours are necessarily destructive, but as necessarily local, and scarcely likely, arguing at least from all cases of which we have sufficient knowledge, to extinguish the fauna and flora of a whole natural-history province, much less of many provinces. But they are the certain indications of far more powerful though less conspicuous and less traceable enemies of life. They are often the indices of epochs of excessive disturbances of the earth's crust, and of elevations and depressions of the surface of the sea-bed. Changes of level and consequent changes of surrounding conditions, even to the extent of change of medium, are the great life-extinguishers. The degree of substitution in an ancient fauna should rather be accepted as an evidence of the extent of the movements that have taken place during an age of volcanic energy, than as a measure of

the intensity of the local outbursts, the products of which at first glance seem to us the most efficient engines of destruction. It is not the ferocity of battles, but the organic changes among nations that afford us the measure of value or importance of a great war.

The fourth and uppermost division of M. Barrande's Lower Silurians is his "Etage D;" strata chiefly composed of quartzites with schistose alternations. Cephalopoda represented by *Orthoceras*, Pteropoda by *Conularia* and *Pugiunculus*, Heteropoda by *Bellerophon*, Gasteropoda by *Pleurotomaria* and *Holopea*, Acephala by *Avicula* and *Nucula*, Brachiopoda by *Orbicula*, *Lingula*, *Spirifer*, *Leptæna*, and *Terebratula*; also Crinoids, Cystideans, Starfishes, and a few Corals and Graptolites make up, with *Trilobites*, the fauna of this group in Bohemia. Trilobites and Cystideans prevail above all other forms, and it is in this zone that the former (and the latter probably also) attain their maximum. This fact has a strong significance in its bearing on the hypothesis concerning the relation of Palæozoic life to the life of all after-periods which I shall hereafter bring out in this discourse. The assemblage of animals found in this stage of quartzites constitute M. Barrande's second fauna. He compares the stage with our Llandeilos and Caradocs, with the Lower Silurians of Ireland, Russia, France, Spain, Portugal, and Thuringia, the regions C and D of M. Angelin in Sweden and Norway, and the formations from the Potsdam sandstone to Hudson's River group inclusive, of the United States. The great geographical diffusion of its fauna is in accordance with its vertical extent. But though widely diffused as a well-marked fauna, exhibiting everywhere a characteristic and easily-recognized facies, the species are by no means universally diffused, and the resemblance between distant regions is maintained rather by representation than by identical forms: thus early in the world's history do we find the partitioning of the earth's surface into natural-history provinces. More and more evident does it become every day that the old notion of a universal primæval fauna is untenable, and that at all epochs, from the earliest preserved to us to the latest, there were natural-history provinces in geographical space. And indeed, if we consider for a moment upon what causes the existence of these provinces depends, how they are not the mere results of various climatal conditions only, but are regulated in their extent in the sea by orographical and hydrographical conditions, and on the land by the inequalities and arrangement of the surface, and thus call to mind that the vast and varying sedimentary accumulations, found at every epoch in great mineral dissimilarity, necessarily indicate the existence of those very inequalities and peculiarities on sea and on land that determine the existence and extent of geographical provinces and limit the diffusion of animal and vegetable species, it seems strange to us how the notion of the universal diffusion of a uniform specific fauna could ever have been accepted for a moment, even as an *à priori* hypothesis. It was imperfect recognition of the phænomena of *facies* in time, that beautiful idea that first seems to have dawned on the mind of Von Buch, which appears to have given rise to the error.

In one of the subdivisions of this "Etage D" of his Lower Silurians, M. Barrande describes the occurrence of isolated patches, as it were, of fossiliferous strata, the population of which consists not of Lower Silurian fossils, but of organic remains characteristic of the Upper Silurian. M. Barrande designates these assemblages by the appellation of "colonies." This colonial fauna, becoming extinguished after a short existence, does not reappear until after the extinction, by trappean eruptions, of the normal fauna of the epoch, and the cessation of the formations amid which the colony is an intruder. In these colonies, he states, there are as many as 63 species, of which 4 are exclusively peculiar, 2 (viz. *Trinucleus ornatus* and *Dalmanites socialis*) common to the colonies and the true fauna of the beds in which they are intercalated, and 57 common to the colonies and third fauna, or that of the lowermost section of his Upper Silurians.

This doctrine of colonies is original with M. Barrande and demands our serious consideration. It is one that materially affects the value of the evidence of organic remains as determining the age and sequence of formations. The proposition that it involves asserts the introduction of a group of species that experience has shown normally to belong to a later and distinct formation, not merely among and mixed with the fauna of an earlier stage, but amid and separate from that fauna. We can conceive, indeed we have ample proofs in many instances, of the fact of the appearance of many species earlier in one geographical region than another, and we can understand how under temporary favouring circumstances any one or a number of such species might be laterally diffused, so as for a time to become a component part of the fauna of a neighbouring region, at an epoch previous to that in which, after having for a time retired, they returned to play a more conspicuous and characteristic part in a later formation. But in any such instance they would be mingled with the ordinary inhabitants of the region they colonized. Yet we can scarcely conceive a colony, composed entirely of strangers and of species known in beds of a later epoch, only in the exclusive association presented by their being intercalated without admixture in the midst of an earlier fauna. On the other hand, in a disturbed Silurian country, where the strata lie at very high angles, and where there are probably numerous convolutions, contortions, and rollings of the beds, there is a probability of the occurrence of overturns and truncated crumplings, that until traced out would cause the appearance of strata containing newer fossils lying under and amid those containing older ones. Such deceptive appearances are not unfrequent in the Alps, and some well-known cases occur in our own country. With these instances vivid in our memory, I feel warranted in objecting to a theory which seems to me as dangerous as it is ingenious, and ask first for the minute local details of the course of the Silurian beds in Bohemia, before accepting a doctrine so repugnant to received belief.

M. Barrande, it is true, endeavours to show most ingeniously that the currents which determined the immigration of his colonies came from the N.E., and that the fauna of his Upper Silurians arrived by the same direction; whereas the fauna of the Lower Silurians of

Bohemia, if not created in place, arrived by currents having their origin in the S.W. If, however, as now suggested, contortions of the strata have deceived this able observer, an argument of this kind can have no weight.

Of the four stages of Upper Silurians in Bohemia, the three lower divisions are typically calcareous, and the culminant section schistose. The lowermost has a base consisting of traps alternating with black slates containing Graptolites, and including occasional concretionary limestones. It attains a thickness of not more than 900 feet, but has a fauna superlatively rich and prolific in fossil treasures. Between 500 and 600 species of organic remains have been collected in this formation. In it is found the maximum number of species of Trilobites, no fewer than 78; and several genera, including *Harpes*, *Bronteus*, and *Proetus*, appear for the first time in Bohemia. Cephalopoda abound; as many as 200 species, of which half are Orthocerata, have rewarded the collector. *Ascoceras*, *Gomphoceras*, and *Phragmoceras* are the characteristic types. Gasteropods, Lamellibranchs, and Brachiopods are numerous, and there are not a few Zoophytes.

The second or middle stage of Upper Silurian limestones presents a decreasing fauna, but at the same time exhibits the maximum of Brachiopoda. Bryozoa and Tentaculites appear, and Cephalopoda rapidly diminish in numbers.

Between the third or upper stage of these limestones and the last there is a gradual passage, and in these fishes commence and Brachiopods have become rare. A considerable number of species in this division are enumerated as common to it and the two last.

In the uppermost stage of culminating schists the community of species is reduced to two Trilobites, and the entire fauna is poverty-stricken. Traces of vegetables indicate some considerable changes in the conditions of the sea-bed.

The four upper stages, constituting in their aggregate the Upper Silurians of Bohemia, contain a fauna (the third fauna of Barrande), which, as a whole, is regarded by its describer as of equal importance with the first or primordial fauna, and the second or chief Lower Silurian fauna. The strongest relations of identity of species between the Bohemian Silurians and those of other regions, are exhibited by the third or Upper Silurian fauna. A curious point concerns the second, viz. that it is represented in France not only by the same genera but also by identical species, whilst in England and Sweden it is represented by the same generic types and a great analogy of distinct specific forms. Of the different classes of animals it would appear that but few Crustacea are common to other countries, whilst the Cephalopoda, Brachiopoda, and Corals are widely diffused. The evidences of communication between the Silurian series of different regions are clearly indicated, and everywhere the distinction between his three great faunas is maintained by M. Barrande to be plainly exhibited. At the same time he pronounces definitely for the unity of the Silurian group as a well-characterized whole.

I would now call attention to the results of his inquiries into the

distribution of Trilobites, and its bearings on the view of the arrangement and phænomena of the Silurian formations, as stated above.

Out of 45 genera of these typically Silurian Crustaceans, 35 are Bohemian, and of the 10 that are not so, 2 (viz. *Olenus* and *Peltura*) belong to the primordial fauna, not exclusively however, for *Olenus*, in our country, ascends higher in the series. Of the second fauna, 6 genera are not Bohemian. And out of the entire list 7 genera have been recognized only in Bohemia. Of the species of Trilobites, the number characterizing each of the stages goes on increasing from the primordial fauna to the lower portion of the Upper Silurians, but one species only is common to as many as four of his stages, and, a fact that is worthy of notice, varies in each. The causes of destruction of species are not always clear. M. Barrande attributes due influence to physical changes as regulating their duration, but I must strongly protest against his belief in the doctrine of a limited vitality for each species ("une quantité limitée de force vital"), so that, independent of all other circumstances, each race will necessarily become extinct after a certain lapse of time. I have elsewhere exposed the groundless fallacy of this pernicious hypothesis,—a favourite one with palæontologists, although it can find but few physiologists to give it support. A curious remark is made by M. Barrande, that the species of the more ancient epochs appear to have been more prolific than those of later ages,—a remark doubtless suggested by local phænomena.

When commenting on the general distribution of Trilobites in Palæozoic rocks, M. Barrande calls attention to the fact, that of the 44 Silurian genera, three-fourths do not range upwards above the Upper Silurian stages; 11 reach the Devonian epoch, with notable diminution of specific richness, and one only is found in Carboniferous rocks. The generic maximum of Trilobites is concentrated in the Lower, the specific maximum in the Upper Silurians. The direction of the development of the Trilobites is as clearly backwards, so to speak, in time, as that of the Malacostraca is forwards. The same remark may be made on the Brachiopoda as contrasted with the Lamellibranchiata, and the Nautiloida as contrasted with the Ammonitoida. On these oppositions I shall have more to say at the termination of this discourse. Most worthy of remark is the fact confirmed by M. Barrande, that the geological position of a species in one region is not necessarily that which it holds in another. This observation is independent of his colonial theory. Thus certain Trilobites are common to the second and third faunas in England that are confined to one horizon in Bohemia, and others that are members of the Lower Silurian only in the British islands, are present in the Upper Silurian only in Bohemia.

An interesting point is the anamorphosis or change of characters within genera in their course through time. M. Barrande's remarks on this matter are highly original and deserving of study. As instances among Trilobites, I may cite the changes in the course of the grand suture; the progressive development of the eyes; the reduction of the thorax; the increase of the caudal shield; the change

in the ornaments in the test, striation mainly preceding granulation. Features, however insignificant, of this kind chiefly give a distinguishing facies to the fauna of an epoch. Well was it said by Von Buch, that "the smallest difference acquires value by constancy."

I shall not attempt an analysis of the elaborate general zoological division of M. Barrande's work, or of the complete treatise on Trilobitic species that follows it. Suffice to say, that no student of Crustacea can be absolved from a close perusal of this most admirable monograph, and that every Silurian geologist should endeavour to understand and master its luxuriant details. In justice to the author, there is one section of this part of his work that cannot be passed without a remark, and that is, his chapter concerning the metamorphoses and modes of existence of Trilobites.

For years, ever since 1828, palæontologists have dreamt of Trilobitic metamorphoses, and some have pronounced definitely for, some as definitely against, the probability of the Trilobite undergoing changes in the course of its existence as an individual. The full discovery and statement of the fact was reserved for Barrande in 1849. In the same year Mr. Salter showed that the young individuals of *Ogygia Portlockii* presented 4–7 segments, and finally 8. Milne-Edwards and Burmeister, naturalists thoroughly versed in the history of living Crustacea, had previously speculated freely from analogy on the probability of their transformations. M. Barrande in the work before us demonstrates a metamorphosis in no fewer than 16 genera and 28 species. The degree of change is variable; its intensity comparable with the phænomenon in existing Crustacea. The successive and progressive elaboration of all the elements in the pygidium before becoming free and passing into the thorax, holds good in all known metamorphosing Trilobites. The number of species in which a change has been proved diminishes as we ascend in time. Among other points M. Barrande has made out the probable eggs of these animals. As to their mode of life he opposes the conclusion of Burmeister and others, that Trilobites lived in shallow water along the coast; and distinctly pronounces against the supposition of their parasitic nature.

The Geology of the British Isles.

The well and often explored mine of British geology has not yet been worked out, and there are still rich lodes to discover, as well as old workings, that yield profitable returns when re-examined. Our Journal has had its full and usual share of papers on British strata during the past year, and, judging from what I know of memoirs in hand, the coming sessions are likely to be quite as well provided for.

Our Palæozoic rocks have received their usual share of attention. Old though they be, they are as attractive as ever, and their warmest admirers during preceding years remain constant to their antiquated yet ever fresh charms. The often discussed question of their classification has been made the subject of a communication by Professor Sedgwick to the Geological Section of the British Associa-

tion at Hull, explanatory of his views concerning the nomenclature of the Primary formations. The division of the Palæozoic strata into an Upper, Middle, and Lower series is a natural classification, although some may prefer a twofold instead of a threefold partition. The question concerning the appellations to be given to the subdivisions of these three sections, is one which will in the end be determined by custom and the authority of general use. Convenience is eventually the settler of all differences about nomenclature, and even in Zoology and Botany, sciences in which many definite rules are observed with laudable strictness, convenience every now and then overrides all our arbitrary regulations. Professor Sedgwick had previously, during the course of our last session, communicated, in association with Professor M'Coy, certain views of consequence concerning a proposed subdivision of the Caradoc sandstones, which demand a special notice on account of their importance, and because there have been more than one paper on this subject lately read before the Society. The result of these inquiries on the part of several observers is to place the relations of the Caradoc sandstone in a clearer light, both as to strata above and those below it.

The Caradoc was originally considered by Sir Roderick Murchison as the sandy and upper portion of the Lower Silurian strata. The rocks east of Caer Caradoc presented the best types, and those shown in ascending sections through what are generally called "the Pentamerus beds," to the Upper Silurian, and the arenaceous masses which occupied this position in the Malvern and May Hill districts, were considered by the founder of the Silurian system to be equivalents of at least a part of this series, while they graduated into the Wenlock shale.

But while our Caradoc sandstone, so constituted, contained in some parts numerous fossils that were Llandeilo species, in its upper portion it was supposed to contain these species mingled with the characteristic Pentameri. In America the latter fossils were found associated only with species characteristic of the Upper Silurians, and the group of strata containing this assemblage appeared to be cut off distinctly from the underlying Llandeilo rocks.

The unravelling of this anomaly is in part due to Professor Sedgwick, and in part to the officers of the Geological Survey. In a communication contained in the fourth volume of our Journal, Mr. Ramsay and Mr. Aveline have shown that the Pentamerus beds around the Longmynd repose unconformably upon the Llandeilo flags, whilst they graduated upwards, as Sir Roderick Murchison had stated, into the Wenlock shale. But here only the upper part of the Caradoc was developed, and this portion contained but few of the Lower Silurian species. In a subsequent paper in our eighth volume, the physical connection of the Upper Caradoc with the base of the Wenlock shale was definitely and fully stated. In the meantime, and quite independently, Professors Sedgwick and M'Coy examined the Caradoc beds of May Hill and the Malverns, and became convinced that these beds, containing as they did only Upper Silurian species, must be regarded as the base of the Upper Silurians, and that the Caradoc

sandstone, as then understood, comprised two distinct formations; that east of Caer Caradoc (Horderly, &c.) being equivalent to the Bala rocks, while the group of May Hill, and probably the Coniston grits of Westmoreland, should be associated with the Wenlock and Ludlow series.

It became necessary for the officers of the Survey to test these views by an appeal to the county originally described, viz. Shropshire. The result of their labours is reported by Mr. Salter and Mr. Aveline, who undertook the task, in the first part of our tenth volume. They have shown that Professor Sedgwick's view is substantially correct, and that the typical district contains not only the equivalents of the Bala and Llandeilo rocks, but also the upper portion of the Caradoc, lying unconformably on the lower, and everywhere characterized by the Pentameri, and full of Upper instead of Lower Silurian species. These latter strata are therefore the exact equivalents of the May Hill, &c. beds. But although these rocks are thus evidently brought into a nearer comparison with the 'Clinton group' of North America and with the Pentamerus beds of Russia, they are still regarded by the Government surveyors as forming a bed of passage from the Lower to the Upper Silurians, inasmuch as several species which characterize the Lower Silurians are common in them, and especially since their distinguishing fossils, the Pentameri and Atrypæ, are found in certain portions of the Llandeilo flags, but are not known to rise into the overlying Wenlock strata. They propose to retain the name of "Caradoc sandstone" for these beds.

This evidence of intermixture of fossil species has received unexpected confirmation from America. In the second part of his 'Palæontology of New York,' Professor Hall has announced the fact, that a few of the most characteristic of the fossils of the Trenton limestones are now found in the upper part of the Medina sandstone, a formation as intimately connected with the Clinton group, as in our own country the conglomerates that skirt the Longmynds are with the overlying Pentamerus limestones and shales, and the analogy of these beds in the two continents is therefore complete.

Of the vast thickness and striking geognostic phænomena of our Lower Silurians, a concise but clear and most interesting statement is presented in Prof. Ramsay's paper "On the Physical Structure and Succession of the Lower Palæozoics of North Wales and part of Shropshire"—the prodromus of a more extensive memoir, now in preparation. These rocks, in the region described, include the prodigious amount of 42,000 feet of apparently conformable strata, including the Cambrian, in the sense in which the term is used on the maps published by the Geological Survey,—the Lingula and Bala series,—and the Caradoc sandstone. The grand facts of Silurian Geology will soon be presented in a complete and consistent picture by Sir Roderick Murchison, whose forthcoming work is anxiously expected, and is sure to fulfil all our anticipations.

The attention bestowed upon the Older Palæozoics of England has not of late been extended to the Middle and Upper. Through the

kindness of my colleague, Professor Ramsay, however, I am enabled to notice an important, though as yet unpublished, contribution to the geology of the Permian districts of the Midland Counties, one with considerable economic bearings.

In all existing published maps the actual upper limit of the Permian rocks south of Derby and North Staffordshire is merely guessed at. These beds are often inserted where they do not exist, and omitted over large areas where they should be inserted.

They have now been clearly mapped and accurately defined around the Tamworth, the Coalbrook Dale, the Forest of Wyre, the Shrewsbury, and part of the North Wales coal-fields. A large area has in consequence been taken from the supposed Bunter sandstone and mapped by Mr. Ramsay and Mr. Howell as belonging to the Permian rocks in the country lying between Tamworth and Leamington, in part of which, at Exhall, a Permian Calamite, and casts of shells having Permian affinities, have been found; by these means, then, geologists have been able to support palæontologically what previously was maintained by Professor Ramsay on purely physical grounds. These facts are also important, since they prove that the Labyrinthodon described by Dr. Lloyd in the Reports of the British Association (Birmingham) 1849, is a Permian reptile, and not, as he supposed, from the Bunter sandstone.

Through the course of last year important additions have been made to our knowledge of the Bunter sandstone, by working it out in four subdivisions in the districts that lie between Chester, the Abberleys, Warwick and Nottingham. Over large parts of this area there is found to be great constancy in the lithological character of these divisions, and by their aid the surveyors have been enabled to determine numerous faults hitherto unknown, which frequently repeat the same strata for many miles.

The supposed thickness of the New Red Sandstone will consequently be much reduced in places, and this, taken in connection with accurate measurements of the extent and thickness of the Permian strata, may at no distant date lead to important economic results, in the determination of the depth at which the coal-measures lie under large tracts of the New Red Sandstone area, where there can be little doubt that it will by and by be successfully sought for.

A great step has been made towards an explanation of some of the organic phænomena of the Oolites by Professor Morris, whose memoir "On some Sections in the Oolitic District of Lincolnshire," communicated to the Society in June last year, throws new and valuable light on the relations of the southern to the northern oolites in England, and rectifies several misconceptions about the comparative order of the strata in different districts. As this paper, one of the most important in its general bearings laid before us during the past year, is printed entire in our Journal, I shall make no abstract of its details, but merely offer a few remarks on its general bearings.

The marine faunas of the Oolitic epoch indicate at least three great and widely-spread assemblages of types, each exhibiting a general and easily recognizable facies. These aspects may be termed

respectively the Liassic, the Bathonian, and the Oxfordian; the two latter terms being used for want of better, and being adopted in a wide and general sense, and not in the restricted meaning in which they are used by M. Alcide d'Orbigny. The horizon of change of facies at the boundary between each is a horizon, to a considerable extent, of change of species. I believe that every year's research will make it more and more evident that the perishing of species is simply the result of the influence of physical changes in specific areas, and depends upon no law of inherent limitation of power to exist in time. If so, we should expect to find indications of the cause of the greater changes in the oolitic and marine fauna in the shape of strata bearing evidence of a wide-spread change of physical conditions within the great oolitic area. An extensive change of species within a marine area in all likelihood is dependent on an extensive conversion of that area into a terrestrial surface.

Now it is becoming more and more clear that such a change of condition occurred over a very wide area in the interval between the main mass of the middle and upper jurassic types. The researches of Mr. Morris do much towards completing the demonstration of the nature and extent of these changes in the area now occupied by the British Islands, and it will be seen hereafter, how, even as far away as Italy, we have clear proofs of a similar change of conditions about the same epoch. Much may be done towards clearing up the details of this matter by more extensive and careful investigations of the Scottish oolites, guided by the light that is opening gradually upon us. Indeed I know of no field more likely to yield fresh laurels to the British geological observer than the thorough exploration of Scottish secondary geology.

In a paper by Professor Buckman, published in the 'Annals of Natural History' for November last, and one of the many interesting contributions to British geology which we owe to that active assembly of provincial observers, the Cotteswold Naturalists' Club, the Cornbrash and associated strata of the neighbourhood of Cirencester are described in detail, and under an economical point of view not always attended to, viz. the agricultural value of the soils formed by the several oolitic rocks. Through the predominance of phosphoric acid and sulphate of lime in the Cornbrash, as compared with the 'stone brashes' of the Great and Inferior Oolite, the value of the soils in the former rock is considerably greater, as shown by the analyses of Professor Vœlcker. Mr. Buckman presents some good facts concerning the distribution of fossils in these beds, and enumerates twenty-one species of lamellibranchiate bivalves common to the Inferior Oolite and Cornbrash in Gloucestershire, and rare or wanting in the Great Oolite of the district. The recurrence of the species in this instance, as indeed in every similar case, is dependent on the recurrence of similar conditions. In every such case we may, *à priori*, assume that the intermediate strata, formed under different conditions, somewhere within the area of the ancient marine region to which they belong, change their character, putting on the mineral aspect and containing the peculiar fossils of the superior and inferior

beds. Phænomena like those recorded by Professor Buckman should therefore serve as pilot facts, and guide us to fresh discoveries.

The upper Mesozoic rocks of Britain have been of late left undisturbed, with the exception of that very moveable and problematical deposit, the sands and gravels of Farringdon, which Mr. Sharpe would elevate to a considerably higher position in the cretaceous series than has hitherto been assigned them. The time is probably fast approaching when the conflicting views upon this disputed question will be tested by fresh data. For the present I abstain from taking up this critical subject.

Our Tertiaries, on the other hand, have been treated with much favour, and form the subject of several memoirs, at the head of which stands Mr. Prestwich's account of the Woolwich and Reading series. This paper completes the series of memoirs by that eminent geologist descriptive of the Lower and Middle Eocene strata of England. These remarkable essays embody the results of many years' careful observation, and are unexcelled for completeness, minuteness of detail, and excellence of generalization. They have a further merit, and a very great one, to wit, that whilst in themselves essentially local and topographical, the examination of the British strata which they profess to describe has been conducted *pari passu* with personal comparisons and examinations of corresponding formations on the continent. This method of treatment, broad and catholic in its spirit, has made the essays of Mr. Prestwich as useful to foreign as to British geologists, and secured for their author a European renown. The special subject of the last of these papers is the series of strata constituting what is usually known as the Plastic Clay formation, the mutual relations of whose several local beds had never been clearly determined, and the relative position of the beds of the Reculvers and Herne Bay to those of Woolwich and Reading were quite unsettled. This condition of things can be said to exist no longer, and we have now, instead of confusion and uncertainty, a clear statement and correlation of the local phænomena at numerous points, with a thorough revision of the lists of organic remains, and most interesting generalizations respecting the geographical and dynamical changes that affected the area during the epoch under review. Since the memoir is printed at length in the first number of our Journal for 1854, I need attempt no detailed analysis here, or enter upon the many important questions and suggestions that are in it discussed.

It has been my own lot to investigate the fluvio-marine series that terminate the Eocenes in the Hampshire basin, and to lay before you a preliminary statement of the results at which I have arrived. The démonstration that a considerable and hitherto unplaced portion of these beds in the Isle of Wight represents the Limburg series of Belgium and the Upper Eocene or Lower Miocene of France, as well as other continental formations, of which we were supposed to have no equivalent in England, will, I trust, prove acceptable to all who take interest in Tertiary geology. Since I communicated my paper to the Society, I have revisited and carefully re-examined the fluvio-marines of Hempstead and those west of Yarmouth; also the sections

at Cowes and Osborne. At the latter locality, and there alone, the peculiar series to which I gave provisionally the inconvenient name of St. Helens, form a part of the surface of the island, so as to admit of being delineated on the map, for which reason I would, in accordance with the remainder of my nomenclature, designate them by the name of the district, and style them, in preference, the Osborne Series. Here also, in consequence of a considerable fault that runs in the course of the Medina, the Headon beds proper are brought up on the shore at East Cowes. A visit to the French tertiaries during last autumn has gone far to confirm the scheme of continental equivalents that I submitted to the Society, and the view which I maintained of the essentially Eocene affinities of our Hempstead and Bembridge series. I am inclined still to maintain that our succession of Middle and Upper Eocenes is more complete and continuous than that met with in either France or Belgium, the equivalents of our Bembridge marls and Lower Hempsteads being probably deficient in the former country, whilst those of our Headon series are absent in the latter. It is through the over-estimated value assigned to these breaks that the discordance in the opinions of geologists respecting the degree of relation between the Middle and Upper Eocenes in a great manner would seem to depend.

We owe to the Marchioness of Hastings an excellent detailed account of the Hordwell fluvio-marine section, the scene of the diligent researches during several years of that distinguished and zealous lady-geologist, whose contributions to British eocene palæontology have been among the most valuable and interesting made of late years.

The newer tertiaries and superficial deposits have received of late a considerable share of attention, but not more than they deserve. As yet we are scarcely in a condition to generalize upon them with safety, but are evidently fast advancing towards that desired point. Minute and repeated local observations constitute the soundest data for our guidance. Mr. Trimmer, who for years has devoted a considerable portion of his attention to this important, though not generally attractive department of geology, has communicated several papers to the Society, among which that constituting the third part of his essay, "On the origin of the soils which cover the Chalk of Kent," is peculiarly interesting and instructive. Mr. Morris and the Rev. Mr. De la Condamine have also contributed valuable notes. The whole subject may be reported upon as in progress, and, for the present, I reserve my comments. In the mean time, I would strongly urge upon British geologists the propriety of a careful comparison of the phænomena and features of the drifts, gravels, and superficial deposits of our southern districts with those of the neighbouring provinces of the continent. I believe that an investigation of this kind, which must be done personally, since continental memoirs scarcely afford sufficient data for the work, would tend to rectify many of our prevailing notions respecting their deposits. I would especially suggest a fresh examination of the fragments of older and igneous rocks met with in some of the drifts of the southern half of England, and hitherto too generally assumed to be of northern derivation. There are sources to

the south or south-east, from whence similar rock-fragments might have come, and from whence, indeed, they have found their way into the gravels that lie beneath the probable equivalents of our northern drift in France. The consideration is at least worthy of notice and inquiry, the more so since there are anomalies, some of them palæontological, which at present tend to make myself, I believe among others, inclined to object to the usually received notions. We are evidently on the eve of a revival of the study of what used to be called 'diluvial' deposits—one in which I trust our continental brethren will take more part than at present they seem inclined to. The older and firmer strata, rich in definite sections and fossil treasures, doubtless present greater attractions than the inconstant charms of gravel beds and sand pits, which, however, if perseveringly studied, are sure to yield their votaries abundant reward and ample results.

The gravels of Yorkshire and Nottinghamshire have been noticed by the Rev. W. Thorp, in a paper published in the Proceedings of the West Riding Geological and Polytechnic Society. He distinguishes three sets of gravels derived from different transporting currents, and notices the existence of considerable tracts that are quite bare. The first and most considerable of these gravels belongs to the northern drift, and contains fragments of rocks now *in situ* in Cumberland. It reaches considerable elevations; masses of granite from Shap Fells having passed over Stanmoor Forest at an altitude of 1400 feet, and over oolitic hills 1500 feet high, down to the east coast. The second range of gravel constitutes in one place a narrow tract, from one to two miles in breadth, touching the northern drift near the river Humber, and extending from Leeds by Ferrybridge to Goole. It contains pebbles derived almost wholly from sandstones of the coal districts of Yorkshire, mingled with fragments from the mountain limestone, and does not extend much north or south of the valleys of the Aire and Calder. Leeds stands upon it. The direction of the transporting current was from west to east. A similar east and west range extends from Doncaster to the south bank of the Humber, formed of coal sandstone pebbles, mingled with others from the mountain limestone of Derbyshire. He places other east and west gravels composed of magnesian limestone pebbles in the same category. The third set of gravels noticed by Mr. Thorp is peculiar to Nottinghamshire. It extends uninterruptedly southwards from Doncaster to the town of Nottingham, lying on the back of the new red sandstone, spreading in a thickness of from 3 to 8 feet, but not present on very abrupt hill sides. South of Nottingham and Derby it becomes intermingled with the northern drift, but in several places is capped by the magnesian limestone gravels of the second set. This third gravel contains no pebbles derived from the neighbouring strata, but is almost entirely made up of quartz fragments, smaller, more even, and more spherical than the boulders of the northern drift. Their drifting currents flowed north and south. Mr. Thorp maintains that this gravel constituted the ancient sea-bottom left by the waters which deposited the new red sandstone itself. The gravels of his second kind he believes to have been exported from the York-

shire coal-field during the epoch of emergence of the British area from the glacial sea; the waters being driven eastwards down the lines of valley which formed the course of easiest retreat. The absence of gravels in many districts he attributes to the protecting influence of high bluffs of land to the north of these bare areas.

The leading features of the northern drift in Yorkshire, as well as the other geological phænomena of the district, are sketched in a masterly style by Professor Phillips, in his lately published volume on the Mountains, Rivers, and Coasts of his native county. In the geological chapter of this work, the subject of the nomenclature of epochs is considered, and a scheme of terms suggested, founded chiefly on the leading organic characters of each section of time. A very neat and clear map of the geology of Yorkshire, by the same eminent observer, has been published during the year, and is remarkable for being printed by chromo-lithography, a process that is fast advancing to an astonishing degree of perfection. And here I may incidentally congratulate our science on the recent appointment of our illustrious associate to the Professorship of Geology in the University of Oxford; one that confers equal honour on the receiver and the givers. In this instance that famous school of learning has endeavoured earnestly and conscientiously to forward the true interests of science; and every geologist in the world will applaud the choice. A University that has boasted for ages of having held in especial honour our great master in Natural History, Aristotle, and that now possesses magnificent collections in all its departments, invaluable for study, may yet become a favoured home of Geology and Biology.

The Geology of Scotland has not received many descriptive contributions during the past year. One of the most interesting is the memoir on the Granitic district of Inverary, in Argyleshire, read before us by the Duke of Argyll. His Grace has rendered good service to the geology of his country before, for to him we owe the discovery of its older tertiary beds. In the paper he has now given, he deals with igneous and azoic rocks. The chief problem which he seeks to solve in the district under description, is the cause of the regular alternations of mica-slate and granite, the beds of which rocks lie conformable to each other at a considerable angle. After showing the insufficiency of any other mode of explanation, the noble author argues that the mica-slates, already completely consolidated and metamorphosed, fell in from a horizontal to an inclined position, and by falling forced the molten igneous matter between the loosened planes of stratification. The considerations put forward in this memoir are highly worthy of attention, and it is to be hoped that they will give rise to not a few minute examinations of the crystalline rocks of the Highlands, in localities where similar phænomena present themselves.

The Silurians of the south-west of Scotland have been described in detail, so far as Kirkcudbrightshire is concerned, by Professor Harkness, who considers these beds to represent successively the Llandeilo flags, the Caradoc sandstone, and the lower portion of the Upper

Silurians. The scantiness of palæontological evidence renders the exact determination of their equivalents peculiarly difficult.

In Scotland the subject of glacial phænomena continues to be discussed and investigated with unabated interest. Mr. Robert Chambers has been actively engaged in the collection of facts concerning the glaciation of Britain and the attendant phænomena. His views have been communicated at some length to the Royal Society of Edinburgh, and may be found printed at full in the fifty-fourth volume (for 1853) of the Edinburgh New Philosophical Journal. He recalls attention to the evidences of the presence of local systems of glaciers, of ordinary and typical constitution, in the mountain districts of North Wales, Cumbria, and Scotland, and notices fresh instances of this phænomenon. From it, however, he distinguishes the evidences of what he considers glacial action of a more general kind, manifested in Scotland in every part of the Highlands, and much of the Lowlands, in the rounding, smoothing, and striation of rocks, generally in the line of valley, and also in elevations to as much as 2000 feet above the sea-level. Professor Ramsay had previously demonstrated two distinct epochs of glaciers in North Wales. The direction of the icy agent in these cases Mr. Chambers maintains to have come from the north-west, and to have acted with little regard to the inequalities of the surface. He interprets the phænomena as indicating the passage over wide areas of an abrading agent, at the same time plastic and of volume sufficient to fill valleys several miles in breadth, and from one to two thousand feet in depth, and he maintains the probability of this agent being ice much water-charged and more mobile than as presented in an ordinary glacier. He holds the power of the denuding force of this agent to have been very considerable. The older boulder clay he regards as the detritus of this general glaciation, which he believes to have taken place at a period anterior to the epoch of the northern drift, which itself preceded the epoch of local glacier systems. There is much that is highly interesting and suggestive in Mr. Chambers' paper, even though we may not be inclined to go along with him unhesitatingly in his speculations. The subject of the ancient glacial phænomena of Britain, Scandinavia, and America, is evidently fast advancing towards new combinations, and the multiplication of local observations, of which many good examples are contributed by Mr. Chambers, will most effectually promote our progress towards definite conclusions. In the mean time those who occupy themselves with these inquiries should closely study the admirable and beautiful work on the existing glaciers of Norway, just contributed to science by Professor James D. Forbes of Edinburgh. The thorough knowledge and science of the author, his great experience, his searching and logical treatment of his subject, and the excellence of his style render all his works on this difficult matter models and guides.

The condition of the surface of the emerged land of the Scottish area during the epoch of general glaciation, the existence of which is inferred by Mr. Chambers, must have been very comparable with that noticed by Dr. Rink, in his late paper "On the Continental Ice

of Greenland *," and by Dr. Sutherland in his researches, published in our Journal, on the western coasts of Northern Greenland. In Greenland at the present moment we have a vast extent of land "covered," to use Dr. Rink's words, "with ice to a certain elevation; mountains and valleys levelled to an uniform plane; river-beds concealed, as well as every vestige of the original form of the country." The movement commencing far inland, which that able observer describes as thrusting the outward edge of this mass of ice forward towards the sea, would doubtless produce over a large area effects of general smoothing, grooving, and striation similar to those presented by the surface of Scotland. To every student of ancient glacial action, Dr. Rink's interesting paper must be of considerable value.

In Ireland the members of the Geological Society of Dublin have sent forth an interesting part of their Journal, containing the proceedings of the last session. Mr. Willson of the Geological Survey contributes an outline of his observations on the Geology of the Southern portion of the County of Cork, chiefly concerning the thickness of the rocks that intervene between the old red sandstone and the carboniferous limestone in that district. To some of the facts stated in this paper, I would direct attention for the sake of English investigators of the middle palæozoic strata. At Bally-cotten bay, shales, slates, grits, and flagstones alternate, and occupy the interval between the carboniferous limestone and Old Red, to the thickness of 2000 feet. At Monkstown similar beds are 2600 feet. More to the south, between the neighbourhood of Bandon and the Seven Heads, 3800 feet of strata were measured without reaching the limestone, and at the Seven Heads, the intermediate beds are 4500 feet, with no certainty of their uppermost portion being reached. Mr. J. Kelly, in an interesting paper "On the Quartz Rocks of the Northern Part of the County of Wicklow," combats the view adopted in some sections, published by the Geological Survey, to the effect that they are beds interstratified with slaty rocks, and maintains the amorphous character of the masses, and their intrusive origin. Considerable difficulties doubtless attend the certain delineation of the relations of these quartz rocks, in some measure owing to the state of the country, which is much obscured by drift. A compact and well-worked memoir on the Geology of Portraine, an isolated district in the neighbourhood of Dublin, famous for the interest of the Silurian fossils that have been procured from a small patch of strata of the Llandeilo type, contains the particulars of a highly interesting tract, previously undescribed in detail. The paper is by Mr. Henry Medlicott, a young geologist of varied accomplishments and much promise, who has lately gone out to India to join the Geological Survey under the direction of Mr. Oldham. Professor Haughton, of Trinity College, Dublin, commences a series of notes on the Irish mines, and, combining his eminent mathematical and physical acquirements with practical field geology, has read a memoir on the newer palæozoic rocks which border the Menai Straits. In this essay, after describing the physical structure

* Journal of the Royal Geographical Society, vol. xxiii. for 1853.

of the south-east side of the Menai, he enters into palæontological details, and connects his subject with the geology of Ireland, by showing at some length the analogy in lithological character and fossil contents, between the lower parts of the series of strata in question, and the 'yellow sandstone' of Mr. Griffith, as seen in the North of Ireland. He maintains that in this Welsh district no distinction exists between the Devonian and Carboniferous deposits, and that the entire series of beds, including the red sandstone conglomerates and yellow sandstones at its base, must be considered as a continuous whole. It must be borne in mind, however, by English geologists, that the so-called Irish Devonians alluded to belong to the neutral ground, between the typical Devonians and Carboniferous limestones, and that for many reasons their affinities may be regarded rather as appertaining to the latter than to the former palæozoic group.

A paper of a strictly Irish character, but bearing importantly on our own Silurian Geology, has been read by Messrs. Jukes and Wyley, on the structure of the northern part of the county of Wicklow. The authors show that the Lower Silurians rest unconformably on the edges of the Cambrian rocks of that locality, and that the granite does not bring up the Cambrian rocks on its flanks, but cuts up through the Silurian; the general dip to the rocks being towards the granite for a considerable space on each side of it.

The new edition of Mr. Griffith's beautiful map has this day been presented to us, enriched by many improvements. The Geological Survey of Ireland has completed the examination of the counties of Dublin, Wicklow, Wexford, Kildare, Carlow, and Waterford, and more than half of Kilkenny and Cork, with parts of the adjacent counties. All the observable data have been laid down on the six-inch maps, and the results published on the index maps of the five first counties. The sheet inch-map of Ireland having now been commenced, and four quarter-sheets, including the northern half of the county of Wicklow, &c., being nearly ready for publication, the early geological work of that portion has been revised and the lines laid down upon the new maps. The publication of these inch-maps may shortly be looked for, and it is to be hoped that the furtherance of this good work, by the aid of the Ordnance, will receive every encouragement from Government.

Geology of British Colonies and Possessions.

In noticing the progress that has been made during 1853 in this highly important branch of my theme, I shall confine myself almost entirely to remarks upon memoirs not contained in our own Journal. That publication is rich this year in contributions to colonial geology, essays of unquestionable value, and whose merits speak for themselves. Thus from the East we have received accounts of the researches in various parts of India of Dr. Andrew Fleming, Capt. Vicary, Mr. Frere, Lieut. Sankey, and Dr. Bell; and a notice of the geology of Labuan by Mr. Motley. Captain Nelson has given us the results of his researches among the coral

formations of the Bahamas, supplementary to those formerly communicated from the Bermudas by this distinguished officer. To Canadian geology Dr. Bigsby has added his account of the structure of the Quebec district. Mr. Dawson and Mr. Poole have added to our knowledge of the details of the Carboniferous formations of Nova Scotia. Dr. Sutherland has given us a full account of his observations in Baffin's Bay and among our inhospitable Arctic possessions, as well as notes on the neighbouring coasts of Greenland. Mr. Wathen has described the gold fields of Victoria; and to return to the Atlantic, Colonel Heneken has offered a contribution to the geology of the West Indies. On this last-named subject I would venture to offer a few remarks.

It is much to be desired that some able and active geologist, practised in the observation of the newer formations of Europe, would visit and explore the West Indian archipelago. There is no finer field for fresh research, and all that has hitherto been done, from the early labours of Sir Henry De la Beche in Jamaica, to the latest memoir, that of Colonel Heneken on San Domingo, communicated to the Society in March last, holds out a rich promise of reward to the man able and willing for the work. Colonel Heneken's account of San Domingo, with the accompanying palæontological comments by Mr. Moore and Mr. Lonsdale, is one of singular interest for the tertiary geologist and the inquirer into the geographical arrangements of the later epochs. The demonstration of something more than a relation of analogy between the fauna of the San Domingo and Panama tertiaries on the one hand, and that of the existing Panamian and Indo-Pacific regions on the other, is a significant advance, and points to an ancient disjunction between the masses of land in the North American area and those of the South, dating probably about the epoch of the middle tertiaries; whilst the indication of some identifications, even though few, of ground-living mollusks, not likely to enjoy a deep vertical range, with species living on the European side of the North Atlantic during the Miocene epoch, would seem to indicate an extensive stretch of land or of shallows from the West Indian region Europe-wards, that remarkably accords with some well-known indications afforded by the distribution of existing creatures.

The number of papers on East Indian geology, referred to as contained in our Journal, would of itself be ample evidence of the diligence and zeal of Indian geologists. But the student of the structure of the East must not confine his studies to the transactions of societies at home; in the journals of Indian Societies he will find many papers of great interest. The excellent report on the geological structure and mineral wealth of the salt range in the Punjaub, by Dr. Andrew Fleming, is an instance. It may be found in the Journal of the Asiatic Society of Bengal; in which work are some remarks by Capt. Young on the much-disputed subject of Laterite. The last-named paper contains interesting notices on the geology of Burmah. Dr. Kelaart, in another eastern periodical, has published his observations on the Laterite of Ceylon. The Journal of the Bombay branch of the Asiatic Society not unfrequently contains

essays of geological interest. Among these, in the last year, is one of the most valuable of recent additions to our knowledge of the geology of India, a memoir on the Geology of the Nagpur State, by the Rev. S. Hislop. A good deal had been done for the investigation of this interesting district, and in a paper communicated to the Society by Lieut. Sankey of the Madras Engineers, a detailed history was given of the results of the researches there of geologists and collectors, more especially Messrs. Hislop and Hunter, who had previously transmitted to us an extensive suite of fossils. Mr. Hislop maintains, supporting his opinion by forcible arguments, that the overlying trap of Central and Western India cannot have been poured out in the bed of the ocean, but must have been erupted in a lake or chain of lakes. The freshwater tertiaries that underlie the trap he considers to be of Eocene age, perhaps too positively, although his view is consistent with some indications afforded by the shells that occur in them; but it should be borne in mind by all describers of fluviatile and lacustrine formations, that mere analogy of form is a very bad guide in the determination of the epoch of freshwater mollusks. "The sandstone of Central India, which appears to be identical with the diamond sandstone of Southern India, belongs with its associated shale and the Indian Coal-measures to the Lower Oolitic formation." He suggests the probability of these sandstones being of freshwater origin, and maintains that the Deccan exhibits no evidence of having been submerged by the ocean since a period anterior to the Oolite.

The description of the fossil animals of the nummulitic rocks of India, by Vicomte d'Archiac and Jules Haime, elsewhere alluded to when the monograph of Nummulites was mentioned, will, when completed, form a manual of the highest value for the study of this extensive formation in the East. The part already published contains the account of the Corals and Echinoderms (as well as the Nummulites), and is preceded by a review of the geology of the nummulitic region of India. This chapter is not a mere summary of what had previously been known and published. It contains much that is new, facts of high value derived from the researches of our associates, Vicary, A. Fleming, Oldham, R. Strachey, Thomson, and J. D. Hooker. Sir Roderick Murchison has been the means of placing these fresh data at the disposal of M. d'Archiac. The result of these studies has been the confirmation of the complete independence of the nummulitic in regard to the Cretaceous formations. "In the province of Cutch, in Scinde, Beloochistan, the Punjaub, and along the slopes of the Himalaya," remarks M. d'Archiac, "the beds beneath the nummulitic limestones exhibit nowhere the characters of any stage whatsoever of the chalk, whilst, wherever the substratum has been recognized, it exhibits those of carbonaceous deposits with clays and sandstones belonging to the lower tertiary formation, and resting either on Jurassic strata, or on more ancient rocks of which the age is yet unsettled."

Every student of Indian geology will be delighted at the appearance of the 'Himalayan Journals' of Dr. Joseph Hooker, a work that will do much to sustain the reputation of the British school of

Natural History. The geologist will find in it a rich store of facts of the highest interest, and for the inquirer into glacial phænomena it abounds with new and invaluable data. I may say the same for the geographical memoir of Capt. Richard Strachey on Western Thibet; and we all look forward anxiously to the publication of the detailed account, now in progress, of his geological researches, knowing as we do, how rich a store of new and important facts was accumulated during his adventurous journeys.

It is most gratifying to think that at the present moment no small proportion of our foreign possessions is being surveyed geologically by able and trained observers, and that the vague and often incomprehensible statements of self-satisfied and shrewd though ignorant miners and unqualified travellers, are fast being supplanted by the results of careful and accurate research. In Canada Mr. Logan pursues his great work, with able assistants, as zealously and successfully as during former years. In Eastern India Mr. Oldham is similarly engaged, and has gathered around him several young geologists of promise, trained in the methods of European research. In the provinces of Australia, mineral exploration is not abandoned to mere gold-seekers, and the government reports are now scientific documents. Mr. Stutchbury and Mr. Clark are at work in New South Wales, and Mr. Selwyn has undertaken the exploration of Victoria, with the advantage of having previously passed through a strict geological discipline in the survey of North Wales. In our colony of the Cape of Good Hope a geological survey is being regularly conducted by Mr. Geddes Bain, whose private researches had previously produced remarkable discoveries; and in that of Natal, a similar official exploration is, I believe, about to be conducted by the Surveyor-general, Dr. Stanger, whose perfect qualifications for the office are well-known to many Members of our Society.

Progress of Geology abroad.

Of late years the literature of our science has annually received so enormous an increase, that to keep pace with the progress of the details of local geological research is a labour almost beyond the ability of a single individual. In every civilized country the number of pursuers of geology is rapidly multiplying, and the transactions of foreign societies have become prolific in memoirs treating on all departments of our science. France, Prussia, Austria, Russia, Italy, and Scandinavia have all, during the past year, contributed largely through their geological and other societies as well as by separate treatises. In the New World a like manifestation of scientific activity is exhibited, so it would be presumptuous to pretend to report, in an address of reasonable dimensions, the particulars of geological progress abroad during 1853. I shall therefore confine myself almost entirely to the noticing of a few papers and works upon foreign geology that bear more or less directly upon questions of peculiar interest to workers at home. One of the most important, the great work of Barrande, I have already noticed at some length. The date

(1852) of the excellent and truly valuable works of Dale Owen (on Wisconsin, &c.) and James Hall (Palæontology of New York), places them out of my plan; both are of the highest merit, and ought to be carefully perused by every British student of palæozoic formations. The beautiful and laborious map of Belgium by Dumont, one of the great works of our day, has only just come to hand in England; as likewise have the very welcome second volume of Professor Studer's 'Geology of Switzerland,' and the commencement of a national work on the geological survey of the Netherlands.

The admirable 'History of the Progress of Geology from 1834 to 1852,' by Vicomte d'Archiac, a work that does equal honour to the Geological Society of France and the French government, under whose auspices it is published, continues to advance steadily, though still far from its completion. During 1853 the second part of the fifth volume has been issued. This part is devoted, like the last, to the Cretaceous formations; the regions treated of being the Iberian peninsula, Italy, the countries around the Levant, those around the Baltic, the north-west and centre of Germany, Poland, Gallicia, the Carpathians, Russia, Asia, Africa, and America. A prefatory chapter is occupied with the discussion of some general principles involved in the consideration of the phænomena afterwards described, and in a concluding essay the author reviews the geographical and stratigraphical distribution of the Cretaceous formation considered as a whole. The essential characters of this work are such as to preclude any analysis in an Address of this kind. I feel bound, however, as one of the many who feel grateful to M. d'Archiac for the inappreciable assistance afforded by this labour of love on his part, to bear the strongest testimony to the ability, learning, philosophical spirit, and impartiality with which he has executed so far the difficult and delicate task undertaken by him in the composition of this History.

The accession to our ranks of a new and able observer is always a subject of commemoration and congratulation; still more so ought it to be, when our gain is in some partially-explored region, and one where men of science are few and far between. We can boast of such an accession in Senhor Carlos Ribeiro, whose excellent notices of the Carboniferous and Silurian formations of the neighbourhood of Busaço in Portugal have been communicated to us in an ably-condensed memoir by Mr. Sharpe, with notes of high value from several of our Members. We may hope that this paper, a valuable addition to the series of contributions to the geology of Portugal, mostly due to the personal labours of our Treasurer, is a precursor of a full and detailed exploration, by native observers, of a region in great part as yet virgin ground for our science.

The geological structure of a large portion of Spain has been outlined in masterly style by MM. de Verneuil and Collomb in a memoir entitled "Coup d'œil sur la Constitution Géologique de plusieurs Provinces de l'Espagne," communicated to the Geological Society of France. To every scientific traveller visiting the Peninsula hercafter this excellent treatise will be indispensable. It is illustrated by sections and figures of organic remains; a geological map of Spain is

promised. The authors, ever ready to acknowledge and do justice to the labours of those who have gone before them, not only satisfactorily show that the spirit of geological research is active and working among Spanish men of science, but also demonstrate, by a detailed catalogue of no fewer than 154 works and memoirs, that Spanish geology is not so unexplored as many of us are apt to fancy. Among the names of British contributors in his long list are those of Lyell, Silverton, Cook, Traill, Daubeny, Pratt, and Smith of Jordan Hill.

Although when British geologists make raids into the neighbouring regions of the Continent, especially France, Belgium, and Germany, where so many able and eminent brethren of the hammer are exploring with success the structure of their native countries, the object and purpose of their predatory incursions are chiefly to benefit by the experience and teaching of their scientific neighbours, occasionally they feel bound to differ and attempt to correct. There are some provinces, indeed, so closely allied in their geological constitution to well-explored portions of our own archipelago that they seem as outliers of our own geology, and therefore fair fields for critical inquiry. One of these lies almost beside our shores, and is well worthy of examination and study by every geologist engaged in the examination of the upper and middle palæozoics. I allude to the country about Marquise in the neighbourhood of Boulogne. Although not unfrequently described by both French and English observers, much obscurity hangs over the chronological affinities of the palæozoic rocks of this district; and although latterly the demonstration of these relations was being more nearly approached than a few years ago, there still remained much to be done, and none among our countrymen is fitter to undertake their exploration and elucidation than Mr. Austen, whose knowledge of the palæozoics of Devon peculiarly qualify him for this task. The valuable memoir communicated to us in March last is the account of his researches. Leaving its details, as published in our Journal, to explain themselves, I will merely call attention to two or three results of leading interest. Mr. Austen clearly proves that all the Palæozoics of this district belong to the Carboniferous and Devonian series. If any doubt could be entertained respecting any portion of these beds, it would fall upon the black schist of Caffiers, the lowest visible member, and hitherto regarded as unquestionably Silurian; this he sets provisionally aside. But Mr Sharpe, in his excellent appended note, places the supposed lower palæozoic nature of this schist in an extremely doubtful position, by showing that the so-called Graptolites contained in it are really plants. The determination of the true relations of the yellow sandstone belts, with their characteristic contained bivalves, is an important step, and gives us a zone of division between the carboniferous and Devonian limestones, the true equivalents of which are evident and similar in our own regions of Devon and in Ireland. In the latter country this horizon marks distinctly what may be regarded as the line of division between the lower carboniferous rocks—the carboniferous slates, &c. of Dr. Griffith—and the upper portion of what may be considered the Devonian series

proper, that part in which the Kilkenny beds, containing *Cyclopteris hibernicus*, *Anodon Jukesii*, and other fossils indicative of shallow and probably estuary or fluviatile conditions, occur. The Marwood sandstones of North Devon (and the Pilton and Petherwin groups) correspond with it. To what extent the comparison of the beds at Marquise lying below this band, the Ferques and Fiennes groups, and the underlying beds are to be regarded as representing the whole Devonian series, is a question about which Mr. Austen and Mr. Sharpe are at variance, though the much-wished-for publication of M. Bouchard's lists of Ferques fossils would possibly go far towards settling the matter in Mr. Austen's favour, his view being that the Eifelian, Abrian, and Rhenane series of Dumont are here represented. These are points that time will certainly clear up. In the meanwhile a good stride onwards has been made towards assisting our own students of Devonians, who would do well to study carefully this memoir upon the Marquise beds, and to ponder over the excellent and highly suggestive comparative table of the succession of mineral characters and physical conditions that is appended to it.

The Devonians of the Rhenish provinces have lately received a full share of attention, chiefly, however, in a palæontological point of view. I shall have hereafter to call attention to several memoirs bearing upon their organic history. A fresh geological description of the Eifel has been published by the veteran Steininger, illustrated by sections and figures of new fossils. It is very questionable, however, how far the identification of Devonian with Silurian species, put forth in this work, can be accepted. The author's mistakes have arisen chiefly from his retaining the old but now untenable notion of the Silurian place of the German Spirifer-Sandstones. The most valuable contributions to the elucidation of the German Devonians are the works of the brothers Sandberger, who have done much towards the definition and precise classification of this series of rock-formations.

The problem of the true relations of the Calcaire pisolitique of the Paris basin is likely before long to receive some satisfactory solution. Hitherto the balance of opinion has inclined in the direction of the view so ably advocated by M. d'Archiac, and urged also by Sir Charles Lyell, to the effect that the fauna of this formation and its stratigraphical relations warrant the reference of it to the tertiary series. M. Hébert, on the other hand, and with much show of reason, insists not only on its connection with the cretaceous series, but also of its equivalence to the yellow chalk of Maestricht. This question is becoming one of general interest, and has already had its influence in debated portions of our own geology. The views of M. Hébert are stated at some length in a note on the synchronism of the Calcaire pisolitique of the environs of Paris and the Upper Chalk of Maestricht, published in the Bulletin of the Royal Academy of Belgium. The English geologists must bear in mind that the term "Upper Chalk" thus used by M. Hébert, and proposed by him as a denomination for that highest portion of the cretaceous series in which he would place as synchronous the Calcaire pisolitique, the Faxoe chalk or

Terrain Danien, and the baculite limestone of the Cotentin, is not to be understood as embracing the beds which we are accustomed to call "Upper Chalk" in England, and which are especially developed in Norfolk and the east of Kent. The equivalents of the latter, of which the *Cardiaster granulosus* may be mentioned as a characteristic, widely diffused, and guiding fossil, may be seen at Cipley and near Maestricht underlying the yellow chalk with *Hemipneustes radiatus*, i. e., the "Craie supérieure" of Hébert. I have never seen in England any beds which could satisfactorily be assigned to the last-mentioned series, but think it extremely probable that the chalk of Antrim in Ireland, which assuredly should be regarded in its greater part as equivalent to our English Upper or Norwich chalk, will be found to include equivalents of the Maestricht or yellow chalk of the continent. I make this suggestion in consequence of having carefully examined the fine collection of Irish fossils brought together and first described by Colonel Portlock, and the still more extensive suite in the Belfast Museum collected by Mr. MacAdam, for the publication of whose long-continued labours among the formations of the North-west of Ireland, all geologists acquainted with that able observer's perseverance and careful inquiries, now continued over many years, impatiently await.

Mr. Prestwich has communicated to the Geological Society of France his views respecting the position of the tertiary sands and lacustrine limestone of Rilly (Marne). The true place of these beds in the series of lower sands of the Paris basin had not been determined with certainty. Much general interest attaches to the question, since, if, as has been maintained by some eminent French geologists, the freshwater limestone of Rilly is more ancient than any known tertiary deposit (providing the reference of the Calcaire pisolitique to the Cretaceous group, as proposed by M. Hébert, be accepted), then we have clear proof of the entering in of the Tertiary epoch in the area under dispute with terrestrial and fluviatile or lacustrine conditions; the Rilly limestone in this case having been deposited in lakes upon the emerged Cretaceous surface. Mr. Prestwich maintains, however, the independence of the sands and the limestones, and the superposition of the latter on the former. He, for the first time, records the presence of fossils in these sands, apparently much in the same condition as they appear in the similar, though not homologous Headon sands in the Isle of Wight. As in the latter case, they are marine. He holds these sands to belong to the same deposits with those of Chalons-sur-Vesle and Chenay, both marine sands below the lignites. He concludes that the Rilly limestone was preceded by a marine deposit of tertiary age, and was not the most ancient of the tertiaries. On many and good grounds, he maintains that it was a local travertine formed in a small lake, swamp, or marsh; a view supported by the fact that out of forty-five species of Rilly shells, no fewer than thirty are of terrestrial habits, whilst most of those that are aquatic are pulmoniferous types. The presence of *Aviculæ* in these beds would seem to indicate the neighbourhood of salt water.

The treatise on the Tertiaries of the Mayence basin, by the brothers Sandberger, is for all who study the relations of the middle to the lower tertiaries, one of the most valuable contributions to our science during the year. Since, however, we are shortly to have presented to us the results of Mr. Hamilton's prolonged and careful labours in the same region, I shall abstain for the present from any comments on an essay of peculiar interest to myself, as well as on other recent German papers, especially those by Beyrich and Dunker, affecting the same, or closely allied localities.

Organic Remains.

The enormous increase of palæontological observations may be measured by a comparison between the number of species recorded in the first edition of Professor Morris's Catalogue of British fossils, and the number mentioned in those portions of the new edition that have gone through the press, and will shortly be published.

The number of plants recorded in 1843 was 510; in 1853, 652 are cited. The increase is chiefly among Mesozoic and Tertiary types. A great deal has been done to elucidate the structure and affinities of fossil plants in the interval, especially by Dr. Hooker, Mr. Charles Bunbury, Prof. King, Mr. Dawes, and Mr. Binney, but not so much towards adding new names to our lists of species. In Fossil Botany this course of proceeding is a sign of advance of knowledge. The most marked increase in number of recorded species is among the oolitic and Wealden beds. The late lamented Dr. Mantell did much of late years towards increasing the latter list. Were all the known fragments of distinct vegetables found in our tertiaries monographed and named in the manner of those I shall have presently to mention, described and figured in the lately published memoirs by Austrian botanists, our lists would be considerably increased. They certainly ought to be made the subject of a treatise, and might be advantageously taken up by the Palæontographical Society, which, as yet, has given us no separate memoir on British fossil plants.

The Amorphozoa come next. In 1843, 76 named forms were recorded. In 1853, the number is increased to 116. The increase is in a great measure due to the labours of Mr. Toulmin Smith among the Ventriculidæ, which, notwithstanding the arguments of their investigator in advocacy of their Polyzoan, and consequently Molluscan origin, naturalists are generally of accord to keep in their old place beside the Sponges.

The Foraminifera, 82 of which are mentioned as named types in the list of 1843, have increased to 168, besides numerous indications of unpublished and, as yet, unnamed forms. The next ten years will probably triple the amount of named fossil species of these exquisite minims of creation. The additions are chiefly new identifications of British fossils, with species described by continental authors, especially by Alcide d'Orbigny and Reuss. The merit of determining these is, I believe, in great part due to our Assistant-secretary, Mr. Rupert Jones, whose authority stands very high in all departments of microscopic palæozoology. Mr. Jones

himself is an addition to the list of British Palæontologists during the last ten years, and one we all welcome. The labours of Dr. Williamson and Dr. Carpenter have also done much towards clearing up our fossil Foraminifera; and the untiring exertions of Mr. Harris, of Charing, though inconspicuous in print, have, I believe, been a chief source of fresh materials towards the history of our cretaceous species.

In the first edition, the Zoophyta are combined with the Bryozoa. When the latter are eliminated there remain 183 zoophytes, chiefly corals. This number has been prodigiously added to within the last ten years, no fewer than 438 species being enumerated in the new catalogue. The increase, in this instance, is due to an entirely new treatment of the subject. To Milne-Edwards and Jules Haime a large proportion of the additions are indebted for their place. Mr. Lonsdale and Professor M'Coy have also contributed extensively.

The Bryozoa, a few years ago regarded as Zoophytes, but now known to be low forms of the subkingdom Mollusca, amounted to about 132 in the first edition. In the new catalogue, they constitute a roll of no fewer than 249 species. This extended list is due to many investigations, and the newly-recorded types come from formations of all ages. Attention seems to have been suddenly directed to these curious bodies both at home and abroad. The study of the British fossil species, vast as is the increase of the recorded numbers, can be regarded only as in its commencement. I trust that geologists who may direct their attention to these bodies hereafter, will bear in mind the complete and searching analysis of the existing species drawn up by Mr. Busk for the British Museum, and guide themselves in describing the fossils by the example of that valuable treatise.

The Echinodermata, 266 in number in 1843, are now 479; the record of species is daily increasing, but I do not think likely eventually to extend beyond 500 British forms. Major Austin, Professor M'Coy, Dr. Wright, and myself have been the principal workers in this beautiful, and in a geological point of view, invaluable order. The additions of the entire family, including not a few genera and species, of Cystidea to the list, (for the Sphæronites of the former catalogue is probably not a cystidean,) a group as characteristic of the lower palæozoic formation, as the Graptolites or myriads of Trilobites are, is one of the most striking instances of the progress of palæontological research, and one due for several of its most curious facts to the exertions of Mr. Fletcher, and Mr. John Gray of Dudley.

The named Annelida were 79 in 1843, they are now 129. The most interesting additions are among palæozoic forms.

The Cirripedia, 21 in 1843, are now 42. The value of the increase in this instance is not to be estimated by the merely doubling of the number. They have been thoroughly sifted by a master-hand, analysed with incomparable care, and by a combination of unsurpassed labour with judgement and knowledge of the highest kind, have been brought to a state which may be regarded as, at least for many years to come, the epoch of maximum in their investigation. To Charles Darwin we are indebted for this service.

The Crustacea are now 291; in 1843, they were 159. This is an enormous advance, and curious, since in great part it has arisen from additions to the list of palæozoic species. It marks, moreover, not merely an advance of names, but one of knowledge, as may be judged from an inspection of the changes in the generic list. The Trilobites have undergone a complete revision, and the number of species of those singular animals is vastly increased, thanks more especially to the work done by Salter and by M'Coy. The Cytheridæ and Cypridídæ have become a feature in the catalogue, mainly in consequence of the researches of Rupert Jones. Professor M'Coy has largely added also to the list of these tribes, and to the catalogue of the higher crustacea from our mesozoic and lower tertiary strata.

The additions to the list of fossil insects more than double this portion of the catalogue. They are due to the Rev. P. Brodie, and are entirely derived from mesozoic strata, chiefly from the Purbecks and Lias. In this department there is a considerable amount of unpublished materials existing in collections.

The number of Brachiopoda has swollen from 459 to 668, an addition of more than 200 species! In the mean time they have been undergoing complete and thorough revision. Mr. Davidson, whose appearance among us as a British palæontologist has taken place in the interval between the two editions, is foremost among the workers in this department, one greatly increased also by the labours of King, M'Coy, and Salter. Some very interesting contributions have come from Mr. D. Sharpe, and Mr. C. Moore of Ilminster. The important discovery of Liassic species of Leptæna and Thecidium in Britain is due to the last-named observer.

The catalogue included 318 Monomyarian Bivalves in 1843; in the new edition 577 are recorded. The additions in this instance come from numerous sources. Both in this and the following group we owe much to the labours of Mr. Morris and Mr. Lycett among the Oolites.

The lists of the remaining groups of fossil animals will, when completed, show a comparable increase in almost every section. In the highest, a large accession as well as a revision of species, will give a new value to the catalogue; many of the researches of Professor Owen among the reptiles and the warm-blooded Vertebrata, and of Sir Philip Egerton among the Fishes, having been given to the world in the interval. Indeed, scarcely a month now passes without the appearance of some published contribution to British palæontology.

The volume, or rather fasciculus of volumes, for the year 1853 issued by the Palæontographical Society is, in respect of richness of illustration and value of matter, one of the finest productions of this useful union. In its distinctive features it differs somewhat from its predecessors, inasmuch as a considerable portion of it is occupied by a series of elaborate treatises on the anatomy, microscopic structure, and systematic arrangement of the Brachiopoda, respectively contributed by Professor Owen, Dr. Carpenter, and Mr. Davidson. The anatomical plates attached to this memoir are, without exception, the most beautiful engravings that ever illuminated a natural-

history treatise. The lithographic plates illustrative of the genera of Brachiopoda are also excellent specimens of their kind, both in execution and arrangement. They are remarkable, not only for their fidelity, but also for their artistic merits, the more so since they are the work of an amateur in art, our accomplished associate, Mr. Davidson, to whose generosity and zeal for science, the world of geologists is deeply indebted for these admirable drawings. The former annual volumes issued by the Palæontographical Society have scarcely, owing to accidental circumstances, received notice in the Anniversary addresses, and I take this opportunity of offering a word of congratulation to the geologists of Great Britain, on the services rendered to their science through this remarkable series of monographs,—products of disinterested zeal and earnest co-operation.

When the Palæontographical Society was started, its founders could not have anticipated the success that has crowned its exertions, or the facility with which able and enthusiastic labourers in the field of science it proposed to cultivate, would have been found willing to devote their gratuitous exertions to the work. Hence there has arisen an inequality of plan and difference of treatment in the several monographs published annually, much to be regretted, but scarcely now to be remedied. Where a subject mainly of importance to a branch of zoology that chiefly concerns the geologist, such as that of the Brachiopodous Mollusks, is treated fully and completely as in the volume for 1853, we are grateful for the boon, even though such a treatise was foreign to the original intentions of the Society. But in the majority of instances it is doubtful how far it is desirable to expend the resources of the Society on printing purely zoological matter mixed up with the palæontological descriptions, and necessarily imperfect, and causing much repetition. Good figures and good descriptions of fossils are the true ends to be kept in view. It is also to be regretted that the Society had not started with a definite scheme of monographs; each and all should have been either stratigraphical, or else systematic; but we have now a mixture of both, which sooner or later will be the cause of not a little clashing and confusion.

The more strictly palæontographical portion of this volume is occupied by the continuations of the Monographs of British Fossil Corals, by Milne-Edwards and Jules Haime; of Mollusca of the Great Oolite, by Morris and Lycett; of the Crag Mollusca, by Searles Wood; and of the British Fossil Reptilia, by Owen. About 250 species of fossils of various orders are described and figured. Of these about two-fifths are either wholly new to science, or else new to the British Fossil Fauna—no small addition to our knowledge of extinct animals to come from one Society in a year.

In this part of the monograph of the Corals our Devonian species are described and figured, British examples only being selected for delineation, a precaution in a work of this character that cannot be too strictly attended to, since on its essentially local or topographical features much of the peculiar interest and value attached to it must depend. Sad mistakes in other works have been committed through the neglect of this precaution by more authors than one, and many a

dispute might have been prevented, had the exact locality, or if none was known for certain, the fact of the want of knowledge, of the specimen figured, been precisely stated. Forty-six corals occur in the British Devonian strata, being rather less than one-third of all known Devonian corals. Almost half of these are as yet peculiarly British, and of the others only six (five of them being also continental in Europe) occur on the other side of the Atlantic, a fact which, when we call to mind the wide latitudinal range of the Anthozoa, has an important significance in its bearing upon the determination of the geography of the northern hemisphere during the Devonian epoch. Three only of our Devonian corals are regarded by Milne-Edwards and Jules Haime as identical with Silurian species, whilst they consider all the others as peculiar to their epoch. All the species described belong to the groups *Zoantharia tabulata* and *Zoantharia rugosa*, and the most conspicuous and recent-looking corals of the Devonian reefs and banks were members of the latter suborder, one of which there are no living representatives. Hence all inductions drawn from the presence and forms of these zoophytes respecting the prevalence of a warm or tropical climate within our area during the epoch of their flourishing must be set aside, since they have been founded on the mistaking of analogies for affinities. If we accept the views promulgated concerning the structure and classification of corals by Milne-Edwards and Haime—numerous facts in whose support are accumulated in the several parts of this monograph—the prevailing opinions concerning the physical condition of the palæozoic epochs must be very considerably modified or subdued, and the separation of those vast and infinitely remote periods from the stages in time that succeeded them be made even more manifest than was indicated by the phænomena presented by other groups of palæozoic creatures.

The appearance of the first part of the "Description of the Fossil remains of Mollusca found in the Chalk of England," by our valued Treasurer, Mr. Daniel Sharpe, will be hailed with pleasure by students of cretaceous beds all over Europe. The portion published embraces the Belemnites, the Nautili, and part of the Ammonites, and contains descriptions and figures of 24 species, of which two are wholly new, and six new to British lists. The range of cretaceous strata from whence the specimens described have been procured, extends from the Upper Chalk of Norfolk and Gravesend, to the Chloritic marl of the Isle of Wight, and "Chalk with green grains" of Somersetshire. It is worthy of notice that of the Nautili described, several are recorded as having an extensive vertical distribution; thus *Nautilus lævigatus* ranges from the Upper Greensand to the Upper Chalk, whilst *Nautilus pseudo-elegans*, *N. radiatus*, *N. neocomiensis*, and *N. undulatus* occur in both the upper and lower divisions of the Cretaceous system; in others words, both above and below the Gault. Every fact of this kind well ascertained, is of no small interest at present, when there is an extreme and unwholesome tendency on the part of many palæontologists to insist *à priori* upon the distinctness of species coming from different stages, and to force their diagnoses accordingly.

The part of the "Monograph of the Mollusca from the Great Oolite," issued for 1853, is devoted to the Lamellibranchiate Bivalves (not yet completed), of which 116 species are here described and figured. Of these 36 are new to science, and 24 continental forms new to British lists. The authors remark that a large proportion of the Oolitic Lamellibranchiata had shells whose hinges were either a lengthened hinge-plate with a parallel series of transverse or oblique teeth, *i. e.* a hinge of the Arcoid type; or a toothless hinge of the Mytiloid and Myoid types; or a hinge with a ligamentary fossa only (as *Pecten* and its allies); or with the ligament inserted in distinct pits (*Perna* and its allies). Shells with cardinal teeth constituted only a minority: hence the *Veneroid* forms of the oolites are especially few in number. The preceding parts of this valuable monograph were equally rich in facts of a general character, and consequently now so well known that they need not be recalled here.

Professor Owen's instalment for 1853 towards his great monograph of the British Fossil Reptiles includes the Chelonia Paludinosa of the Wealden and Purbeck beds. Eight species are described and figured (six of them new), members of the genera *Pleurosternon*, *Chelone*, and *Platemys*. Those of the first named genus (four species) are all from the Purbecks, those of the two latter from the Wealden beds, properly so called. So far, then, the Reptilia tend to support the views that I have promulgated, after a careful and extended study of the Dorsetshire Purbecks and Wealdens, to the effect that these groups are not members of one series of freshwater beds, but perfectly distinct, and indeed belonging in part (the Purbecks) to the Lower, and in part (the Wealdens) to the Upper Mesozoic epoch. During the past summer I have had occasion again to go over the sections in the Isle of Purbeck, deliberately and in minute detail, and I remain confidently of the opinion which I put forth at the Edinburgh Meeting of the British Association in 1850. The detailed memoir on this subject, to be amply illustrated, is in progress, and if possible will be published in the course of the present year. In the mean time I do not regret the delay, since I have thereby been enabled to work out deliberately numerous points requiring time for their elucidation.

The monograph of the Crag Mollusca is fast advancing towards completion, and the fresh part is as remarkable as the former ones for the fulness of knowledge of the subject that has throughout characterized this important contribution to British Palæontology. Mr. Wood has spared no pains, and has worked from the most ample materials. The genera of Bivalves with cardinal teeth occupy this portion of his treatise. Of these 57 species are enumerated; not a few are now fully described and figured as British fossils for the first time, the previous notices of them having been restricted to a bare mention. I would earnestly urge upon continental geologists the consideration of the results at which Mr. Searles Wood has arrived in this most careful monograph. There cannot be a doubt that the epoch (or rather epochs) of the Crag, was as distinct from that of the

present stage in the world's history,—whether we consider the physical conditions of the area from whence our data are derived, either under a climatal or an orographical aspect, or the natural-history features of the population of that area,—as any "étage" of the upper or lower Mesozoic period was from any proximate "étage." Nay, the difference was even greater; for the physical and natural-history characters of the Pleistocene epoch that intervened were quite of as much differential importance as those of either "étage." Yet now that we know the Crag Molluscan fauna, we might almost say perfectly, no sane naturalist can for a moment deny that a large proportion of the species are positively identical with living types. Let those who would hastily draw a line of death between the faunas of proximate "étages," and regulate their geological conclusions accordingly, ponder well over this significant fact.

The essay on the classification of the Brachiopoda, by Mr. Davidson, contains the conclusions arrived at after many years of conscientious labour, mainly devoted to this interesting order of Mollusks, for whose illustration we owe so much to his pen and pencil. No other palæontologist has ever had so great an amount of perfect materials for his particular task at his command, and neither expense nor labour has been spared by our indefatigable associate to render his monograph as perfect as possible. If any of our brethren dissent from some of his specific decisions, they must all admit that they have been arrived at on no superficial grounds. The portion of Mr. Davidson's work now sent forth is entirely systematic, and is devoted chiefly to an exposition of the characters and definition of the families and genera of Brachiopoda. He admits 33 genera assembled under 10 principal families, with some intermediate and doubtful or provisional groups. As he has endeavoured to define his genera on the strictest natural characters, and appears to have succeeded in arriving at an arrangement, in the main sound and near to the truth, it becomes an inquiry of considerable interest to ascertain how far the ranges of these genera are continuous in time; in other words, whether the theory of unique generic time-areas be borne out among the Brachiopoda, now that we may be said to have attained so extensive a knowledge of their generic and specific types. This was doubtless the idea working in the mind of Von Buch, when with indifferent materials, he attempted to fix the characters of the fossil Brachiopoda, and plainly has often influenced the numerous attempts at their classification made by subsequent palæontologists. I have no reason to suppose that an *à priori* hypothesis, connected with either time- or space-distribution, influenced Mr. Davidson in coming to his final arrangement, and therefore I have been the more curious to see how far that arrangement accorded with geological considerations.

In the first family, *Terebratulidæ*, the typical genus *Terebratula* (of which *Terebratulina* and *Waldheimia* are regarded as subgenera), the succession of types is continuous from the middle palæozoic or Devonian epoch to the present time; whilst the other genera are either Upper Mesozoic, Tertiary, and recent (as *Terebratella* and

Argiope), exclusively Upper Mesozoic (as *Mayas*), or exclusively recent (as *Bouchardia*, *Kraussia*, and *Morrisia*).

Stringocephalus follows as the type of a provisional family, exclusively Devonian.

The *Thecididæ*, represented by *Thecidium* alone, range continuously from the Trias to the present time.

The *Spiriferidæ* concentrate towards the palæozoic pole. In this family Mr. Davidson includes *Spirifer* (with *Spiriferina* and *Cyrtia* as sections), *Athyris*, *Spirigera*, *Uncites* and *Atrypa*.

Rhynchonella, with *Camerophoria* and *Pentamerus*, form a family under the name of *Rhynchonellidæ*. The absence of perforations in the shell is the rule in this group. The typical genus is one of the links between the palæozoic and present epoch, and has its maximum in the Mesozoic.

The *Strophomenidæ*, *Productidæ*, and *Calceolidæ* all concentrate in the Palæozoics; *Leptæna* only, in the first named family, extending into the lower Jurassic strata.

In the *Craniadæ*, represented by the single genus *Crania*, we have a type of Brachiopod almost equally present at all epochs. The nearly allied group of *Discinidæ*, though extending to the present, is generically concentrated in the Lower Palæozoics. The same remark may be made respecting the *Lingulidæ*.

Accepting the genera adopted by Mr. Davidson as mutually equivalent groups, and regarding their distribution in time as determined by him from a vast amount of specific materials, enough to induce us to believe that future discoveries will not materially disturb any inferences drawn from the numbers as now presented to us, then we arrive at several striking conclusions concerning the entire sub-class. Regarding the Present and the Lower Palæozoic epochs as opposite poles of time, we find the generic types among the Brachiopoda concentrate as it were around or towards each, whilst they depauperate towards the equatorial region of the scheme, about which indeed no generic types originate. The loop-armed types are regnant, as it were, anteally, the spiral-armed types posteally; and the latter are in the main so dominant, that the Brachiopoda, as a great assemblage of types, has its major development towards the past, its minor towards the present, and its zero in the parting epoch between the palæozoic and after-ages.

Some special memoirs on fossil Brachiopoda may here be noticed. Mr. Davidson has communicated an excellent tabular view of the classification and distribution of the genera to the 'Bulletin' of the Geological Society of France; and in our own Journal he has described and figured a number of species from the Devonian rocks of China, a region where some future palæontologist is likely to reap a rich palæozoic harvest. The remarkable discoveries in the lias of our own country by Mr. Moore of Ilminster, have found a parallel in France, where M. Eugene Eudes-Deslongchamps, who promises to be worthy of the distinguished name of his father, has found numerous species of *Leptæna* and *Thecidea* in the Liassac beds of several localities in Calvados. His essay, amply illustrated, forms part of the newly

published volume (the ninth) of the Mémoires de la Société Linnéenne de Normandie, a work in which not a few geological notices of interest may be found. It is indeed remarkable that the two genera in question, the one until lately regarded as characteristically and peculiarly palæozoic, and the other as principally cretaceous, should have their epochs of cessation and commencement thus as it were in contact.

One of the distinctive features of our science during the year just past, is the monograph of Nummulites by Vicomte d'Archiac, constituting a portion of the "Description des Animaux Fossiles du Groupe Nummulitique de l'Inde." For some time geologists have looked forward anxiously to the appearance of this treatise, the fruit of careful and conscientious researches, conducted amid abundant materials, and guided by the wise, logical and truth-seeking spirit, so characteristic of its illustrious author. They have not been disappointed; the result of his labours is the production of a most valuable memoir, illustrated by figures of the highest excellence. Every natural group of organized beings, whether existing or extinct, would seem to have its epoch of elucidation, a point of maximum in the history of its study, and the accumulation of facts towards that history. When the time comes, the man is present for the work; but the right moment is ever preceded by long series of preliminary labours, necessarily more or less imperfect, but not the less essential for the eventual right and full understanding of the subject. We are apt to forget when all is made clear to us, apparently as if in a moment, how we have been progressing step by step towards that hill-top from whence we are enabled to command a full and fair view, and how every movement, though not always a straight one, summit-wards, was requisite for the attainment of an eventual position, even though what we sought to see was hidden from us during our upward course. The so-called "discoverer" is too apt to attribute to his own individual efforts what is really but the fruit of time, and the produce of the less fortunate labours of his predecessors. This is not a fault of M. d'Archiac; conscientiously and carefully does he analyse and assign due credit to the essays of those who have gone before him in the difficult and curious study to which his monograph is devoted. Not fewer than 200 volumes, papers, or separate notes upon Nummulites (the work of 128 authors) are analysed in his treatise. First in the list is the ancient and venerable name of Strabo; among the latest are our countrymen Carpenter, Carter, and Williamson, who have independently striven with remarkable ability and success to elucidate the structure of recent and extinct Rhizopoda, attracted to the study by the same mysterious but fortunate impulse that has simultaneously directed the attention of D'Archiac, Rutimeyer, and numerous continental observers to the same interesting subject.

The author describes and figures 52 species of true Nummulites. Of these 20 are entirely new. But these numbers give no idea of the laborious task performed in sifting and rectifying synonymes, reconciling species in duplicate, and abolishing useless names. The

confusion that prevailed is instanced by the state of knowledge and nomenclature of some 22 species that were best known before. Of these 5 were placed in 2 genera, 3 in 5 genera, 2 in 4, 1 in 3, 1 in 6, 1 in 7, and 1 in 8 different genera. Among the species, 4 had received 2 names, 4 others 3 names, 1 four, 3 five, 2 six, 1 seven, 1 nine, 2 ten, and 1 eleven names; so that out of 22 true species of Nummulites no fewer than 98 reputed ones had been constructed!

M. d'Archiac divides the history of the study of Nummulites into five epochs. The first, or fabulous period, and by far the longest though of least importance, commenced with the writers of antiquity, and, after a long interruption during the middle ages, was resumed after the middle of the sixteenth century to extend into that of the eighteenth. The second period, more scientific than the first, but scarcely nearer the truth, extended from 1770 to 1804, when the sagacity of the illustrious Lamarck commenced to shed a new light on the affinities of the lower animals. The third period, from 1804 to 1825, was marked by numerous attempts towards a classification of the Rhizopoda, and Nummulites were described and figured with considerable care, the opinion of their Molluscan and Cephalopodous position prevailing in the writings of naturalists. The fourth epoch extended from 1825 to 1835, when zoologists seem to have settled into a fixed faith about the affinity of Nummulites and Foraminifera with Nautili and Cuttle-fishes (the doctrine taught two hundred and sixty years before by Conrad Gesner), and directed their attention closely to the structure and minuter classification of these curious bodies. It was marked by the commencement of the extensive labours of Alcide d'Orbigny among the Foraminifera. The fifth and final epoch commenced with the notable discovery by F. Dujardin of the low and Amœboid nature of the animal of the Rhizopod, and is signalised by numerous and excellent researches into the features and forms of existing and extinct Foraminifera. At length these living problems may be said to be understood, and the monograph by M. d'Archiac himself fitly closes their history for the present.

The high geological value to which the Nummulites and their order, the Rhizopoda, have speedily attained during the last fifteen years, contrasts curiously with the degradation they have as rapidly undergone during the same period in zoological position. Before 1835 they were generally regarded as Cephalopoda, and naturalists of repute were not wanting who went so far as to describe even the parts of the minute cephalopod that constructed the foraminiferous shell. That they were not Mollusca was scarcely suspected, though half a century before their lower nature had been, on slender grounds however, often maintained. The assumption of their elevated zoological position led to many an argument against support of the theory of the prevalence of a warm climate during the ante-tertiary epochs, from the fact of the abundance of chambered cephalopods in the ancient sea-beds of now cold or temperate latitudes. The abundance of minute chambered Cephalopoda in the North Atlantic at the present time, and their almost universal distribution, were confidently appealed to as conclusive against the inference. Their number in

the later formations, when the genera of Ammonitoida and Nautiloida had become scarce or disappeared for ever, was interpreted only as a continuance of the same class under new and minuter forms. Analogy was mistaken for affinity; and substitution of one group for one totally and organically different, although in the mere form of test not dissimilar, was mistaken for succession and representation within the sphere of one type. But the discovery of Dujardin led the way to an entirely new interpretation of the value of the Rhizopoda, and a new view of the part they play in time. Proving, from good evidence, to be among the lowest of animal forms, to be in fact Protozoa like *Amœba*, but differing from both Proteus and the animal element of the sponge by their investment with a hard and symmetrically arranged (generally in spiral symmetry) exo-skeleton, it is most interesting to note that their advent and maximum development have been, not during the apparent dawn of life, but amid the later epochs, and chiefly during those ages which many palæontologists regard as especially characterized by the highest forms of the animal kingdom. Indeed, so far as we know at present, the whole great group of *Protozoa*—the group that stands as it were at the very base and constitutes the rudiments of the animal series—is as characteristic of the tertiary section of time as the Vertebrata themselves are. A comparable phænomenon is becoming rapidly manifest in the molluscan subkingdom, now vastly increased by the accession of the Polyzoa to its ranks. These curious, lowly-organized, zoophytoid mollusca, instead of being the first of their type to appear, were preceded by members of all the higher orders of it, and do not become of much chronological value until the testaceous forms of the highest class of Mollusks occur, few and far between, and lose their strength and their importance.

The exquisite symmetry and regularity of conformation of the shells of most recent and fossil Rhizopoda were the chief sources of the errors that prevailed so long about their nature and zoological position. The true explanation of their structure appears to me to be that given in detail by our fellow-member Dr. Carpenter, to the effect that the entire mass, however symmetrical or regular, represents the products by successive gemmation originating from a single ovum. It matters little whether we regard each 'joint' or cell of a Nummulite as representing an individual or a zooid, provided we regard it as an element of the same essential nature with each polype of a polypidom, each cell-animal of a polyzoon, or individual of a Botryllus. The value of the regularity of the whole is not invalidated, because that whole is a compound and not a unity, and our faith in the specific value of the fossil, and its consequent geological importance, may be as strongly based on the constancy of characters whose diagnosis is drawn from the features presented by a congeries of individuals as from those presented by a single being. I make this remark, because the only serious objection that I can take to the views of M. d'Archiac touching the nature of the Nummulite concerns this fundamental point. When he states as an argument against its compound nature, that, if each of the cells were the proper

envelope of a particular individual, we ought to find a greater irregularity in their development in the same shell, and asks why, if this theory were true, should the heights of different coils of the same spiral present constant relations, and why the first and last cells should be less large than those of the median whorls, we cannot accept the objections, for a crowd of comparable phænomena presented by the Sertularian zoophytes, animals having considerable affinity with the Polyzoa, although of higher organization, come to our recollection. The variations of the Hydroida, their morphology and reproduction, bear too close a relation to the phænomena exhibited by the rhizopodous organism, to permit us to regard the Nummulite and its allies as simple bodies, or to dispute the theory of their gemmigerous constitution; in other words, the regulation of their organization by the law of paramorphosis.

The stratigraphical distribution of the Nummulites is especially of interest to the geologist. As compared with the grand scale of epochs, their reign was short, but it was well-marked and compact, and offers but one more proof to the thousands now known towards the demonstration of the unity of time-areas of natural genera, facts that should make us strongly hesitate before admitting the value of apparent and daily-decreasing exceptions, and that should give us fresh hope of the future attainment of a knowledge of the grand laws regulating life in its relations to time, and fresh faith in the biological section of the foundations of geology. The Nummulites characterize a portion, not the whole, of the tertiary epoch. Though once, and not many years ago, Nummulites were regarded to be as probably indicative of the cretaceous date of a formation as of its tertiary place, it would now appear that, between the nummulitic tertiaries and true cretaceous strata, deposits intervene, whose fauna and flora are such that we must regard them as of tertiary age. A most interesting and important feature of these deposits, traceable in the north-west of Europe, the south of France, in Savoy, in Switzerland, along the southern slopes of the Alps, in Istria, and even in India, is, that in numerous localities they exhibit evidences of a terrestrial origin, marked by the presence of coal, often accompanied by lacustrine shells, and sometimes by freshwater limestones. In facts of this kind we may get at the true explanation of the break between the cretaceous and tertiary faunas, without having recourse to prodigious cataclysms or paroxysmal elevations of mountain chains, which, if they did occur, as might have been the case, could have made far less impression on the distribution of animal and vegetable life, except in the immediate vicinity of the convulsion, than slow and almost imperceptible changes affecting gradually the disposition of the geography of a wide-spread area.

"The dial moves, and yet it is not seen," paradoxically writes an old poet. Time cannot progress without change, however slow may seem his course. The true measure of the extent and importance of a convulsion (as well as of the importance of unconformity), should be the amount of organic change that we can trace to a connexion

with the paroxysm. And yet what system of paroxysmal elevations has stood the trying test, when questioned on this principle?

It is of the Middle Eocene epoch—that section of the lower tertiaries of which the calcaire-grossier of the Paris basin may be cited as a central type and key-stone,—that the Nummulites are especially, and apparently exclusively, characteristic. The supposed carboniferous and oolitic Nummulites are of too doubtful a nature to be taken as exceptions. There is, it is true, a Nummulite (*N. intermedia*) found in the Miocene beds of Piedmont, and another (*N. garansensis*) in the Lower Miocenes of the Pyrenees. But I am not inclined to conclude with M. d'Archiac that these rare exceptions prove the existence of the last representatives of the genus after the Lower Tertiary fauna had disappeared, but rather to cite them in favour of the view that I have attempted to demonstrate, I trust successfully, when describing during the past year the Lower Tertiaries of the Hampshire basin,—to the effect that the so-called Lower Miocenes are essentially Lower Tertiaries and a portion of the true Eocene series, and that the passage from them into the Middle Eocenes is perfect and gradual, when we have for our examination an area presenting a full sequence of deposits.

Nevertheless it is not the less true that the nummulitic horizon is distinctly and definitely marked, and, from the frontiers of China and Thibet, even to the shores of the Atlantic, occupies a fixed position in the geological scale, a place above and succeeding the horizon of the lower tertiary lignites. The full demonstration of this great fact is a precious gain to our science; and when we consider what a vast area the nummulitic rocks occupy, what mighty mountains are made up of them, the prodigious accumulation of individuals of the fossils from which they receive their appellation, and the readiness with which their age can thereby be determined, we cannot but admit that the elucidation of their history has been a boon of no small value to comparative geology. This great tertiary formation extends across Europe, Asia, and Africa, forming a zone of 98° of longitude, comprised from south to north between the 16th and 55th degrees of latitude, and through much of its course exhibiting a breadth of 1800 miles. In the Himalaya, nummulitic rocks attain an elevation of more than 14,000 feet.

It will ever be a matter of just pride to our Society, that within our meeting-room and in our proceedings the main task was effected of clearing up the mist that clouded so long the geological history of the great nummulitic formation, and that here it was our indefatigable colleague, Sir Roderick Murchison, effected this great advance in tertiary geology. And now that the palæontology of the Nummulites has been made as clear as noon-day by the genius and labour of M. d'Archiac, it will ever be a matter of congratulation to us that the cabinets of our Society and the collections of its Members were freely and heartily placed at his disposal, and have proved of some value towards enabling him to perfect his researches.

The discovery, by Sir Charles Lyell and Mr. Dawson, of an am-

phibian related to new-world types, and of a probable land shell, of the family *Helicidæ*, in the interior of a fossil tree in the coal-measures of Nova Scotia, has excited general and deserved interest, and holds out a promise of future additions from unexpected sources to our roll of palæozoic animals. It is an event of no light significance. The number of palæozoic reptiles is steadily, though gradually, increasing at home and abroad. A new and highly curious form of Labyrinthodont from the Carluke Coal-shales, the *Parabatrachus Colei* of Owen, has appeared on this side of the Atlantic to support our hope of obtaining sooner or later a far larger list of palæozoic air-breathing animals than we at present possess.

Those who are interested in Permian palæontology will find a valuable contribution to this subject in the "Sitzungs-Berichte der Kaiserlichen Akademie der Wissenschaften" for June 1853. It is a memoir on the fauna of the German Zechstein formation by Baron Karl von Schauroth. A comparison is instituted between the German and English species (the latter as described by Professor King), and a concordance is given. From the lists in this paper it appears that there are 61 Permian species common to Germany and England; of these 21 are Lamellibranchiate and 17 Palliobranchiate bivalves. The total number of German species is 116, of which 21 are plants. In England we have 143, including 7 plants. The total number of known Permian species is stated as 237. In a contribution to the palæontology of the Triassic beds, an essay on the organic remains of the Muschelkalk near Jena, Dr. E. Smid enumerates 81 species. A striking feature of the assemblages of fossils in both Permian and Triassic series is the very small number of peculiar generic types. Of all the zones of life in time, these are the most unprolific in new and distinct generic types. Species they have in plenty of their own, but almost all belong to genera that are more important either above or below their horizon, than they are within them.

A long list might be given of recent papers on Oolitic, Cretaceous, and Tertiary palæontology, all more or less interesting, none without its value. For indications of most of these I would refer my hearers to the excellent 'Palæontographica' of Dunker and von Meyer, and the useful pages of the 'Jahrbuch' of Leonhard and Bronn. The memoirs by Reuss on cretaceous and other fossils are especially deserving of attention. In America, too, there is much doing in the study of organic remains. The vertebrata have found a most able investigator and describer in Dr. Joseph Leidy, who promises to be for the United States what Owen is to us. Much that I could wish to say on the progress of cretaceous and eocene palæontology I must for the present reserve; and of that of the newer tertiaries I will confine my remarks to an important work, yet uncompleted, the contents of which are equally worthy of notice at a time when the relations of the middle and lower tertiaries are subjects of discussion.

Most highly, indeed, to be commended is the admirably illustrated monograph of the miocene mollusca of the Vienna basin, published at the cost of the Austrian government and written by Dr. Hörnes, at whose disposal the fine collections of Partsch have been placed for

this special labour. The figures are exquisite. The fifth part appeared in 1853, and contained monographs of the species of *Ranella* and *Murex* (6 of the former and 43 of the latter genus). When this work is completed we shall be in a better condition than ever for deciding upon the *vexata quæstio* concerning the limits of the middle tertiaries. From the materials already before us we may obtain foreshadowings of the conclusion, and it may not be undesirable to offer a few remarks suggested by the facts recorded by Dr. Hörnes; in other words, by the fossil species he has so well described and carefully elucidated.

As far as the work has progressed, the genera monographed are canaliculated Gasteropoda; well-marked types, that are not likely to mislead, belonging to as many as 24 genera. Now, in looking over the lists of species in each, several points strike our attention, viz. 1st, the great development of species in certain tropical genera, or genera in the main tropical, such as Conus (19 species), Cypræa (10 species), Mitra (13 species), Terebra (8 species), Murex (43 species), Ranella (6 species); 2nd, the fact that the species of the more extensive genera are mainly extinct; 3rd, the fact that a considerable number of existing mollusks, characteristically Mediterranean, are present in this fauna; 4th, the presence of very few, scarcely any, existing forms not Mediterranean; 5th, the fact that whatever Celtic forms are present, such as *Cypræa europea*, *Erato lævis*, *Nassa incrassata*, *Chenopus pes-pelecani*, and *Murex erinaceus*, they are shells common to the Mediterranean and Celtic faunas, and therefore most probably original members of the former; 6th, the very large proportion of species common to tertiaries in the north of Italy and south of France; 7th, the small number of references to the Touraine Faluns, though those that occur are of considerable significance; 8th, the small number and doubtful character of the identifications with eocene species. This fauna seems as it were to have been the cradle of the existing Mediterranean fauna, but in the main to have been characteristic of the arms of a great previous Mediterranean, *whose main centre* was tropical, though not a portion of the Indo-Pacific provinces of our times. It seems to have had no northern communications, at least in the direction of Austria. Its tropical character is not derived at all from either the presence of eocene species or from the stamp of an eocene *facies*. Some great intervention of different physical conditions over a vast area must have separated its epoch from the latest eocene æra. It is decidedly not the fauna of the so-called lower miocene. A well-worked list of more than 150 species warrants the suggestion of these provisional considerations.

The search after and description of fossil plants has been actively prosecuted on the continent, and not a few memoirs, several of them beautifully illustrated, have appeared during the year. As contributions of facts towards a future understanding of Fossil Botany, these papers and figures are welcome and valuable; but as palæontological data for the service of the geologist, the use and appreciation of them requires the greatest judgement and caution. The vegetable unit in lists of extinct beings is of far inferior value to the animal unit, and

conclusions respecting the age and affinities of formations drawn from the fragments of an ancient flora should always be put forth as problematical and provisional. Yet in geological memoirs we too frequently find this caution lost sight of, or apparently unknown to their authors, who sum up the columns of animal and vegetable species alike, and add the numbers together, as if by diluting certainties with uncertainties we could come nearer a definite conclusion. Every botanist knows how difficult is the attempt to determine species of living plants from imperfect fragments, how slight is the clue in many cases afforded by a leaf, and how hopeless the task when he has before him only the fragment of a stem. Yet such are the materials from which in nine cases out of ten the describer of fossil plants constructs his species. Not content with indicating the possible or probable affinities of the morsel before him, he confers upon it the dignity of a generic and specific name, and enrols it in the catalogue of new types. When the specimen presents characters so positively different from any known form whatsoever, this proceeding may be excused; but such is not the excuse in the majority of instances. The nearer we approach our own epoch, the more difficult becomes the task, and the more are extreme care and forbearance demanded. With the greatest respect for the distinguished men who have of late contributed so much towards our acquaintance with the floras of the Tertiaries, I cannot but think that the positive nomenclature they have introduced into our lists is quite as likely to retard as to advance geology. Would that the warnings so often and admirably pronounced within our walls by my most able friends and fellow-members, Dr. Hooker and Mr. Charles Bunbury, were heard by some of the palæophytologists of Germany!

Among the most recent researches on this subject are the labours of Göppert on the flora preserved in amber. In this ancient resin portions of plants, even the flowers, are occasionally preserved as perfectly as the well-known insect remains that have so long excited the wonder of the curiosity-seeker, and yielded so rich a harvest to the entomologist. Of cellular plants 59 species were noticed thus embalmed by the eminent botanist just mentioned, and among them about two-fifths, and possibly more, as existing forms, Liverworts and Lichens being the prevailing identities. One Fern only is mentioned. The monocotyledons are restricted to the remains of an *Alisma*, a *Carex*, and portions of grasses. No fewer than 51 Gymnosperms are noted, and among them are identified *Thuya occidentalis*, an *Abies*, probably *canadensis*, and the *Libroccdrus chilensis* of Chili! Of Angiospermous exogens 42 species were found. Among these are several regarded as identical with living types, as *Andromeda hypnoides* and *ericoides*, *Pyrola uniflora*, *Verbascum thapsiforme*, and *Sedum ternatum*. The whole list and the comments of the author are such as to excite the greatest curiosity, and to hold out hopes of fresh results from an investigation so likely to throw light on the climatal condition and geographical conformation of the northern hemisphere during the late tertiary epoch of the formation of the deposits in which the amber occurs. The same author has given an

account of the tertiary flora of Java, with a list of 38 species all marked as new. Dr. Ettingshausen has published a finely illustrated memoir on the Fossil Flora of the Monte Promina in Dalmatia, mainly of an eocene character. Out of 45 species enumerated, one is considered identical with a Sheppey species. Leaves referred to Proteaceæ and to tropical Leguminosæ and Laurineæ are among the more curious forms. But the objections I have made to the definitely naming of fragments must be held good against all these papers, and to the extensive and in many respects highly valuable memoir of M. Heer upon the tertiary flora of Switzerland.

Dr. Ettingshausen has made the tertiary flora of Häring in the Tyrol the subject of a finely illustrated and elaborate monograph, one of the many beautifully got-up scientific publications that have of late been issued at the cost of the Austrian government. He describes no fewer than 180 so-called 'species,' or, more properly speaking, portions apparently of different plants. Of these 73 are common to the floras of other localities; out of this number 41 are eocene, 9 miocene, and 23 species common to eocene and miocene. Proteaceæ, Myrtaceæ, and Leguminosæ form as much as a third part of this flora. The Flabellariæ and Chamæcyparites remind us of certain eocene plants of the Hampshire basin. Compared with existing floras the general aspect is Australian. The author infers that the climate was tropical, and ventures to pronounce on the probable mean annual temperature of the region in which these plants lived, determining it to be 18° to 21° Reaumur. In this conclusion, as well as in the decisions about species and genera, there is a degree of overprecision assumed to which fossil botany can justly lay no claim. In a previously published memoir on the tertiary flora of the Vienna basin, the age of the latter is stated to be miocene and the climate subtropical. In these determinations scarcely sufficient allowance is made for difference of locality and varying conditions, such as time of year of deposit and local elevation. The botanical differences between the plant-bearing beds of our own eocenes might lead to conflicting conclusions were we not well acquainted with their geological affinities.

M. de Zigno has announced the discovery of a new locality in the Vicentin for fossil fishes of the Monte Bolca type, and a rich tertiary flora probably of somewhat later age. Of greater consequence and general geological interest are his investigations in a stratum of grey Jurassic limestone containing vegetable remains at Monte Spitz de Botzo in the Sette commune of the Vicentin, first indicated by Fortis towards the close of the last century. The bed lies upon oolitic strata containing *Terebratula spheroidalis*, and is covered by others containing *Ammonites athleta* and *viator*, *Terebratula diphya*, and other organic remains indicative of the horizon of our Oxford clay and Kelloway's rock. M. de Zigno regards the plant-bearing bed as the equivalent of the Great Oolite, or thereabouts. He has obtained more than 400 specimens from the localities where it appears. All the plants are of terrestrial origin, and bear the strongest analogy to the oolitic floras of Scarborough and Mamers. The number of spe-

cies does not exceed 40, but the majority are new. They belong to the genera *Equisetites, Sagenopteris, Cycadites, Zamites, Otozamites, Araucarites,* and *Brachyphyllum.* The *Cycadeæ,* and especially the *Otozamites,* predominate. M. de Zigno is about to publish a monograph of his highly important discoveries, and it is to be hoped that British geologists will render him due assistance, the more so as all students of the English and Scottish oolites must feel greatly interested by this announcement.

But, on the risk of taking subjects out of the order of time, I must not omit to notice progress in the old and favourite direction of the vegetation of the carboniferous epoch and the origin and working of coal. The papers by Mr. Dawson and Mr. Poole on the phænomena of the coal-formation of Nova Scotia are contributions to this subject of very high interest, and are accessible in the pages of our own Journal. An excellent sketch, not without original matter, of the natural history of coal and the "Fossil Flora of the Mountain Limestone formation of the Eastern Borders," by Mr. George Tate, appended to Dr. Johnston's delightful work on the Natural History and Antiquities of the Eastern Borders, well deserves the notice of the geologist and student of fossil plants. Circumstances of commercial interest have directed the attention of many men of science during the past year to the investigation of the nature of coal, and attempts at a strict and unmistakeable definition of what coal is has, I fear, after carefully reading all that has been said upon it, taken up in vain much of the time and thought of both philosophers and lawyers. Coal has become a geological chameleon. Opinions on this vexed question must necessarily vary according to the point of view, whether chemical, or geological, or mineralogical, or microscopical, at which we regard it. By making an *à priori* rule as to what coal should be, any man may arrive at a strict specific character, and more than one view of the matter may be right.

Petrological Inquiries.

The often-discussed subject of cleavage, about which so many geologists are at variance, has been treated in a fresh and novel manner by Mr. Sorby, who has communicated an essay of singular interest, "On the Origin of Slaty Cleavage," to the Edinburgh New Philosophical Journal for last year. This diligent observer has called the microscope to the aid of the hammer and clinometer. By an examination of extremely thin sections of rocks under high powers (that which he recommends as most generally useful for the purpose in view is about 400 linear), he has been enabled to throw new light on some of the greater geological problems; among others that of the cause of slaty cleavage. For the examination of slate rocks he recommends the use of a polarizing microscope. The physical structure and the optical properties of the component minerals may be identified thus, even when in grains less than $\frac{1}{1000}$th of an inch in diameter. A comparison of sections of uncleaved with those of cleaved rocks, having similar mineral composition, shows that the minute par-

ticles are differently arranged in each. The alteration of the arrangement in the latter case is such as would result from the rocks having suffered a change of dimensions, been greatly compressed in a line perpendicular to cleavage, and elongated to a certain extent in the line of its dip. Of these changes there are evidences afforded also by the diminution in the distance between any two points lying in the line of pressure in contorted beds, the dimensions of the beds in different parts of contortions, the change in the dimensions of the organic remains, and the arrangement of the green spots so generally seen in Welsh slates, and resulting probably from original concretions. These spots, Mr. Sorby remarks, in rocks without cleavage are almost perfect spheres, or are elongated in the plane of bedding. In cleaved rocks they are like the minute particles compressed in a line perpendicular to the cleavage, and more or less elongated in the line of its dip. The result of Mr. Sorby's inquiries is the strong support of the mechanical theory of cleavage, and a confirmation of the observations of Professor Phillips and, partially, of the views maintained by Mr. Sharpe, from whom Mr. Sorby differs in maintaining that the *particles* in general have suffered a change of position without actual compressing or crystalline arrangement. Mr. Sorby maintains that it is not possible to reconcile the mechanical facts noticed in his essay with the supposition of an electrical action or other non-mechanical agent being the efficient cause of the phænomenon of cleavage. By ingenious experiments he has been able to produce similar arrangements of minute particles with those observed by him in nature, all favourable to the theory which he so ably upholds.

In the West Riding Geological Proceedings, Mr. Sorby has a paper on the oscillation of the currents that drifted the sandstone beds of the south-east of Northumberland, and on their general direction in the coal-field in the neighbourhood of Edinburgh. By careful study of the minuter characters of the drift-structure in sandstone,—more minutely and closely than has hitherto been done,—Mr. Sorby proposes to arrive at definite results concerning the precise directions, characters, and velocity of the currents. The instances given in this essay, which may be regarded as the prodromus of more extensive memoirs, are most interesting, and warrant the conclusions at which he has arrived so far. I am convinced that the path chosen by Mr. Sorby is one of very great consequence to the future progress of geology, and that by methods similar to those which I have advanced and put in practice in the observation in the field of the distribution of organic remains in strata, viz. the observation and careful noting of phænomena, inch by inch, is as sure to yield valuable results to the purely physical as to the natural-history observer. The smallest of facts is not only worthy of notice and record, but may often prove to be the key by which we are enabled to acquire a philosophical knowledge of the rock-masses we are studying. The geology of no region, however extensive or however limited, can be said to be done until its minute as well as its more conspicuous constitution has been fully and fairly made out. Hitherto this has rarely been attempted, and perhaps our science is not yet ripe for an extensive employment of the method.

The microscopic researches of Mr. Sorby on the structure of fresh-water marls and limestones open out a new field for inquiry as yet little more than indicated. The idea of ascertaining the origin of the structure through a determination of the forms of the minute particles into which shells resolve themselves by decay, and of estimating the relative proportions of the microscopic ingredients of a rock by delineating on paper the outlines of the particles present in a thin section of the stone with the aid of the camera lucida, then cutting them out and weighing the figures of each kind separately, is a process I believe wholly new in geological research and due to our ingenious associate. The value of the proceeding may be tested by the results, which, so far as they are published, are excellent. So long as the microscope thus employed is guided by a practical geologist, our science will be a gainer by this kind of investigation.

The distinction of all granites into two species or varieties, each characterized by mineralogical and geological peculiarities, has been forcibly insisted on by M. Delesse, and illustrated from his researches among the rocks of the Vosges mountains. He distinguishes,—1st, the 'granites des Ballons,' containing little quartz, orthose in large crystals, felspar (of the 6th system), dark mica affected by acids, and frequently hornblende, ordinarily accompanied by sphene; and, 2nd, the 'granite des Vosges,' mainly made up of quartz and orthose, with the addition of a little felspar (of the 6th system), dark mica affected by acids, and transparent mica in smaller quantities not affected by acids. This granite often takes a gneissoid structure. The former kind is eruptive, and constitutes the more elevated portions of the granitic chain; the latter has rather the characters of a metamorphic rock. The distinction between the two sorts is not merely local, and has been observed by M. Delesse in not a few granitic localities; among other regions, in Ireland.

In a memoir on the mineralogical and chemical constitution of the rocks of the Vosges, M. Delesse discusses those phænomena of metamorphism characterized by felspathization, that is, by the development of crystals of felspar (of the sixth system) in ancient stratified rocks. To these felspathised rocks of the Vosges he applied the name Grauwacke, a term by which he proposes to designate every sedimentary rock, whatever be its age or structure, in which crystals of felspar of the sixth system have become developed. I am inclined to object to the revival of the name Grauwacke in the present stage of geological research; it has been used so variously, loosely, and indefinitely that it had better be wholly dropped from our nomenclature. The sense in which it is used by M. Delesse is not that in which the majority of geological writers have employed it, and since the class of rocks to which he would restrict the name are highly important and well deserving of specific distinction, the invention of a new term would not only have been excusable, but also of good service. The question may arise whether the apparent felspathization, in the sense in which this word is used by M. Delesse, may not in some instances rather depend upon the original diffusion

of felspar crystals through a sediment derived from showers of volcanic ash, constituting thus a rock of which numerous instances are familiar to the explorers of our palæozoic districts.

The line of research chosen by M. Delesse in the papers just noticed, and many others from his pen, is one sure to be productive of valuable results. The mineralogy of rock masses is of great consequence to the geologist, but to be satisfactorily treated must be dealt with by inquirers who are, like the author cited, practical geologists, and ready at the same time to avail themselves fully of the aid of chemistry. The treatment of the majority of simple minerals falls, in the main, within the sphere of the chemist; so much so, that we might almost be warranted in regarding mineralogy as the palæontology of chemistry.

Among the "general observations" prefixed to the new volume of M. D'Archiac's History are some brief but profound remarks on petrographical changes, and on the distinctions between the greater metamorphism of sedimentary formations and the lesser or metamorphism of contact, the latter being dependent on the action of igneous causes. The author calls attention to the fact of consolidation and tendency to metamorphism in the sedimentary strata of mountain masses, exhibited by the hardening of the limestones, their tendency to assume certain peculiarities of colour and frequently subcrystalline and even saccharoid textures, the conversion of the marls and sandy clays into schistose beds, and the indurated and compact characters of the sandy elements. On the other hand, the continuations of the same beds, when forming horizontal table-lands or extended plains, composed of conformable and undisturbed strata, exhibit entirely distinct mineral characters, being comparatively unsolidified and putting on very different features of colour and texture. These differences between the same set of rocks—in the one case disturbed, crumpled up and contorted, in the other resting almost in their original repose—are exhibited by formations of all ages indifferently, and would lead to the inference that the greater metamorphism is mainly due to energy of dynamical causes.

Although properly the subject should be mentioned under a distinct head, I may here allude to Mr. Tylor's interesting essay on the changes of sea-level effected by existing physical causes during stated periods of time, a paper abounding in suggestions of general interest and in curious calculations. As the author continues to pursue the same line of inquiry, it would be premature to discuss his conclusions now.

Still more distinct and far less practical in its theme is Mr. Saull's pamphlet treating of the connexion of geological phænomena with astronomical causes.

Text-books.

The spread of a love for geology among the people and students of science has its surest indication in the appreciation of text-books and synoptical treatises. The year 1853 has not been behind in affording evidences of the popular appreciation of our science. That great

standard of geological philosophy, the 'Principles of Geology,' by Sir Charles Lyell, has reached a ninth edition, one carefully and learnedly brought up to the ever-increasing knowledge of our day. A second edition has appeared of the 'Geological Observer,' a volume in which Sir Henry De la Beche embodies the fruit of years of fieldwork and reflection. A new elementary work of peculiar merit, entitled 'Popular Physical Geology,' has come from the pen of Mr. Jukes: this little book may be studied with advantage by the most experienced, and, keeping as it does, in a style highly commendable for perspicuity and nerve, the leading physical laws and facts of the science before the reader, unmixed with palæontological statements and conclusions, will serve as a wholesome corrective of a tendency to regard too exclusively its biological aspects, a bias on the part of geologists which a naturalist holds quite as much in dread as the sternest mineralogist or dynamical observer. A useful companion to elementary treatises in the form of an engraved table of the characteristic fossils of the several formations has been sent forth by Mr. Lowry. A new edition of Professor Pictet's 'Manual of Palæontology,' by far the best work of its kind, is a welcome contribution to our geological libraries; and the same may be said of Professor Phillips's 'Geology,' and of the lamented Dr. Mantell's 'Medals of Creation,' edited by Mr. Rupert Jones. Among elementary works that have appeared on the continent is one by the illustrious veteran Omalius D'Halloy, and in America Professor Hitchcock and Messrs. Adams and Gray have sent forth introductory treatises.

Conclusion.

In the course of this Address I have used some expressions that, as far as I am aware, are new to geological language, and involve an idea which, although hypothetical, I wish to put forth upon this occasion. I am strongly impressed with the belief, that, fanciful though it may seem, there is within it the germ of a great geological truth. I have spoken of genera concentrating towards the palæozoic pole, and *vice versâ*, of the substitution of groups, and the opposition of the more ancient to the mesozoic and modern faunas. The phrases have been incidental, and arose naturally out of the subjects under commentary, but the idea that lies at the base of them, whether true or fallacious, requires to be stated, and there cannot be a better opportunity than the present for venturing to start this fresh geological hare.

Every geologist whose studies have been equally or nearly equally directed to the organic phænomena of the three great sections of time usually received, Palæozoic, Mesozoic, and Tertiary or Cainozoic, cannot fail to have been struck with the greater value of the difference between the first or oldest section and the two newer divisions taken together, than between the first and middle terms and between the latter and the last. The degree of organic difference between the upper mesozoic and the lower tertiary epochs is rather more, but only slightly more, than the degree of difference between the lower

and upper sections of the great mesozoic period. But the gap between palæozoic and mesozoic, although the link be not altogether broken, is vastly greater than any other of the many gaps in the known series of formations. I am one of those who hold, *à priori*, that all gaps are local, and that there is a probability at some future time of our discovering gradually somewhere on the earth's crust evidences of the missing links. All our experience and knowledge, theoretical and practical, warrant the affirmation that at every known stage of geological time there were sea and land. Even those who believe in a primæval azoic period will hardly sanction the supposition that there has been any repetition of azoic epochs since the first life-bearing æra commenced. And if so, and if there were always sea and land since the commencement of the first fossiliferous formation, we are warranted in assuming that both earth and water had their floras and their faunas. All geological experience goes to show, that wherever you have a perfect sequence of formations accumulating in the same medium, air or water as the case may be, there is, if not a continuance of the same specific types, a graduated succession and interlacement of types and of the facies of life-assemblages: even as on the present surface of the earth the faunas and floras of proximate provinces intermingle more or less specifically, or, if physical barriers prevent the diffusion of species, assume more or less one general facies. This passage, by aspect and type, of one stage in time into another is but scantily indicated at present in the uppermost manifestations of the palæozoic life and the lowermost of the mesozoic. The missing links will sooner or later reward the diligence of the geological explorer.

But in the general aspect of the palæozoic world, contrasted with the worlds of life that followed, although all are evidently portions of one mighty organic whole, there seems to me to be something more than the contrast that depends on the loss or non-discovery of connecting links. There is more than we can explain by this theory. Granting for its support all facts capable of being so applied, there are residual phænomena to be accounted for, and which as yet have not been referred to any law that I know of.

For some years I have lived in hope of the discovery of a palæozoic fauna and flora more in accordance with those of after-epochs than those we know, and fondly fancied that local differences of physical conditions alone might account for the discordance. But the fields opened by Murchison, Sedgwick, and Phillips have been so extended and have yielded such rich harvests at the hands of James Hall and his fellow-explorers in America, and of Barrande, de Koninck, de Verneuil, the Römers and Sandbergers, M'Coy, King, Salter, Roualt, and many other able palæontologists who have worked at palæozoic fossils in Europe, that it is becoming evident that we have before us a fair and true image of at least the marine aspect of the primæval group of faunas. The more they are investigated, the wider the ground is explored, the more striking is the difference in the main between the life palæozoic and the after-life.

Doubtless a principal element of this difference lies in *substitution* —in the replacement of one group by another, serving the same pur-

pose in the world's œconomy. Paradoxical must be the mind of the man, a mind without eyes, who in the present state of research would deny the limitation of natural groups to greater or less, but in the main continuous, areas or sections of geological time. Now, that greater and lesser groups—genera, subgenera, families, and orders, as the case may be—or, in truer words, genera of different grades of extent—have replaced others of similar value and served the same purpose or played the same part, is so evident to every naturalist acquainted with the geological distribution of animals and plants, that to quote instances would be waste of words. This replacement is *substitution of group for group*—a phænomenon strikingly conspicuous on a grand scale when we contrast the palæozoic with the after-faunas and floras. A single instance of these greater substitutions may be cited to assist my argument, viz. the substitution of the Lamellibranchiata of later epochs by the Palliobranchiata during the earlier. In this, as in numerous other instances, it is not a total replacement of one group by another that occurred; both groups were represented at all times, but as the one group approached a minimum in the development of specific and generic types, the other approached a maximum, and *vice versâ*. I think few geologists and naturalists who have studied both the palæozoic and the after—I must coin a word —*neozoic* mollusca will doubt that a large portion of the earlier Brachiopoda—the Productidæ for example—performed the offices and occupied the places of the shallower-water ordinary bivalves of succeeding epochs.

Now in this substitution the replacement is not necessarily that of a lower group in the scale of organization by a higher. There is an appearance of such a law in many instances that has led over and over again to erroneous doctrines about progression and development. The contrary may be the case. Now that we have learned the true affinities that exist between the Bryozoa and the Brachiopoda, we can see in these instances the *zoological* replacement of a higher by a lower group, whilst in the former view, equally true, of the replacement of the Brachiopoda by the Lamellibranchiata, a higher group is substituted for a lower one. Numerous cases might be cited of both categories.

But can we not find something more in these replacements and interchanges than mere *substitution*, which is a phænomenon manifested among minor and major groups within every extended epoch? Is there no law to be discovered in the grand general grouping of the substitutions that characterize the palæozoic epoch when contrasted with all after-epochs considered as one, the Neozoic? It seems to me that there is, and that the relation between them is one of contrast and opposition—in natural-history language, is the relation of POLARITY.

The manifestation of this relation in organized nature is by contrasting developments in opposite directions. The well-known and often-cited instance of the opposition progress of the vegetable and animal series, each starting from the same point—the point at which the animal and vegetable organisms are scarcely if at all distinguish-

able,—may serve to illustrate the idea, and make it plain to those to whom the use of the term POLARITY in geological science may not be familiar. In that case we speak of two groups being in the relation of polarity to each other when the rudimentary forms of each are proximate and their completer manifestations far apart. This relation is not to be confounded with divergence, nor with antagonism.

If we take the scale of geological formations, representing the succession of the leading divisions of time, and note for each of the epochs the known generic types present during its duration, we shall find there is not an equality of production, so to speak, at all times of fresh generic ideas. Genera have appeared, as it were, in batches. I am forced to use expressions that seem almost irreverent, and a phraseology of a loose and popular kind, in order to convey the more vividly my meaning. To talk of the appearance of a genus, that is, the appearance of an ideal type, is loose language I am aware, but its meaning or intention can scarcely be misunderstood. In the individuals of a species only can we have the embodiment of a generic idea; but in discussing a question of the kind I am considering it is convenient to use the word genus as if it were a realized unit and an entity. We speak, as it were, through a diagram. Now if commencing, upon our scale, at the dawn of the palæozoic epoch, and noting the beginning of genera or groups from the first known fauna up to the advent of man at the termination of the so-called tertiary epoch, we cannot fail to perceive the following general facts:—

1. During the earlier and middle stages of the palæozoic epoch there was a great development of generic ideas.

2. During the middle and later stages of the neozoic epoch there was a great development of generic ideas.

3. During the terminating stages of the palæozoic epoch the origination of generic ideas was very scantily manifested.

4. During the commencing stages of the neozoic epoch the origination of generic ideas was very scantily manifested.

5. The majority of generic ideas that originated during the palæozoic epoch belong to groups (of various degrees of generic intensity) which are characteristically palæozoic, *i. e.* have their maximum development and variety during the palæozoic epoch, or else are even exclusively palæozoic.

6. The majority of generic ideas that originated during the neozoic epoch belong to groups which are characteristically neozoic in the same manner.

7. The minimum development of generic ideas in time is at or about the passage or point of junction of the palæozoic and neozoic epochs.

8. Groups characteristically palæozoic swell out, as it were, in a direction *towards*, not from, the commencement of the palæozoic epoch.

9. Groups characteristically neozoic swell out in a direction *from* the commencement of the neozoic epoch.

That there are apparent exceptions to these general facts I do not pretend to deny, but the rules are so much more powerful than the

exceptions that we may safely wait with confidence for the explanation of the seeming anomalies during the course of the progress of research.

Now there is but one conclusion that can be drawn from these facts, if after being tested with every evidence now known to us they remain intact as our science progresses. This conclusion is to the effect, that the relation between the palæozoic and neozoic life-assemblages is one of development in opposite directions, in other words, of *Polarity*. In the demonstration of this relation it seems to me that we shall, in all probability, discover the secret of the difference between the life anterior to the Trias and the life afterwards. The notion is in some degree a metaphysical one, but not the less capable of support through induction from the facts. I plead for its consideration, believing it to be worthy of earnest inquiry. I know that its novelty and seeming vagueness may repel many when it is thus briefly, and as if in outline, put forth. But before any geologist or naturalist rejects it, I would ask him to study carefully the admirable monographs, written without a bias, of whose merits I have been discoursing in this Address; to seek out the manifestation of the idea in the first instance in some important and characteristic group of beings about whose time-distribution we have now a sufficient knowledge, such an assemblage as the Trilobites described to us in the work of Barrande, or the Brachiopoda as exhibited in the monograph by Davidson; to take and analyse the ample lists of extinct beings marshalled in the pages of Morris, or in the more general muster-rolls of Bronn and Alcide d'Orbigny; and then, having done this, to consider earnestly and fairly the idea that I have ventured to suggest of *the manifestation of Polarity in Time*.

Gentlemen, since I have occupied this Chair I have heard two reproaches cast upon our Society, the one that we throw cold water upon theories, and the other that we are opposed to the practical applications of Geology. The fate of the concluding paragraphs of this Address will not, I hope, be confirmatory of this first accusation, one seldom urged against Geologists. As to the second, I believe I speak the sentiments of every working geologist in this Society, when I say that no papers, no discussions within these walls, are heard with more pleasure or received with more approbation than those which have a practical and economic bearing, always providing that sound science and original research constitute their foundation. Empiricism we eschew and abhor. Solid knowledge, careful observations, and sound scientific theory are as necessary for economic as for unremunerative geology. During the Session just concluded the various aspects of our science have each had an impartial share of attention. In the Session which is about to commence we have every prospect of holding our forward course in the sound and safe path that the Geological Society of London has chosen from its beginning.