ADDRESS.

GENTLEMEN,

At the close of another year we meet once more on the anniversary of the Society, to take a brief retrospect of our progress during the past year, and to strengthen, by mutual intercourse, our hopes and our energies for the coming session.

And seldom has the Society met, when such encouragement was more needed. Our country, still weakened by the misery and suffering consequent on its distress, has been visited, in the all-wise dispensations of Providence, with an alarming scourge. Sudden affliction, and unlooked for suffering, have darkened the gloom of the past year; and we meet this evening thankful, I trust, that we have been saved from the unwonted mortality which hovered around us.

The depression caused by suffering, however, and the anxiety for its relief, are not compatible with that undivided attention which Science claims from her votaries; and while most of us may plead our own losses, or the pre-eminent calls of duty to our fellow-sufferers, as abundant excuse for any apparent neglect of our science which may have occurred, we still must look forward to a more successful future, when greater prosperity around us, may enable many who are now wholly engaged in charitable works, to devote at least a portion of their time to scientific pursuits.

It is, however, no small gratification to be able to state, that your Society has not retrograded during two years of severe trial, in which it has had to contend against the great disadvantages consequent on changes in locality and in other respects, and also against those arising from the general state of the country. Your permanent income has been added to—your numbers have not diminished.

I had last year, Gentlemen, occasion to state briefly, the reasons why in the few words which it was customary for your President to address to you at your annual meeting, I preferred rather to give a brief outline of what had been done in the principal branches of our study during the past year, including the labours of Foreign as well as British geologists, than simply to review the papers read to the Society itself, with the aim of which, I must suppose you are already acquainted; and I further mentioned the reasons why I thought it convenient to subdivide the subject under three or four distinct heads

I regret much that such a sketch must necessarily be very imperfect. There are not sufficient opportunities here of becoming rapidly acquainted with foreign publications: many works published during, and belonging to a former year, have only reached us during the past twelvemonths, yet cannot, therefore, strictly be included among the labours of the year. And even did those means exist, time has been wanting to me to employ them to advantage. The use of the hammer, to a certain extent unfits the hand for wielding the pen; and constant occupation in the field is not calculated to afford either the opportunity or the desire for much reading. Imperfectly, however, as it must be executed, I shall endeavour to outline a few of the more important papers of the past year.

In doing this, however, I would be understood as anxious simply to lay before you the views of the various authors themselves, in a few cases offering a remark or two on the tendency of, or the objections to, such views. And this, not only because I am inclined to think this the most useful plan to adopt, but also because I am satisfied that the occasion of an address like the present is not one which should be made use of by the President for the advocacy of his own peculiar views on any subject. For this there are manifold other opportunities, which appear to me more appropriate.

Adopting, therefore, in some degree the same classification of subjects, as in the remarks I had the honour of addressing to you last year, we have first to notice briefly such papers on descriptive geology, as have, during the twelvemonths since elapsed, tended to throw additional light on our knowledge of the structure or forms of the earth's surface, of the laws which control its variations, and of the distribution of the many members into which its rocky skeleton may be divided.

Early in the year (19th February, 1849,)* M. Coquand gave a description of the primary and igneous rocks of the *department du Var,* in which he proposes to classify all the varieties which occur there into seven distinct groups, viz.—the granites, serpentines, red quartzose porphyries, melaphyres, (including amygdaloids, spilites, traps,) blue quartziferous porphyries, trachytes, and basalts. The granite is not found to occur in large masses, nor forming an independent group, but chiefly in veins and threads in the gneiss and mica slate, and is subordinate to the crystalline schists. To this rule an exception appears in the plains of Tour; but the porphyritic granite of Roquebrune passes, by insensible gradations, into a gneiss, and even leads to a doubt that gneiss and granite are only different forms of the same rock. The gneiss is much more extensive than the granite; in parts it contains so much graphite, that speculators have been led to suspect a coal deposit, and have even made trials for coal. The gneiss rocks are also frequently amphibolitic and porphyritic, and form a passage between the garnet-bearing quartz and the mica slates. To the gneiss succeed mica slates, containing abundantly staurotide, garnet, tourmaline, rutile, disthene, andalusite, and quartz crystals; and containing also subordinate beds of *siderschist,* a mica slate, in which the mica is replaced by fer-oligiste —a variety now for the first time described in Europe. North-east of Collobrieres it is found in strong beds. There are also seen east of Collobrieres garnets, massive—six, and even sometimes thirty feet thick.

Silky slates, (*les phyllades satineès*) form the outer border of the crystalline schists, and are connected with the mica slates by insensible gradations; but between Collobrieres and Hyeres, the argillaceous slates pass into a dark "*coticulaire*" schist, containing rounded grains of quartz, the presence of which would tend to prove that the crystalline character of the schist is a fact posterior to its deposition.

M. De Beaumont had already observed, and the author confirms the statement, that as regards direction, the beds in the Var belong to two groups; one lying north-east and south-west, the other north and south, corresponding to the two systems of elevation established by De Beaumont, viz.—that of Westmoreland and that of the north

* Bull. Soc. Geol. France, page 289.

of England. The crystalline schists are, *par excellence*, the locality of the quartzose and metalliferous veins.

Of the serpentine there are only three or four masses of any extent. All the serpentine of this district is remarkable, as being entirely free from *diallage*, but is very asbestiferous. It is used for ornamental and other economical purposes. Chromate of iron is found in one or two places, in rognons more or less large. Talc is found interlaced in small threads, like the ores of copper in the serpentine of Tuscany. It is difficult to decide the precise age of this serpentine; but every evidence which there is tends to prove that it is more ancient than the jurassic system, being like the serpentine of the Vosges and of Limousin.

The red quartziferous porphyry forms almost the entire mass of the Esterel, and gives a peculiar physical aspect to it; sharp peaks, and irregular indentations cutting in a hard line against the sky, contrasting strongly with the rounded tops and long slopes around. The valley of Reyrau divides the mass into two parts, or unequal bands. In the constancy of its mineral constituents, this rock forms one of the most marked and best defined terms in the igneous series; and there is as little doubt as to its age, or its relations with the rocks which it traverses or which cover it. The paste is generally a petrosiliceous orthose, of a more or less distinctly red colour, containing numerous simple or hemitrope crystals, of a paler orthose, and also grains of quartz, which in crystalline form approach the dodecahedron. These red porphyries appeared during the period of the *gres-bigarrè*, as is clearly shown by the fact of the lower beds of this group being altered by their contact, while the upper are made up, in a great degree, of the debris of the porphyry itself; and besides, the porphyry has been affected by all the subsequent disturbances of the *gres-bigarrè*.

Under the head of Melaphyres, are included all the varieties of spilites, trap, amygdaloid, wacke, and melaphyres, which may all be taken as one great series, differing in the minerals included; and which might be subdivided into four groups of granular, porphyritic, amygdaloidal, and variolitic melaphyres. Of all these the geological epoch is, according to the author, anterior to, or at least cotemporaneous with, the *gres-bigarrè*. He further thinks, that the successive appearance of dolomitic beds, is in some way connected with the successive eruption of these melaphyres—not altogether by subsequent alteration, but by the circumstance of the waters at these successive times holding carbonate of magnesia in solution. The melaphyres as a whole, form one geological formation or group, of which the first appearance followed quickly the deposits of the earliest beds of the gres-bigarrè, and which is also connected with the appearance of some metallic veins, and of gypsum and dolomite in Provence and parts of Dauphinè.

The blue quartziferous porphyry, in which the paste is formed of oligoclase, and in part of albite, with dodecahedral crystals of quartz, (which forms one of the essential elements,) the author believes to be the cause of the disturbance of the Esterel.

The trachytic group is very variable in composition; as to age, apparently anterior to the miocene, and posterior to the nummulitic group of the middle of France. The basaltic group is of later date, and produces very marked disturbances and alterations in the rocks adjoining. Of the several facts stated, M. Coquand gives a tabular view, exhibiting the geological period of the production of the several groups of igneous rocks, and the class of veins associated with, and dependent on them.

Large, however, as these masses of igneous rocks are, to get a true notion of their relative importance, we must compare their extent with the area of the seas in which the eruptions occurred; and thus—as the author very justly remarked in reply to objections raised—it would appear that such exhibitions of igneous matter would bear a smaller proportion to the area over which deposits were going on at the time, than the recent cases of the formation of islands in the Mediterranean, would to that sea; and yet no one would expect any appearance of disturbance, other than very local, from such a cause.

M. Daubree has established the very interesting fact, that the granite of the Vosges at Champ du feu, was produced prior to the silurian rocks of that district, in which rolled masses of this granite occur. In those slates fossils are found; while at the other side of the granite mass, slates occur, in which no fossils have hitherto been noticed, which are of a totally different lithological character, and which are traversed in all directions by veins of the granite. There are thus two distinct systems of slates, intermediate between the deposition of which the granite intrusion took place.*

In two communications † which I myself brought before this Society during the past year, I had occasion to point out the distinct evidence which existed as to the age of the granite rocks of the south-east of Ireland; showing unquestionably that the granite was subsequent to the latest silurian rocks we found in the same district, and long prior to the old red sandstone conglomerates, which in part contained rolled lumps of the granite. If it be sought to ascertain more closely its age, it must be borne in mind, that the only group of the silurian series represented by the rocks in connexion with this granite, is the lowest, or the equivalent of the Llandeilo group; while, at the same time, the occurrence of the rolled masses of granite in the conglomerate of the old red, proves not only the existence of the granite, but further, that it had been long exposed at the surface, and subjected to the action of the degrading and wearing forces, which formed the well rounded lumps we now see imbedded in the sandstones. And in connexion with this I might remark, that in such enquiries regarding the geological epoch at which certain protrusions or intrusions of igneous rocks have occurred, especially of granites, some most important and indeed essential considerations appear to me to be too frequently overlooked The epoch of intrusion is often taken as equally that of protrusion. The time at which the molten matter has been forced into and among the stratified deposits above it, has been confounded with, or even in many cases tacitly assumed to be the same as that at which the same igneous rock has come to the surface, and there become subject to the operation of ordinary mechanical forces. Now, especially in reference to granite, of which we were more immediately speaking, no misconception can possibly be more fruitful of error than this. Independently altogether of the physical impossibility of conceiving a rent in the earth's crust, through which a mass of matter in a state of igneous fusion, extending for some sixty miles in length, and occasionally fifteen to twenty in breadth, (such as that of Wicklow and Wexford) could come to the surface, without—to use the forcible words of

* Comtes Rendus, tom xxix. page 114.

† Jour. Geol. Soc. Dublin: On the Geology of the County Carlow, vol. iv. page 146. On the Geology of the County Kildare, vol. iv. page 150.

Darwin—the very entrails of the earth gushing out, it must be remembered, that nothing is more thoroughly established than this—that the peculiar mineral or lithological character which any of these igneous masses assumes, depends essentially on the peculiar circumstances in which it is placed, or the peculiar conditions to which it is subjected, while cooling. As far as we know, also, certain conditions of pressure and continued high temperature are essential to the production of a granite, which conditions cannot exist at the surface of the earth. Granite, therefore, or in other words, the formation from a molten mass of mineral matter, of that peculiar kind of lithological structure or mineral texture, to which geologists have applied the term granitic, being the result of certain definite conditions, which conditions have not existed at the surface of the earth, the mere occurrence of any mass of granite now appearing at the surface appears to be in itself perfectly conclusive evidence of very considerable changes in that portion of the earth's surface since the formation of the granite; for had the fused or molten mass become subject to the conditions there existing, it would no longer have formed granite, but would have assumed a structure very different indeed from that indicated by this term. The forces which suddenly brought the cooled mass to the surface, may have been of the same kind, or the result of the same general cause; but whatever it were, it must have been exerted subsequently to the consolidation of the mass, under conditions very dissimilar to those which could exist at the surface. While, therefore, the occurrence of granite pebbles in any rock, proves that the granite from which these pebbles have been derived, was exposed at the surface prior to their deposition, their absence, on the contrary, can only be taken to establish the opposite of this, *and even this not conclusively;* but will by no means serve as a proof of the *non-existence* of the granite, or in other words, of the subsequent intrusion of it. We are so very prone to forget the successive and enormous changes through which the surface of our globe has passed, and to reason from tacit assumptions, that the former aspect of that surface has been very similar to its present one, that such a caution appeared desirable. I have felt the necessity of attending to it frequently myself, and I can trace the results of a neglect of such considerations in the statements of others.

Dr. Dale Owen* has published the results of his examination of the northern portion of the United States, up to 49° of north latitude, embracing the Red River, Lake Winnipeg, Rainy Lake, and the northern border of Lake Superior, as well as the St. Pierre River, and its tributaries. Though not entirely completed, he thinks sufficient has been done to prove that there are five or six distinct beds containing trilobites, in the lower group, hitherto supposed to be without any fossils of that kind. These beds are entirely below the lower magnesian limestones of Wisconsin and Iowa, which is the equivalent of the lead-producing limestones of Missouri, and of the calcareous group of New York. Some of the trilobites found are remarkable for their long spiny appendages, occasionally several times as long as the body of the animal.

The devonian rocks described in 1847, as found in the southern portion of the Dubugue district of Iowa, have been proved to extend far up the valley of the river Lower Iowa, and of its tributary, the Red Cedar, and as far as Lime-creek and Shell-creek.

Of each of the subdivisions of the several groups, the author gives a detailed account. Viewed on the large scale, the lower portion appears to be characterized by a series of sandy beds with slaty partings, frequently covered with lingulæ and oboli, and with layers containing abundance of trilobites, at least of individuals; the upper portion is, on the other hand, more calcareous. Working under considerable difficulties, in countries almost inaccessible, much of the journey performed in canoes, carried by the party themselves across the country, frequently without seeing a human being for weeks, Dr. Owen and his party have thus tracked out the great lines of subdivision of the series of rocks which spread over this enormous tract, and have clearly shown, on the great scale, their relation to, and agreement with, similar groups acknowledged by geologists. They have also thrown much light on the economic relations of the district, and have pointed out the occurrence of numerous veins of lead, &c., a portion of which has been already opened, and with profit.

Professor Nicol† has more fully established the silurian age of the slate rocks of the south-east of Scotland, having discovered graptolites in them in several localities. He has found six species, one of

* Bull. Soc. Geol. France, tom vi. page 419.

† Quar. Jour. Geol. Soc. London, 1850, page 65.

which is new (*G. griestonensis*,) and they all tend to show that these slates belong to the lower silurian, and are equivalent of the Llandeilo-flag series. Mr. Nicol points out the close resemblance which these rocks and their contained fossils have to the silurian rocks of the County of Tyrone, described by Portlock. He gives a rude estimate of the thickness of these deposits, derived from calculating an average dip over a known extent of surface; and supposes that they have a thickness of forty thousand feet. Exceeding caution is necessary in admitting the truth, even as a very rude approximation, of such calculations. Indeed, with the older rocks in these countries, there are very few instances in which they are not more apt to lead astray than otherwise, for they proceed on an assumption which everything seems to disprove, namely, the constancy of dip either as to direction or amount. And I feel perfectly satisfied that many, if not most of the estimated thicknesses of the older stratified rocks will be enormously diminished, when the districts in which they occur are more closely examined. A thickness of regularly stratified deposits of *an uniform average character, and regularly superimposed during the period of the existence of the same group of organized creatures*, amounting to nearly eight miles, is to my mind, an impossibility, or nearly so; inasmuch as the production of such a series must involve such continuous changes of level of land and sea, and such continued and immense degradation of previously existing rocks to furnish the materials, as, under the circumstances of the case, appear to me totally inadmissible.

Professor Nicol derives from the structure of the south-east of Scotland, as he has described it, some very forcible objections to M. Elic De Beaumont's theory of the system of elevations, and further points out the interesting connexion of the position of some axes of elevation with remarkable physical peculiarities, particularly the river drainage. He believes that the very irregular boundary line between the old red sandstone and the silurians in the south, as ontrasted with its nearly straight line on the northern margin, is to be accounted for by the circumstance that the old silurian rocks on the north formed a sea coast, where they were exposed to the wasting influence of an open sea, while the southern portion was being cut into valleys by river action. Professor Nicol concludes his paper by descriptions of the graptolites found in these rocks.

M. Tchihatchef* has given a brief sketch of the results of his long-continued researches in Asia Minor, during which he believes he has established the fact of devonian rocks covering a large portion of that country, and that the "gypsum and red sandstone" formation, the age of which was unknown, contains nummulites; and as to the area covered, is the most extensive formation in Asia Minor.

Mr. Hamilton who, in conjunction with Mr. Strickland, had already contributed much to the geology of other portions of Asia Minor, has now published his observations in the more eastern parts of the country. The extent and variety of the igneous rocks which have pierced and disturbed the area is very remarkable, while the stratified rocks, being for the most part deficient in fossils, it is difficult to give any definite classification of them. He has subdivided them, therefore, into two great groups of secondary and tertiary; the former being of two ages, one the lower secondary, probably representing the jurassic or oolitic system; the other, the upper secondary, probably corresponding to the cretaceous system. Upon them rest the nummulitic group, basins of rock salt, marl and gypsum, and other rocks. The mineral character and arrangement, as far as it could be ascertained, of these several groups of deposits, is described.†

The geology of the several countries visited by the American exploring expedition has been published—a large volume full of details, and illustrated by a volume of plates of fossils. Among other notices, we have from M. Dana an account of the geology of Upper California, which has excited so much of public attention from the abundance of gold found there, and some valuable information on the same district has been also contributed by the Rev. C. S. Lynam.‡

Mr. Dawson has described in considerable detail, the appearance presented by the curious masses of gypsum and associated marls which occur at Plaistercove, in the Strait of Canseau, near Cape Breton, and endeavoured to point out the successive steps in its formation §

Professor Göppert, whose contributions to Fossil Botany are well

* Quar. Jour. Geol. Soc. London, 1849, page 360.
† Quar. Jour. Geol. Soc. London, 1849, page 362.
‡ Sillimans' Journal, 1849, page 290 and 305.
§ Quar. Jour. Geol. Soc. London, 1849, page 335.

known, has published the essay on the coal formation of Silesia, to which the Haarlem Scientific Society awarded its prize. In this valuable work, illustrated with numerous plates of the fossil plants found in the coal measures of that country, the question of the origin of the coal, whether from drifted vegetable matter, or from the decay and subsequent mineralization of plants growing on the spot, is fully discussed; and with more especial reference to Silesia, the distinctive peculiarities of the coal beds in upper and lower Silesia are ably pointed out.

M. Saemaan has given* a general sketch of the relation of the chalk group of the north west of Germany, and of the same formation in France. He considers the *unterer-kreide-mergel* of M. Roemer, to be the true representative of the white chalk, containing *Ananchytes ovata, Terebratula defrancii, carnea, Ostrea vesicularis, Plagiostoma spinosum, belemnitella mucronata*, and a tooth of *mosasaurus.* In opposition to this opinion, was the idea that cephalopods with ornamented septa (*a cloisons decoupèes*) ceased in the upper chalk, while in reality they attain a great size in it. The *ammonites peramplus*, usually quoted to prove the age of this deposit, is not, according to M. Sæmaan, the species known under that name in Touraine, being more nearly related to A. *lewesiensis.* The bed below this in the upper part is full of green grains, of a very marked colour, which gradually decreases in the lower parts. It is very poor in fossils, but contains *ammonites varians,* fortunately characteristic, and which proves it to be the equivalent of the upper chloritic chalk. Next below, we have a compact limestone, grey and marly, much like some of the varieties of the planerkalk of Saxony, and containing many *inoceramus mytiloides.* The lower bed is a grey-brown friable argillaceous sandy bed, not calcareous, containing much pisolitic iron. The lower portion has no grains of quartz, the iron alone forming the base, and it rests directly on the coal measures. This is the *hils conglomerat* of M. Roemer, considered for a long time to be the equivalent of the Neocomian. The fossils from it, however, all tend to show that it is the representation of the *upper* green sand, such as ostrea carinata, exogyra haliotidea, discoidea subuculus; and there is not a single neocomian fossil (*exogyra sinuata,* quoted by Rœmer,

* Bull. Soc. Geol. France, tom. vi., page 146.

being probably a mistake.) The ***hils conglomerat*** agrees most remarkably with the *tourtia* described by D'Archiac, and to which we referred last year. There are the same terebratulæ; as ***T. biplicata, latissima, paucicosta, canaliculata, nuciformis, nerviensis*** (longirostris of Rœmer,) ***tornacensis, subundata*** (Roemer.)

The lower portion of the same group—the ***hilsthon*** of Rœmer, equally contains no neocomian fossils, according to Sæmaan, nor has he found any trace of the gault in Germany.

Among the most important communications which I noticed last year, it will be recollected was Sir Roderick Murchison's determination of the age of the great and widely extended group of rocks containing nummulites. At that time, this valuable paper had not been published at full, and I was obliged to rest satisfied with brief abstracts. Since then, however, it has appeared, and it is certainly one of the most important contributions to geological knowledge which recent years have afforded, whether we consider the amount of observations grouped, or the importance of the classification now introduced.

For the details of Sir R. Murchison's labour, and the numerous and satisfactory proofs on which he bases his conclusions, I must, however, refer to the paper itself, which will be read with pleasure by every geologist.

Bearing on the same subject, M. Victor Raulin has added to his former communications some additional notes on the nummulitic rocks of the Pyrenees, and has shown that what he had before established for the western portion is equally true for all, viz.—that the cretaceous group is there as perfect in its upper portion, as in the basin at Paris, or at Maestricht; and he thinks there are not even plausible reasons for supposing the ***terrain a nummulites*** to be any part of it.* M. De Verneuil† has established the range of the nummulitic group in the Asturias, and has there entirely confirmed the views of Sir Roderick Murchison. M. De Zigno, also, in a general sketch of the geology of the Venetian Alps, (in which‡ he

* Bull. Soc. Geol. France, tom. vi. page 531.

† Phil. Magazine, July 1849, page 34. He has also pointed out some peculiarities in the carboniferous group of that country, and states that the coal there is subordinate to the mountain limestone, as in Northumberland and Scotland.

‡ Comtes Rendus, tom xxix. page 15.

states, that by the guidance of fossils alone, he has been able to identify the triassic, lower and middle oolitic groups, and traces of the upper, and to point out the several divisions of the cretaceous group,) has subdivided the tertiaries of that district, which had hitherto been all grouped together, and considered miocene, into eocene, miocene and pliocene; and has satisfied himself that the nummulites are altogether eocene. He corrects an error, into which he had formerly been led by imperfect specimens, supposing that he had found nummulites in the scaglia, and he now thinks that the nummulite is the most characteristic fossil of the eocene group.

The eocene rocks of America have been illustrated by the memoirs of Mr. C. S. Hale, on the geology of south Alabama,* the surface of almost the entire state being composed of rocks referable to that geological epoch; and of Mr. Holmes, who has described the formation on which Charleston, South Carolina, stands. This author also gives a list of one hundred and forty-seven species of post-pliocene fossils from the beds there; detailing at the same time the section of the eocene beds, including the remarkable one in which the *zeuglodon* has been found, and entering into detailed particulars as to the structure and arrangement of the series.

M. Hebert has very carefully examined the fossils derived from the tertiary argillo-sandy beds of Limbourg in Belgium, and thinks that M. Nyst has been in error in referring them to the parallel of the *calcaire grossier*, to which they have but slight analogy, and according to M. Hebert not a single identical fossil. He points out for each species the differences between those assigned by M. Nyst to the Paris Basin, and to the beds of Limbourg. He thinks these beds are really the equivalent of the *ostrea cyathula* beds of the Paris basin, which occur at the base of the fifth group of Brongniart and Cuvier, or the second marine group. This communication, if M. Hebert's results be substantiated by further enquiry, will effect a great change in the classification of the tertiaries of Belgium.‡

M. Prestwich has established the existence of some fossiliferous beds, overlying the red crag at several points in Suffolk, and remarkably contrasting with it by the perfect evidence they afford

* Sillimans' Journal, November, 1848, page 154.

† Do. Do. March, 1849, page 187.

‡ Bull. Soc. Geol. France, tom vi. page

of the quiet and tranquil deposition from which they resulted. The organic remains also, instead of occurring heaped together in confusion, and often fragmentary, as is generally the case in the crag, are regularly perfect, and lie in the position in which the animal lived: the bivalves have constantly both valves together. These sands and clays, from ten to twenty feet thick, are immediately overlaid by the coarse clay-drift. Out of twenty-three species of shells, only one, or possibly two, do not occur recent; all, or nearly all, occur in beds of the age of the Clyde pleistocene beds, and the whole character of the fauna is arctic. The paper is distinguished by that conscientious and accurate attention to detail, and that simple and effective statement of facts, which have characterized all M. Prestwich's communications.

Mr Ringler Thomson* has been led, by the unvarying position in which the bivalve and univalve shells are found in the crag of Suffolk and Essex, to speculate on the cause of this fact. He observes that the countless number of pectunculi and other shells are deposited in layers of various thickness from six inches to as many feet, "each shell having its inside concavity downwards, and the umbones of the shells having in general an easterly direction." He found by repeated experiments, that in waters, whether at rest or in motion, the shells were invariably deposited with their concavity or inside upwards, and univalves with their mouths upwards; and from this not being the case in the crag, inferred that although water may have transported them to their present localities, it could not have been the cause of their actual position. And suspecting the wind might be so, numerous experiments were made, and it was observed, that in all cases the shells, however originally placed, were turned over or came to rest with their concavity downwards, and with their umbones turned towards the point from which the wind blew. If these experiments be considered conclusive, the shells in the crag, which present this remarkable arrangement, must have been left dry, and subjected to the force of a long continued east wind, probably of considerable force. These speculations of Mr. Ringler Thomson. appear to me very interesting and curious, as opening up a class of observations which may, by judicious extension, be fruitful of important deductions regarding the forces which have tended to modify

* Quar Jour. Geol. Soc. London, 1849, page 354.

the disposition of materials on the earth's surface at early as well as at recent geological epochs. On more occasions than one in this Society, and even so recently as in December last, I have had occasion to notice the peculiar character and disposition of some of the sandy masses in the older slates, and to point out how perfectly analogous they were in their arrangement and materials, to many of the sand dunes of the present day, (excepting, of course, their subsequent induration.) And I feel satisfied that many more instances could be adduced, in which the wind, as well as waves, could be shown to have been a very effective agent in producing or modifying geological results. And if in such enquiries, we can derive additional evidence from the position of the fossils imbedded, we most gladly accept the slightest glimmer of additional light, which such observations are calculated to throw on the origin and mode of formation of the masses.

In a brief notice of the tertiary, and some recent deposits in the Island of Nantucket, by Messrs. Desor and Cabot, the authors describe the varying mineral character and position of the beds of sand, gravel, and clay, which rest upon the tertiary clay of that district, and which are considered as forming part of the "drift." And from the similarity of the fossils found in these beds at Nantucket, to those of the newer pliocene of the southern States, the authors conclude that they form a link between the northern and southern deposits; and that, instead of considering them as so many distinct formations, we must henceforth view them simply as modifications of the same great deposit, the result of the same agencies; these being oceanic tide-currents along the whole coast of the United States—local variations being fully accounted for by local changes in the strength or direction of these currents.*

M. Collomb has endeavoured to bring into a chronological arrangement, the quaternary deposits of the valley of the Rhine, more especially with a view to establishing the connexion between those in the plains and those in the mountains.†

In the plains, these deposits consist of two distinct groups—

1st lower, of sand and pebbles.
2nd upper, of sand, clay, and marl, or *lehm*.

* Quar. Jour. Geol. Soc. London, 1849, page 340.
† Bull. Soc. Geol. France, tom. vi. 479.

The lower part is called by M. D. Archiac, the *formation erratique*. The upper has many names, *lehm*, *loess*, diluvium, ancient alluvion, &c., but all authors agree in distinguishing these two groups. In the upper group or *lehm*, ninety-six species of shells have been found by Messrs Braun and Walchner; of these fifty-six are terrestrial, and forty fluviatile; seven belong to living species, and nine others are probably only varieties of living species. Those forms, however which are most common now, are the rarest in the *lehm*, and *vice versa*. The very common recent species, which love warm and dry exposures, never occur in the lehm, while the perfect preservation of the shells proves that they lived where their remains are now found. Besides these, we have remains of *Elephas primigenius*, *Rhinoceros tichorhinus*, *Equus caballus fossilis*, *Bos priscus*, *Cervus euryceros*, and other extinct quadrupeds, the remains of which are very little rounded or altered; and it is not uncommon to find a large portion of the bones of the same animal still united.

In a similar manner the formation in the mountains is composed of two distinct groups, which have a chronological relation with those of the plains, but differ essentially in their composition, their external aspect, and the arrangement of their materials. One of these has been called *terrain erratique*; but to avoid all confusion arising from this name, the author purposes to call it, including the moraines, erratic blocks, and all debris of every kind transported by ancient glaciers, the *terrain glaciaire*. This distinction is especially necessary, as the "terrain glaciaire," and the "terrain erratique" are not cotemporaneous. There is no question that among the mountains, these deposits have had a glacial origin; but the ancient glaciers which formed them have never extended into the plains of the Rhine nor of the Moselle. Besides this glacial formation, there is in all the valleys of the Vosges mountains, another which the author provisionally calls, *formation inferieure*. It fills the lower parts of the valleys—is composed of the same elements as the glacial deposits, but differs essentially from them in the degree of wear of the materials, and in the place which it occupies, being constantly below the other. It is besides always stratified—large blocks are rare, sand and gravel prevail. On this formation, wherever the rock *in situ* is not exposed, rest the moraines.

Above both, there are sometimes turf-bogs, frequently caused by the glacial moraines having dammed back the water, and caused marshy ground, on which peat grew, and these seem to indicate the termination of the glacial period, and the commencement of the existing order of things. This passage he believes to have been very gradual, but marked by a greater force of watery currents, &c. than at present; this additional force arising, not from the melting of the glaciers—which before this had retired to the limits they occupy at present—but to the naked and unclothed surface of the ground, arising from the action of these glaciers, and before there had been time for it to become clothed again. This state of things has given rise to old torrent beds, in some of which torrents still flow, but in many not.

Such being the deposits in the valleys of the Vosges, what is the chronological connexion between these and those found in the plains? Now the lower deposit of the plains is perfectly continuous with the lower deposits of the hills; it does not differ in the nature of its materials, but only in the mode of their aggregation, being horizontal and continuous in the plains, but in terraces in the hill-valleys. These are therefore identical. The *lehm*, on the other hand, is not so easily traced; it does not spread into the mountain valleys at all, but is constantly separated from the moraines there, by a band of pebbly sand. In fact, the author supposes this *lehm* to be nothing but the mud of glaciers, not deposited or left by the glacier itself, but derived from the glacier, and deposited by water, rivers, &c. in the plains.

Thus we have, as the three necessary results of the existence of these glaciers, the striæ and polishing of the rocks, and the moraines in the mountain valleys, and thirdly, the mud, in what is now called the *lehm*. All the shells found in the latter indicate a period of cold.

M. Collomb therefore concludes, that the two quaternary deposits of the basin of the Rhine, viz.—the lower, or erratic, of M. D'Archiac, and the upper, or *lehm*, in the plains, correspond chronologically with the lower, and with the upper, or glacial, of the mountains—the striæ, moraines, and the *lehm* being the results of one and the same cause, and not separated chronologically.

In connexion with these deposits, M. Scipio Gras has arrived at the following conclusion with regard to the Alps:—

1st. The vegetation which clothed the Alps at the close of the tertiary epoch, and of which the existence is proved by the various deposits of lignite, as well as various remains of ruminantia and pachydermata, had completely disappeared at the period of the transport of erratic blocks.

2nd. This vegetable denudation confirms the hypothesis of an extraordinary extension of glaciers, covering the Alps, at the epoch of the erratic phenomena.

3rd. Afterwards, by the return of a milder temperature, this covering of snow and ice was removed, and their flanks, then entirely naked, were exposed for a long period to the powerful action of atmospheric causes. It was at this time that most of the deep ravines and funnel-shaped cavities were formed, and the materials produced deposits posterior to the erratic blocks, but still anterior to historic time.

4th. After a considerable time vegetation spread again over the the Alps, and

5th. Finally, Man commenced to inhabit the district.

M. Studer has studied the quaternary deposits of the Tyrol,* where he finds an enormous development of the "erratic block" group composed of gravel and sand. This appears to have filled, before the existent epoch, a large portion of the valleys. There is an immense development of it near Insbruck. M. Studer thinks it evident that these deposits belong to a state of things during which the inclination of the river courses was much less than it is at present; and he supposes the cause of this difference to be a continental elevation, similar to that now taking place in Scandinavia—an elevation quite distinct, however, from that which caused the eastern Alps to appear, since the "diluvium," although raised, is not dislocated, nor have the rocks supporting it suffered any great contortions since its deposit.

Sir Roderick Murchison has discussed the whole question of the character and distribution of the superficial detritus of the Alps, and believes that the physical phenomena of the Alps and Jura are such as to force the geologist to restrict the former extension of glaciers in that country within very much narrower limits than Agassiz, Charpentier, and Forbes had supposed. He shows, from the still

* Bull. Soc. Geol. France, tom vi. page 445.

existing remnants of the water-worn and water-deposited detritus which exist at considerable heights on the sides of the valleys, that water entered into those valleys, then at a considerably lower level (two thousand or three thousand feet) than now. It is asserted that, as each glacier is formed in a *transverse* upper depression, these glaciers have by their movements pushed their moraines *across* the longitudinal valley, and have not united to form one great glacier in it: and thus proving that not even the upper longitudinal valleys around Mont Blanc were ever filled generally with glaciers, he thinks it very easy to show that the lower and great trunk valleys of the Arve, the Doire, and the Rhone, have no trace of moraines, although they contain large erratic blocks irregularly dispersed; all the other detritus is more or less water-worn, and this to great heights above the present bottom of the valleys. He supposes, therefore, that the country of the Alps and Jura has undergone great and unequal elevation since the period of the formation of the earliest glaciers; and that these elevations dislodged great portions of these glaciers, "which floated away many huge blocks on ice," and "hurled on vast turbid accumulations of boulders, sand, and gravel."

All the detritus in the low and undulating region between the Alps and the Jura is water-worn, and does not any where occur as a true moraine, while the great granite blocks from Mont Blanc, which are found on the Jura, appear to Sir Roderick Murchison to have been translated there by ice floats, when all the intermediate country was under water. The surface of the whole country has since been much changed by considerable and irregular elevations.

In this general resumé of the prominent facts regarding the distribution of the detritus of the Alps, Sir Roderick Murchison has thus appealed, in explanation of the phenomena, to the united forces of glaciers and ice-borne materials.

Bearing on the subject of glaciers, we have had a very interesting communication from Mr. John Ball, on the former existence of small glaciers in a part of the County of Kerry. The author describes the phenomena observed in two or three places. On the side of Connor Hill, between Loughs Doon and Beirne, on the steep northern slope of Brandon Hill, above Lough Cruttia, and on the north-eastern side of Purple mountain, Killarney. The several facts were clearly given, and the supposed extent of the glaciers pointed out, as evidenced by the heaps of detritus representing, according to Mr. Ball, the moraines formerly deposited by these glaciers. From the facts noticed, Mr. Ball concludes, that whatever may have been the climatal condition of this country prior to the existence of these glaciers, the mean temperature at that time cannot have been excessively low, nor such as could have admitted of any considerable extension of glaciers in the adjoining district; for the extent of this glacier at Lough Doon, even under the probably different conditions of elevation of the land above the sea at the time was, according to Mr. Ball, very limited indeed. And secondly, he considers that, therefore, the conditions which gave rise to these small glaciers, must have continued with tolerable uniformity for very long periods; as it must be difficult otherwise to account for the amount of matter in the moraines, considering the slow rate of motion of small glaciers, the limited surface of rock from which the fragmentary materials were to be derived, and the small proportion of those fragments which would be deposited on the lateral moraine.*

The phenomena of striated, furrowed, and smoothed surfaces of rock had been noticed, as occurring in the County of Kerry, many years since, first by Mr. C. W. Hamilton before this Society in 1843, when he exhibited some excellent illustrative sketches; subsequently, Professor Airy had at the Meeting of the British Association, at Cork, mentioned some instances in which similar scratchings had been observed by him. During the past year, Mr. W. C. Trevelyan, has stated, that he had noticed similar polishing and scratching of rocks in several parts of Ireland, as at Limerick, on the cliffs at Kilkee, and at Howth, near Dublin, where the Society will recollect I noticed their occurrence several years since. Indeed it is difficult to conceive how any one could visit some of the districts mentioned, as for instance, the County of Kerry, where the absence of any drift covering allows the surface of the rocks to be well seen, without being at once, and most forcibly, struck with the peculiarly well marked, and beautifully defined furrowing, polishing and scratching, which every surface of rock presents. There is, for instance, scarcely a square yard of rock surface in the neighbourhood of Glengariff, on which such striæ cannot be distinctly seen. The occurrence, however

* Jour. Geol. Soc. Dublin, Vol. iv. page 151.

of these scratchings, over such extended surfaces, at elevations, reaching to even 1,300 and 1,400 feet above the present level of the sea, and at every intervening level, until they are concealed by the water itself, under which they extend as far as can be seen, and the peculiar positions in which such scratchings occur, as I have myself pointed out at Bray Head and Howth, were sufficient to satisfy, at the first glance, any unbiassed mind, that they had not been produced by true glaciers. Mr. Ball, therefore, very justly lays but little stress on such evidence of former glaciers, unless it be found coupled with other proofs. And while, therefore, we are satisfied, that as regards these countries, there is no sufficient evidence whatever to lead us to admit, that either the entire of the surface of this island was at one time covered with a sea of ice, or that glaciers had that enormous extension which has been assigned to them; we are at the same time far from thinking that there have not been true glaciers of limited extent in some of our mountain valleys, which have left unquestioned proofs of their former existence. For directing our attention to some hitherto unnoticed cases of this kind, in which it is probable such small glaciers may have existed, we are indebted to Mr. J. Ball. I see no reason to doubt the probability of such having existed, although they unquestionably appear to me to have been extremely rare, and though many of the instances which have been quoted, have on closer examination been proved to have been of very different origin. The heaps of gravel in Glenmalur I have myself shown not to be moraines. The mass of materials at the entrance, to the valley of Glendalough, on which stands the group of ruined buildings for which it is famous, is another instance of a so-called moraine, but which is undoubtedly the result of the ordinary action of water in forming a bar, by heaping up the detritus brought down by the two streams which here unite, at or near their junction.

There is one point on which Mr. Ball strongly insists—the necessity of admitting the lapse of a long period, for the production of the phenomena presented to us, which is even much more forcibly impressed on us, while considering such masses of water-borne, and water-deposited materials, as that to which I have just alluded.

There is, perhaps, nothing more calculated to give us just conceptions of the littleness of our ordinary times and periods, as compared with the long story of the world, than the contemplation of such a scene. Before us stand the now ruined remains of buildings, the epoch of whose erection is shrouded in the darkness of antiquity, of whose date we have no record—buildings raised with all the care and skill which the most practised architects of the time could bring to their construction, and designed, by their form, to stand as lasting monuments of the piety of their founders; buildings, too, which have been in a great degree protected by their sacred character, from suffering by the sacrilegious hand of the destroyer. Over their head many a century has passed, and left its withering stains upon their brow, and yet even their date, thus too distant to be reckoned with the accuracy of recorded fact, or classed among historical statements, even this long period will not suffice to be the unit by which we may count back the times and the seasons, during which the same laws of matter, and the same cosmical forces, which now rule the material globe, exerted their untiring sway, and to reach the epoch when that heap of water-borne masses, on which these ruins stand, was accumuated—the measure of the forces which gave it birth, and the lasting evidence of their direction and amount.

Into what a mere shred does the long web of man's existence shrivel itself, when thus exposed to the light of nature's records! What a lesson of humility ought we to learn from this contrast of the unerring decay of man's proudest triumphs, with the lasting destiny of nature's monuments! And yet this, too, but forms a mere page in the long history of former change, and serves but as the record, into which are collected the scattered fragments of the tales which tell of mountains once washed by stormy oceans, and of gorges which once formed the long shores of a troubled sea.

In connexion with this subject, we would allude to a paper by Mr. Charles Maclaren, on grooved and striated rocks in the middle region of Scotland,* a paper distinguished for its candid exposition of the facts, while the author's views are expressed with equal strength and determination. Mr. Maclaren points out the serious objections which many persons have urged against Sir James Hall's idea of such groovings having been produced by the passage of a wave or waves carrying fragments of rocks, gravel, and sand; and he conceives that no agent yet known but ice, or ice conjointly with

* Jameson's Journal, July 1849, page 161.

water, can explain the phenomena; and then proceeds to detail the appearances presented in the several cases of groovings which he has noticed, at nearly thirty different points, shewing that as should be expected, if such groovings were caused by ice-carried agents, the side of prominent rocks which faces the source from which such glaciers have been derived, is always the most grooved and polished. These groovings were also frequently found horizontal on a nearly vertical face, a position in which water-borne materials could not have produced them. Some very interesting cases are given, and well described; and while the author very justly and wisely concludes, that much remains yet to be done before adequate materials for a satisfactory theory are collected, he speculates on the probability of certain results. Thus, the rarety of occurrence of moraines is accounted for by the probability that during the rise and fall of the ocean, deposits of moveable matter, like these moraines must have been frequently swept away.

Mr. Maclaren supposes further, that it is established by the phenomena, that the nucleus of the great force which produced these groovings, or the common centre from which the agents moved, was in the mountains which extend from Lough Goil to Lough Laggan: on the north and west side of which, the striæ are seen to have been produced by an agent moving from the south and east, and on the south-east side, by agents moving from the north and west.

Though a most valuable contribution to our knowledge of the facts, like everything proceeding from Mr. Maclaren's pen, there yet appear to me some assumptions in this paper to which it is needful to allude, in order to guard against the possibility of mistake on the part of future observers. Thus, speaking of the rise and fall of the ocean-level, Mr. Maclaren says, "we have evidence in support of the alleged changes of relative level in the fact, that striæ and grooving certainly produced by glaciers on terra firma, are found covered by the old boulder-clay, which has been deposited from water, and which ascends to the height of 800 feet, at least, above the present seas." Now, Mr. Maclaren appears to have in this assumed two circumstances all-important in the consideration of this question—1st, that the groovings have been produced by glaciers on terra firma; and 2nd, that this grooving has not been cotemporaneous with, or the result of, the formation of the old boulder-clay. If these be granted as facts, the whole question of the so-called glacial drifts is very much simplified; but these are in reality the very points in dispute, which are assumed as settled. Again, speaking of the smooth side of hills between Garelock and Loch Lomond, at an elevation of 2,400 feet, the author says, he had at the time he first noticed this no authority for concluding that glaciers ever attained the depth of 2,400 feet necessary to cover the ridge on the west side of Loch Lomond. "But this objection is now removed, as the able French geologist, M. Martins, has found traces of an ancient glacier in the Alps, 758 metres, (2,468 English feet,) above the bottom of the valley which contained it. There is no difficulty now, therefore, in admitting that a glacier might abrade the surfaces of the highest of these ridges." In what way, the circumstance stated by M. Martins, even granting it to be an established fact, could prove or support the notion of the existence of such a glacier in the Loch Lomond country, is not to me clear. That glaciers *might* abrade these ridges, no geologist would deny; but the probability of their having ever done so, is only to be proved or established by evidence derived from the district adjoining, and this evidence is no more confirmed by the occurrence of similar phenomena among the Alps, than would the statement of the occurrence of a peculiar kind of rock, (protogene, for example,) in one district, be established by the well known fact of its occurrence in the other.

Nor can the injurious tendency of viewing the phenomena of the so-called drift deposits, only in connexion with, and as illustrated by, the phenomena of glaciers in the Alpine country of the south of Europe, be too strongly insisted on. The area of the earth's surface covered by such deposits, the distribution and limits of that area, and the phenomena exhibited by these formations are all too large, and too general, to derive their elucidatiou from such a comparatively insignificant outlier, as it were, of the phenomena resulting from the action of intense cold, as occurs in the Alps; and the whole range of the Scandinavian phenomena must be grasped by any one who will fairly undertake the subject, as well as those of the glacial district of Switzerland.

M. Visse, in a brief notice of the erratic-blocks of the Andes, near Quito,* has referred to those "fields of stones," or immense trains or

* Comtes Rendus, 1849, March 5th, page 303.

deposits of large blocks, having unquestionably the same mineral structure as the rocks of the mountains adjoining, but at a great distance from them, and their superposition on clayey, or arenaceous deposits. These have already excited much attention; and they have been supposed to be large blocks thrown out by volcanoes. On examining them more closely, however, the author has shown, that they occur for the most part in regular trains, having a definite direction, and are traceable up to the mountains, where they invariably end in a distinct escarpement. The size of the blocks diminishes, as the distance from this escarpement increases: the bands or trains being much more distinct in the higher portions of their line. After a careful search, it is remarkable that the author could not find a single scratched block among them, while all the facts obviously showed, that these trains were not the result of volcanic eruptions.

Another communication to our knowledge of similar phenomena is the work of M. Eugene Robert, forming a portion of the results obtained by the French scientific expedition to the north, in 1835 to 1840. In this M. Robert gives an account of his studies of the last traces which the sea has left on the surface of the northern continents, especially in Europe.

To the results, which he had previously brought forward, and which he has reproduced here, M. Robert adds many others. He has found rocks exhibiting proofs of wear and polishing, from the level of the sea up to 1,170 feet above it: he differs entirely from all previous observers, in stating that the furrowings and striæ are always in the direction of the bedding or lamination of the rocks; and do not occur in granites; and he supposes them due to the greater facility with which the several laminæ degrade on exposure. And uniting with these observations, many from tropical countries as well, he thinks that the whole of these superficial deposits are but terms of one and the same series, and assigns to them all, a common origin; namely, the presence of the waters of the ocean during ages, on surfaces becoming successively less and less deep; and emerging one after the other, either by slight displacements of the ocean from one hemisphere to the other, or by the effect of partial or general liftings of portions of the crust. The presence of blocks he accounts for, by supposing them carried successively by floating ice, their great development at certain points being due to the length of time elapsed, rather than to any other cause. The striæ, as I have stated, he attributes to the prolonged action of the sea, on the unequally resisting laminæ of the rocks. This latter statement forms one of the most remarkable instances of how completely a preconceived notion can blind the eyes of an observer, that we know of, for nothing can possibly be more perfectly established, nor yet more obvious on the most cursory examination, than that the striation, the polishing, and the furrowing, or grooving of such rocks, is completely independent of their lamination or bedding. Unfortunately such assertions raise a doubt about the truth or accuracy of all the other statements put forward by the author.

While the general question of the distribution of detritus by glacial action has thus engaged much attention, M. Collomb has considered the complicated movement of the larger erratic blocks, which form *tables* on the surface of the glaciers.* The formation of these tables is a phenomenon long known, but the peculiar motion of the blocks has attracted but little attention. These blocks are rarely found on the moraines mixed with other materials. The most beautiful tables occur scattered over the surface of the middle of the *mers de glace;* they are met with isolated, as if thrown at random far from the moraines—they stand alone independent of the long trains of debris, which follow so remarkable a line on the surface of the glaciers. Now these facts of their distance and separation from the other debris, arise from the complication of their movements. This can be divided into *two* parts—one due to the general motion of the glacier itself, the other to that of the block. The author shows, that in proportion as the "table" is elevated from the general surface, the sun acts with greater force on the south side of the block than on the north, which is kept in the shade; and so the supporting ice being dissolved on that side, the tendency of the block, when about to fall, will always be to fall to the south. The motion is in fact double; on the one hand the block is carried by the general movement of translation of the glacier; on the other hand, its own peculiar motion consists of a succession of slips, which complicate the result. Thus a block can form a "table," several times during the

* Bull. Soc. Geol. de France, tom. vi. page 161.

same summer. The removal of the surface of the glaciers in the Alps, in their lower portion, is about four metres in the year; while the height of the supporting column of ice of these tables is seldom more than two metres, so that a block can form a table at least twice in the same year.

Now this being the motion of the blocks, it is clear that if the general direction of motion of the glacier be the same,—viz., from north to south, the blocks must arrive at the terminal talus *before* the other materials; but if the glaciers have a motion in the opposite direction, or from south to north, then the reverse will be the case, as we must then subtract the motion of the table from the general movement of the glacier at large; or supposing the whole motion of the glacier to be fifty yards, and the block to make two slips or falls of two metres each, we would in one of the supposed cases have an actual movement forward of the block, amounting to fifty-four metres—in the other case to only forty-six. It follows also, from this peculiar motion, that a block can start from one bank of a glacier, and after a few years arrive at the other, (provided it does not meet during its progress, with any of those accidents common in glaciers, such as large crevasses or high moraines.) Since if the glaciers have a direction of motion from east to west, or west to east; the line of motion of the blocks will be a resultant of the two rectangular motions, proportional to the mean movement of each of them in a given time.

The author shews also, how the character of the surface as to inclination, and as to exposure, will materially modify such results: and then points out the application of these to the phenomena of erratic blocks, and as tending to explain the exceptions to the general law which M. M. Charpentier and Guyot have established—that the materials are distributed each in their own province; and some cases, where we find larger blocks of foreign matter mixed with the smaller debris. He shews also, the importance of not taking these large blocks as points of observation, in any attempt to determine the motion of glaciers, giving instances in confirmation.

Lieutenant Strachey has brought together many new observations, and compared them with the previously recorded ones, to determine the height at which the limit of the belt of perpetual snow is found in the Himalaya range.* This phenomenon, though not strictly

* Jour. Asiatic Society, Bengal, April, 1849.

geological, becomes to the geologist a very important element in the consideration of the speculations and reasonings which frequently engage him, as to the distribution of heat on the globe, and the consequences of variation in this distribution. Humboldt had already stated the interesting fact, that while on the southern slope or declivity of the Himalaya, the limit of perpetual snow was about 13,000 feet English; on the northern aspect in was 16,600, attributing this greater elevation of 3,600 feet to the conjoint effect of the radiation from the elevated plains of Thibet, and the comparatively unfrequent formation of snow in cold and dry air.

After discussing all the observations, Lieutenant Strachey concludes, that Humboldt has understated the height of the snow line; that it is on the southern side of the chain, 15,500, while on the northern it is 18,500, and that this is chiefly caused by the fact, that a much smaller quantity of snow falls on the northern slopes of the mountains, the winds prevalent there being from the south, which passing over the snowy peaks, become cold and unable to support moisture. Lieutenant Strachey thinks that the radiation from the plains of Thibet has little to do with it, as its effect would be, he thinks, entirely intercepted by the outer flanks of the chain. Captain Cunningham, however, has pointed out, that Humboldt was probably correct, in attributing the difference in elevation, partly to radiation; and that the form of the surface in any great chain is a more important consideration than the latitude, as the snow line constantly recedes, as the ground around the flanks of the chain rises, but with a constantly diminishing rate of difference.*

In connexion with the important subject of the extent, kind, and force of tidal action in modifying or producing deposits of varied character, I cannot forbear referring to a most valuable communication on the Tides of the Irish Channel, by Captain F. W. Beechey,† although not strictly within the range of this address, as the paper was published at the close of the year 1848. This is unquestionably one of the most important contributions to our knowledge of the tidal phenomena of the Irish channel, more especially as these bear

* Jour. Asiatic Society, Bengal, July, 1849.

† Phil. Trans. London, 1848, page 105.

upon geological investigations, that we have had for many years. And although to us, as geologists, this portion of the paper of Captain Beechey may, of course, be considered the most interesting, yet his observations are not without their great value in a commercial point of view, also, as tending most materially to facilitate the navigation of our seas, both by correcting erroneous ideas hitherto prevalent, and by furnishing accurate and sufficiently detailed data for future navigators. In this respect, one of the most interesting of his results is, that the time of the stream is simultaneous, notwithstanding the variety in the times of high water; that the northern and southern streams, in both channels, commence and end, practically speaking, in all parts at the same time; and that this time happens to correspond with the time of high and low water at Morecambe Bay, or Fleetwood. Thus, while it is high water at one end of the channel, it is low water at the other, the same stream making both high and low water at the same time. There are two spots in the channel, in one of which (near Courtown, County Wexford,) the stream runs with considerable velocity, although there is no perceptible rise or fall of tide, and in the other of which (off Dundrum Bay,) the water rises and falls from sixteen to twenty feet, without there being any perceptible horizontal motion.

I cannot possibly detain you by entering into the details of Captain Beechey's paper, in which he describes so graphically the course of the tides as they enter the Irish Channel, both from the north and south, noting the rate of rapidity of the water at the several prominent points. When the detailed charts of these observations shall be published, the connexion of this rate of motion with the character of the sea bottom at distant and varied parts of the channel, will be a question of great and important interest, of which Captain Beechey gives a glimpse in the few facts of the kind he has stated, as, for instance, the fact that the bottom of the space in which there is no perceptible motion, coupled with a considerable rise of tide, (a space of considerable extent between Dundrum Bay and the Calf of man,) is composed of soft blue mud. And another very remarkable fact, that the great body of the northern tide pressing more heavily on the Wigtonshire coast than on that of Antrim, has, in Captain Beechey's words, "*scooped out a remarkable ditch upwards of twenty miles long, by about a mile only in width, in which the depth is from* 400 *to* 600 *feet greater than that of the general level of the bottom about it.*" Now, whether we fully admit with Captain Beechey, that this has been actually produced by the tidal action, or only suppose that some previously existing valley or depression is by that action kept clear of any deposit, in either case, the geologist will at once recognise the application of such well established facts to his enquiries or speculations regarding the forces which may have produced similar phenomena at earlier periods. And I know of no more fertile subject than this very consideration would open up for any one having time at his disposal for such enquiries; thus, to trace out, by the combined aid of geological and physical researches, the resulting modification as regards tidal action, which must necessarily have arisen from the remarkable and thoroughly established changes of level of land and sea, even in the most recent geological epochs. So early as 1844, I had the pleasure of being the first to lay before this Society maps, in which I had endeavoured to show, roughly, the most remarkable, and at first sight almost incredible, alteration in the general aspect of our seas, which even a change of level of 500 feet in this island would produce; and of pointing out, though briefly and imperfectly, some of the remarkable alterations which from such change must have resulted in the prevailing course of the tidal waters. But I am sanguine enough to hope that, by such enquiries carried out with greater detail, and with the aid of additional data since acquired, some of the remarkable facts relating to the distribution of the more recent deposits in Ireland (those which the French denote *terrains meubles*,) may be reduced to general laws; that precisely as we can now see the cause of the heaping up and accumulation of sandy-banks into Morecambe Bay, so will we be able to trace the general currents, and the direction and force of these currents, which have produced similar accumulations at former periods; and that in this as well as in all other branches of geological investigation, we may much more philosophically and simply explain the phenomena, by a reference to known and existing forces and laws, than by having recourse to any speculation as to enormous climatal changes, or the operation of mighty forces, the former existence of which, to say the least, is doubtful. And to Captain Beechey, I think, geologists are much indebted for the contribution to the data necessary for such enquiries, which his paper affords.

I do not refer to the many other points discussed by Captain Beechey with equal ability, such as the position of the mean water level, the curve or outline of the surface of the tidal wave at different parts of its course, and on different sides of the channel; and the unequal motion of the upper and lower half of the tide wave. These, though they are all points of great interest, do not so immediately bear upon geology.

We would also refer to a very valuable and interesting communication on a similar subject, from Mr. R. A. C. Austen, on the valley of the English channel,* read to the Geological Society of London, in June last. In this Mr. Austen has applied his knowledge of the sonndings and bottom of the channel, with great skill, to determine the distribution of materials in that channel, and from this to argue back to the former outline of coast, and afterwards to determine the period of the formation of the channel. I regret much that the details of this paper have only been published within the last few days, so that I am unable to refer to them as fully as I could have wished, and as their great interest to geologists demands.

M. Perrey, to whose continued labours in bringing together, as far as in his power, a complete list of all observed earthquakes, we alluded fully last year, has since published,† in continuation of former lists, one of all the earthquakes which he has found any notice of as occurring in the year 1848. The political and social disturbances so general during that year appear to have prevented many from being recorded. The total number does not amount to more than fifty; of these, the direction of the oscillation of only eleven is given; and the mere fact of a trembling having been observed is in many cases all that has been recorded. The same author has also prepared a list of the earthquakes observed in the United States and Canada, not yet, however, completed. We have also some notices of earthquakes in Assam‡ which appear to have come from the north. The sound wave, was in some cases heard very distinctly three seconds before there was any disturbance of the ground.

The comparative uselessness of such observations, I had occasion

* Quar. Jour. Geol. Soc. No. 21, page 69.

† Bull. de l'Acad. Royale, Bruxelles, 1849, page 223.

‡ Journal, Asiatic. Soc. Bengal, Feb. 1849, page 172.

to insist upon last year, and the necessity for more accurate and systematic observation of earthquake phenomena, is daily becoming more obvious. With this increased necessity, however, we have had increased facilities, and greatly improved methods pointed out. Mr. Mallet has furnished to the British Association during the past year, a very able and detailed report on the statical and dynamical facts of earthquakes, in which he has discussed the several theories of their origin, and clearly enunciated the several conclusions which he considers himself entitled to draw from a review of the whole, supporting each by the details of the cases on which it is founded. As bearing immediately on geology, we will just notice the important conclusion, which necessarily follows from the fact established by Mr. Mallet that the shock or earth-wave is a true undulation of the solid crust of the earth, that earthquakes, however great, are *directly* incapable of producing any permanent elevation or depression on the surface of the earth. *Indirectly*, or by their secondary effect, they may, as by causing land-slips—forming new lakes or river courses—producing fissures, &c., or by the great sea-wave which occasionally results, and which acts with enormous power on the coasts.

Mr. Mallet also discusses the relation of the weather, the state of of the thermometer, barometer, &c., to earthquakes both before, during, and after the actual shocks; and points to the want of correct experiments on the elasticity of the substances forming the earth's crust, and on the rate of transit of the shock through known materials. Mr. Mallet has since been conducting some well devised experiments to determine the latter points, and I believe, with results of great interest. These are not, however, as yet published. I must however, refer to his admirable little essay on the same subject, forming one of those included in the Manual of Scientific Enquiry, published by the Lords of the Admiralty, in which many excellent and simple devices for earthquake observations are pointed out, and clear succinct directions given on points requiring elucidation. And we shall look forward with great interest to the completion of Mr. Mallet's reports and experiments.

Our *palæontological* acquisitions during the past year, have been numerous and interesting. The knowledge already acquired of the forms of organized creatures, of which remains exist in the fossil state, and the comparatively accurate acquaintance with the forms, structures, and habits of existing organisms, which naturalists have obtained during the last few years, have, however, necessarily exerted a very obvious influence on the *character* of such additions to our knowledge; and while we are constantly having new species, or new genera established, or the history of the development of old and well known ones elucidated; while additional facts are being acquired, bearing on the distribution of these genera, whether viewed geologically or geographically, we cannot expect, nor should we look for, such general and striking results, as in the earlier epochs of the history of geology astonished and captivated its students. These great generalizations, essential as they were to the progress of our knowledge, must continually be subject to slight and ever-varying changes, in proportion as we become more accurately informed on the details of our enquiries; and thus it is, that the prominent features being sketched in, it is now the duty of the geological investigator to seek out the minute details, to range these details, each in its peculiar and proper order, and thus, as it were, to bring together and group into general results the statistics of our science. Now though every branch of our enquiry opens up a wide field for the application of this mode of reasoning, and though we are fully satisfied that many important results would be obtained by a more strict and searching reduction to numerical tables of the facts connected with the distribution of minerals, metals, &c., still there is no branch of geological investigation which is more obviously adapted to such methods, than that which concerns itself with the number, variety, and distribution of the forms of organic life, in the several geological groups of stratified rocks. So obvious, indeed, is this, that many writers have already devoted themselves to the collection and collation of such numerical aggregates, and important and valuable results have been obtained.

It may be objected to such enquiries, that with the present imperfect state of our knowledge of the facts of distribution, or even of identification of species or genera, any general results obtained from such imperfect data, must themselves be imperfect. And this is unquestionably true, but true only to a certain extent.

The imperfection of our knowledge on these points, arises from several causes; one of these in the imperfect state of preservation in which the fossils are found. This source of error can readily be eliminated, by rejecting from our calculations all such species as have been named or determined upon such insufficient data. But such cases are extremely few, as compared with the whole number; and a much more fruitful source of error is, that in the majority of cases, the remains of plants or animals, from two or more distinct localities have been identified or described by two or more distinct observers; and we have thus a most important "personal error," introduced into our observations. The chances of this error are happily becoming every day less and less, from the frequent interchange of specimens and opinions among geologists; and this has now been done so frequently and so carefully, that although there undoubtedly are still in our lists of fossils, very many called by different names by different persons, while the fossils themselves are in reality the same, still the total number of such, as compared with the total number of known and acknowledged species, must be represented by a very small fraction indeed, while the rest, forming by very much the majority of the whole, remain as sound and unquestioned data on which the palæontological statist can found his enquiries, and from which he can deduce his results. In several groups, the investigation of which has been specially undertaken by individuals, to whom access had been afforded to the best collections in all countries, the number of such species described under various synonymes by different authors, is very small; as, for instance, in the case of fossil fish. But even taking the group, in which the greatest amount of such confusion is acknowledged to exist, and in the conchylia we have not more than 0.10. to 0.20. which rest under this confusion. Another great difficulty in such investigations, consists in this, that we do not accurately know even the present creation; and still more, that even granting that we know the fossils already discovered perfectly, these said fossils only represent a small portion of the whole which once existed.

In this point of view, the most important contribution of the last few years, has been the very laborious and detailed work of Professor Bronn, in his *Geschichte der Natur*. The amount of labour and detail which he has brought together in this, may be estimated in some degree from the total number of fossil species which he has enumerated, being 26,421; and in his general tables he has grouped these among the several formations in which they are found, and the several natural history classes to which they belong. It would clearly be impossible in an address like the present, to give even a rude idea of such results, and we must therefore refer to the original work.

Professor Bronn has further taken up some other questions, as the results of these enquiries, and discussed them with some detail. One of these is the "*duration of species,*" (*Dauer der Arten.*) After enumerating many cases in which species are known to pass from one formation into another, or even into two or more other formations, he shews that while the duration of species taken singly, may be very varied, still the average or mean duration may be obtained from a large number of such cases; thus as the general result, it is found that out of

	2,055 plants,	12 =	0.06.	Species pass into other formations.
	24,366 animals,	3322 =	0,134.	
Total	26,421	3334 =	0.124.	

Or allowing for the fact that in this the numbers for the plants are too small, and for the animals probably too large, owing to causes which the author points out, he deduces the conclusion, that each species has had an average duration of less than 1.12 formation; remembering at the same time that the occurrence in any one period does not represent an occurrence through the whole of that period, but on the average for a much shorter time. Taking the question of duration of the genera, it appears that there are several limited to a single *formation,* others to a single *period,* consisting of several formations, while others pass through several periods, and some exist at present.

		In different Periods.	Formations.	
Thus of	35) genera of plants,	463	592 times	= 1 : 1.32 : 1.69
	2501 „ animals,	3347	5415	= 1 : 1.34 : 2.17
Together,	2851	3810	6007	= 1 : 1.34 : 2.11

Or in other words—out of 100 genera, 34 per cent. pass into a second period; and 100 genera of plants occur in different formations, 69; 100 genera of animals, 117; or of both taken together, 211 times.

The author then considers the very interesting question of the number of the species, *(Zahl der Arten;)* or as he puts it—whether (admitting that the actual proportion of the separate divisions of the organic kingdoms to each other has obtained so long as these divisions themselves have existed,) it be possible from the number of still living species to estimate the number of all that have ever existed: in this enquiry, calculating from the number of species preserved in the easily preservable classes, orders, &c., to the number which may have existed in those more dificult of preservation: from the number of parasites, the number of organisms on which they lived, and *vice versa:* supposing a numerical proportion, similar to the present, to have existed between the several groups from their first appearance up to the present period.

Now this proportion of the fossil species to living is thus:—

	Fossil.	Living.	Fossil and Lving.	Proportion.
Plants,	2,050	70,000	72,050	3 : 100 : 103
Animals,	24,000	100,000	124,000	24 : 100 : 124
	26,050	170,000	196,050 =	15 : 100 : 115

that is taking the numbers in round sums, and allowing a little further reduction to be introduced from imperfect specimens, or want of proper identification introducing synonymes.

From this we see, that the number of living animals is not much greater than that of living plants—the proportion being 100 to 70; while the number of fossil animals bears the proportion of 100 to 9 to fossil plants. It must, however, be admitted, that such a proportion, one so widely different from that now existing between these two groups, which have such an important and acknowledged reciprocal influence, one on the other, never existed, and their absence must be due to their being comparatively so difficult of preservation.

In order, however, to follow out the calculation here indicated, it becomes essential to establish first of all, the number of formations which in a palæontological point of view may be considered as reciprocally *equivalent* or of equal value. Professor Bronn assumes of these fifteen, in the whole series. Now though it was previously seen that 12 per cent. of the fossil species passed from one formation into another, still it must be remembered that by far the larger proportion only continued for a portion, or even a small portion of the duration of that formation; so that estimating all these changes, generally speaking gradual, occasionally sudden, it may fairly be concluded that the mean average *life of a species* was equal to one-half the time of a formation; or in other words, that there have been during the formation of the whole known series of stratified rocks, thirty changes of species, or thirty times the duration or life of a species (= 30 *Arten-wechsel, Arten-dauern, and Arten-Alter setzen.)* Again, in endeavouring to ascertain whether at former periods the earth was as fully or as numerously peopled with species as at present, it is obvious that we can only obtain a fair result by comparing not the entire fossil flora, or fauna with the present, but the fossils of some one locality, (the circumstances of which were favourable for their preservation, and the rocks of which correspond to the duration of a life of a species, or in other words, form a portion of a formation,) with the existing fauna and flora of the same locality; and then combining several such local results, arriving at a general conclusion. Professor Bronn gives instances from all the principal groups of rocks bearing on this question, for the details of which, however, I must refer you to his valuable work, and he concludes from these that although all classes, orders, or families, may not have at all times existed on our earth, though some few groups of them may have vanished, yet that those which then existed were at all times as numerously represented by genera and species as at present. At the same time this did not exclude greater or lesser variations, both in horizontal and vertical direction, and thus many groups might regularly and constantly be more numerously or less numerously represented than at present.

Thus, then, there have been—1st, at least thirty times on the globe a change of species, or thirty "lives of a species." 2nd, during each of these lives of a species, each group in the organic kingdom, which existed at that time, was as numerously represented in former times as now; and 3rd, that notwithstanding the variations and oscillations of several groups, the existing number of the species and genera of each group may be considered as unity, or as the equivalent of each life or duration of a species, *(Arten-alter;)* and these variations, *(Schwankungen)* may even be shown by an exponent placed after the number of existing species.

These exponents clearly cannot be taken with perfect accuracy in the present state of our knowledge; but Professor Bronn has established provisionally for each group its exponent, acknowledging that in some cases it is too high, in others too low; and he thus obtains a general view of the duration and number of the various groups during all geological time. He thus obtains in round numbers 1,500,000 species of animals, and 500,000 species of plants; and it will not in the slightest degree affect the accuracy or the originality and value of Professor Bronn's *method* of arriving at this result whether future corrections increase or diminish this total. Of the 2,000,000 species thus estimated to have once existed, probably not $\frac{1}{10}$ or 200,000 were such as to leave their remains imbedded so as to be recognised, and even of these 200,000, a large portion will never come to our knowledge.

Professor Bronn then enters on the question of the relative richness in fossils of the several periods, (Carboniferous, Triassic, Oolitic, Cretaceous, Tertiary,) into which he divides the whole series. As regards their absolute richness in fossil species, they would stand thus according to

Plants, Cretaceous, Triassic, Oolitic, Tertiary, Carboniferous.
Animals, Triassic, Oolitic, Carboniferous, Cretaceous, Tertiary.
Together, Triassic, Oolitic, Cretaceous, Carboniferous, Tertiary.

He points out fully the difficulty also of saying which period, estimated from time of equal length, was richer, from the many disturbing causes to be considered in the calculation, and from our absolute ignorance as to the existence or non-existence of an uniform proportion between the time and the causes that destroy species, and some other considerations.*

This very brief analysis of some of Professor Bronn's results, will, I hope, be sufficient to indicate the value and importance of his labours. As a work of reference for the student, it is one of the most useful that have issued from the press, and has, as it were, completed for the whole series of fossil organisms, what a monograph on any detached group accomplishes, by bringing together detached and isolated notices, and rendering them all accessible at one view.

* Neues Jahrbuch. Leonhard and Bronn. 2nd Heft, 1849, also since translated by Professor Nicol, in Quar. Jour. Geol. Soc. London. No. 20, Nov. 1849, page 30.

But the work itself must be in the hands of every palæontologist, and I need not impress on them its great value and interest.

If we adopt the plan of grouping the several palæontological contributions, published during the year by the geological succession of the groups of rocks to which they most particularly refer, among the first we would place the fragment of his larger work on the silurian system of Bohemia, which M. Barrande has given us, in which he treats at full, of the successive steps in the development of the species which he had originally (1846) named *Sao hirstua.* In this memoir,* he satisfactorily points out the several stages through which this crustacean passes, the changes in its form, and in the number of rings, or thoracic segments, which are only three in the young state, but increase as the animal grew. The cephalic shield in the young animal constitutes nearly the whole animal, but forms a very small portion of the adult; and so great are these metamorphoses in form, that it is scarcely to be wondered at, that previous writers had classed the several stages under different species, and even genera. In fact, Barrande has reduced to the one species of Sao hirsuta, no less than twenty-two species described under thirteen different genera.

These metamorphoses have a remarkable interest also for the physiologist, bearing on the question of the affinities of these crustaceans as indicating their embryonic state; and judging from this fragment of his larger promised work, M. Barrande's labours will, doubtless, throw much light on the fossil history of the earlier geological epochs.

During the past year, two decades of fossils have been published in connexion with the Geological Survey of the United Kingdom, one of which (No. 2,) is devoted to trilobites; and here also we have a notice of a somewhat similar metamorphosis in another genus of this interesting class. Mr. Salter has observed in the species which he has named *Ogygia Portlockii*, that the youngest specimen found has only four thoracic rings, while others more fully grown have seven and eight. We may be allowed here to direct attention also to the extreme beauty and accuracy of the illustrations published in these decades, in the engraving of which, advantage has been taken of the facilities afforded by the modern improvements in steel engrav-

* Leonhard and Bronn, Jahrbuch, 4th part, 1849, page 385.

ing, so that the most perfect effects of tinting is produced, while the lines employed to produce the effect of form, do not in the slightest degree interfere with those used to represent structural markings.*

Mr. M'Coy, in a paper on the classification of British fossil crustacea, &c., has not only described several new genera (*Chasmops, Trimerocephalus, Barrandia, Tretaspis, Harpidella,*) and species of trilobites, but has also given some general views on the classification of the whole family. As the chief ground of his subdivision he takes the character of the *pleuræ*, or lateral portions of the thoracic segments; and he adopts five sub-families to include the whole group. Taking into consideration the remarkable facts we have just noticed, as established by the researches of Barrande on the metamorphoses of trilobites, it may fairly be questioned whether many of these divisions will not be necessarily modified by the progress of investigation, although such changes will not detract from the present value of these classifications.

Mr. M'Coy has further examined the homologies of the cephalic portion of trilobites, and the much discussed "facial suture." He considers the cephalic shield as composed of an extension of the two first cephalic rings, the facial suture itself being the line of separation between the first and second cephalic ring—the portion bearing the eyes, or that anterior and external to the eye line, being the first or opthalmic ring, as in other crustacea. Such is Mr. M'Coy's view, in support of which there is much to be said, although there are also several important difficulties in admitting it. The character of the *pleuræ* is also more fully described than they have hitherto been, and they are divided into two groups—facetted and non-facetted, the *facet* being "the smooth flat triangular space at the extremity of the anterior margin of the pleuræ of certain trilobites." The paper also contains valuable remarks on some other families of crustacea besides the trilobites.†

M. Marie Roualt, has described and figured a new trilobite of the genus Lichas (*L: heberti*) from the schists of Vitre, in Britanny, in which he a..nounces the discovery of *Homanolotus, Ogygia, Illænus,* &c.‡

* Memoirs of the Geological Survey of the United Kingdom. Figures and descriptions illustrative of British organic remains. Decade 2.

† Ann. Nat. History, Dec. 1849, page 392, &c.

‡ Bull. Soc. Geol. de France, March, 19, 1849, page 377.

Mr. Fletcher of Dudley, whose very beautiful and perfect collection of the fossils of that neighbourhood is well known, has recently described some species of Lichas from Dudley.*

Mr. Davidson has added to his former valuable descriptions of the Brachiopoda, figuring a new species *Leptæna grayi.* He questions further the propriety of grouping under one species, (as Mr. Salter had done,) *Orthis rustica, walsali,* and *calligramma,* thinking, with M. De Verneuil, that *O calligramma* does not occur in England. In the same paper he describes a new species, *Leptæna granulosa* from the marlstone of the lias near Ilminster, found associated with *Terebratula pygmæa,* which latter also occurs in France associated with *Lep : liassiana.* This is an interesting discovery, and with the other species already described from the lias, (viz. *Leptæna liassiana, bouchardi, moorei, pearcei,*) prove that the genus leptœna, supposed to have died out with the palœozoic rocks, has really continued to exist, although in small number and of minute size, in the newer deposits.†

Professor M'Coy has described a considerable number of new Palœozoic Echinodermata, principally derived from the carboniferous limestone of Derbyshire and Yorkshire. We have to regret the absence of any figures of the fourteen new species established, some of which are, however, well marked and will be recognizable.‡

Sir Philip Egerton has continued his valuable additions to our knowledge of fossil fish. In his Palicthyologic notes, (No. 2,) he proved that the genus Platysomus of Agassiz must be classed with the *Pycnodonts,* not the *Lepidoidei,* and that the *globulodus* of Münster is a true *platysomus,* so that his genus must be cancelled.§ And in No. 3 of his notes, he has given a general survey of the heterocerque ganoids—describing and figuring some new species.||

M. L. Abbé Danielo has found vast numbers of the curious, and hitherto little known remains, called *bilobites* by Cordier; and he has come to the conclusion that they are distinctly vegetable. They occur in beds associated with others containing Arca, modiola, tere-

* Athenæum, Jan. 19, 1850.

† Bul. Soc. Geol. France, tom vi. page 271, Feb. 5, 1849.

‡ Ann. Nat. Hist., April, 1849, page 244.

§ Quar. Jour. Geol. Soc. London, 1849, page 329.

|| Quar. Jour. Geol. Soc. London, 1850, page 1.

bratula, &c., and which he considers to belong to the Devonian groups, in the department of Morbihan.*

Mr. Morris has announced the discovery of a species of Siphonotreta, (*S. anglica*, Morr,) in the Wenlock shale of Dudley.†

The discovery by Mr. Isaac Lea, of the foot-prints of reptiles in the old red sandstone at Pottsville, Pennsylvania, consisting of six distinct markings in a double row, is another very interesting addition to our knowledge of the distribution of animal life in the stratified rocks. Until very recently, as you are aware, no reptile forms had been observed in any rocks older than the Permian group, but Goldfüss had found two skeletons of reptiles in the coal formation near Treves; and Dr. King, in America, had also found foot-prints of a reptile in the western coalfield; and now Mr. Lea has shewn the existence of these air-breathing animals at an earlier period in the old red sandstone epoch. He proposes to name the animal whose tracks upon the sand are thus so wonderfully preserved—*Sauropus primævus*.‡

In connexion with these foot-prints we would notice an elaborate and detailed account of all hitherto described, illustrated by numerous plates—(128 pages, and 24 plates,) by Professor Hitchcock, President of Amherst College. He describes fifty-one species in all—of which twelve are quadrupeds, four of lizards, (?) two chelonian, six batrachian, two mollusca or annelida, thirty-four bipeds, three doubtful.§

Mr. Binney, who has already contributed so much to the history of those remarkable fossils, the *Stigmaria* and *Sigillaria*, has more recently found Stigmaria, in the middle of a seam of coal, full of the spores of the lepidostrobus, an important and additional fact in their history, as bringing the two together. It may be remembered, that in the case of the Dixon fold trees, described by Mr. Bowman, and which were by him considered to be Sigillaria, there were numerous lepidostrobi lying around their roots. Mr. Binney's specimens were derived from the so-called "brasses," or lumps of iron pyrites, which abound in the "King coal" at Wigan, and which have to be picked

* Comtes Rendus., 26 March, 1849, page 415.

† Athenæum. Brit. Ass. Report, page 992.

‡ Brit. Ass. Report. Athenæum, page 937, 1849.

§ American Academy Transac., Boston, 1848, vol. iii., 2nd series.

out before the coal is sent to market. In the centre of these "brasses," Mr. Binney frequently found a stigmaria, composed of clay ironstone, generally much compressed, but occasionally so preserved as to exhibit their original round form, and their structure. Mr. Binney also states, that after careful examination of many specimens in situ, he has not been able to confirm the idea of their being a true *taproot* to Sigillaria.*

In this latter circumstance, Mr. Binney differs altogether from Mr. Brown, who has described some erect Sigillaria with roots in situ, found in the roof of the Sydney Main coal, in the Island of Cape Breton; the stem, and roots attached, were found in their place of growth, rooted in a bed of hard shale covering the coal. On carefully clearing out the under surface of the fossil, Mr. Brown found that the horizontal roots branched off in a very regular manner, the base being first divided into four quarters, by deep channels running from near the centre outwards—(the "crucial suture" of J. Hooker?) an inch or two further from the centre, these quarters are again divided into two roots which themselves bifurcate again, so as to produce thirty-two roots in all, within a circle, in Mr. Brown's specimens, of eighteen inches diameter. In each quarter of the stump, there were four large tap roots, one on each rootlet, and beyond these, about five inches, another set of smaller tap roots, so that there were forty-eight in all—viz., sixteen in the inner circle, and thirty-two in the outer. Mr. Brown points out the curious correspondence between the number of the roots, (thirty-two,) and the vertical rows of leaf-scars on the stem, (also thirty-two,) and infers from the character of the roots, and their peculiar position with regard to the beds of shale and coal, that the plants to which they belonged were adapted for living in a soft muddy soil. He also shows that the remarkable "dome-shaped" fossil figured by Lindley and Hutton, is nothing but a similar root of Sigillaria, with the stem broken off.

The roots of these large sigillariæ were found not to cover an area of more than thirty square feet; while the roots of lepidodendron, which the same author previously described, and whose stem was only two or three inches in diameter, covered an area of two hundred square feet. Now the lepidodendron were lofty trees with spreading branches; and he concludes from this proportion in

* Quar. Jour.Geol. Soc. London, Feb. 1850, page 17–21.

the size of their roots, that sigillariæ were, on the contrary, trees of low growth, and without spreading branches.*

A very important contribution to the knowledge of fossil fish has been made by Mr. W. C. Williamson, in his memoir on the microscopic structure of the scales and dermal teeth of some ganoid and placoid fish.† After reviewing the opinions held by previous investigators, Mr. Williamson gives the result of his examination of the scales of the genera *Lepidosteus, Lepidotus, Seminotus, Pholidotus, Ptycholepis, Beryx*, and *Dapedius*—all of which seem to be constructed after one common type, with modifications. Another group of structures was found in *Megalicthys, Holoptychius*, and *Diplopterus*. Many others were also examined, and the structure of their scales is given in detail, and very fully illustrated. The author concludes from all, that what has hitherto been called enamel, is in fishes a compound structure, separable into two—ganoine, and what he calls kosmine; the former being superficial, transparent, and laminated, but otherwise without structure; the latter consisting of minute branching tubes, resembling the dentine of true teeth;—that the kosmine covering the osseous scales of many ganoid fishes is homologous to, and identical with, the substance forming the dermal teeth of placoids, so that the distinction of ganoid and placoid can scarcely be retained as a physiological one; and that the ganoid scales consist of variously modified osseous lamellæ, successively added chiefly to the lower surface, but also occasionally to a part or the whole of the upper surface. He shows also, the mode in which these lamellæ have been formed, and points out the advantage of using the microscope as a means of distinguishing genera and species, and also of establishing their affinities, wisely cautioning against the danger of urging such investigations too far, without giving full weight to the importance of the other portions of the fish to which these scales belong.

As connected with the palæontology of the older rocks, we must also refer to the publication of the geological investigations of the American exploring expedition, illustrated by a large folio volume of plates. Many of the fossils figured have been already described

* Quar. Jour. Geol. Soc. London, 1849, page 354.

† Phil. Trans. London, 1849, page 435.

by Count Strzelecki and others; but the work contains also numerous additions to those previously published.

M. Bayle has announced the occurrence in the well known beds of Saint Cassian, of a mixture of palœozoic and mesozoic species; of fishes, there are species of Gyrolepis, Hybodus, &c.; of cephalopoda —Orthoceras, Goniatites, Ceratites, Ammonites; also Bellerophon, Porcellia, Nucula, Trigonia, Terebratula, Spirifer, Producta (leonhardi) Cidaris, &c. He considers the beds as an intermediate term, belonging, however, to the *marnes irisees.**

The fossil fish of the Muschelkalk of Jena, Querfurt and Esperstädt, have been described by Von Meyer, who has also published the fish, crustacea, echinoderms, and other fossils of the same rock, at Oberschlesien.† In this monograph, which is very well illustrated by finely drawn and neatly printed figures, he describes twenty species of fish alone, belonging to the genera Leiacanthus, Hybodus, Acrodus, Palæobates, Saurictbys, &c. &c.

The fossils of the Muschelkalk of north-west Germany, have been investigated also by Von Strombech, in an excellent memoir, published in the Proceedings of the German Geological Society. In this communication, the important point of the distribution of the species is particularly attended to.

The fossils found at Spitzbergen, and referred by their finder, M. Eugene Robert, to the carboniferous group, have been shown by M. De Koninck really to belong to the Permian series, or the Zechstein. Among them were *Spirifer undulatus*, *Productus horridus*, *P. cancrini*. Some of the species of spirifer belong to the genus spiriferina of D'Orbigny, having their shells perforated; of which subgenus none have as yet been found in the carboniferous group.‡

Mr. Morris, whose accuracy and research are so well known to, and so highly appreciated by, all British palæontologists, has described a new genus of shells from the secondary strata, to which he has given the name *Neritoma*, differing from the true *neritæ*, with which they had previously been associated, in having on the outer lip two sinuses more or less deeply marked, and also in the

* Bull. Soc. Geol. de France, 5th March, 1849, page 323.

† Dunker ünd Von Meyer, Palæontographica, 1 Band V. lief, page 195—216.

‡ Comtes. Rendus, and Bull. Soc. Geol. de France.

form of the aperture and the columellar lip. Mr. Morris also points out the interesting fact, that this group of shells forms a distinct generic type, and adds another instance of molluscs, which, with analogous forms, have yet a distinctive character similar to Neritoma, in possessing a greater or less sinus in the outer lip. And in grouping such genera with their analogues, it is remarked that most of those which have this sinus belong to extinct genera. Thus *Acroculia, Murchisonia, Platyschisma,* found in the palæozoic rocks, are represented by the analogous existing genera without sinuses, of *Pileopsis, Cerithium,* and *Trochus. Neritoma* in the secondary rocks, by *Nerita* existing, &c.*

Mr. King, whose catalogue of the Permian fossils of Northumberland, &c. is in the press for the Palæontographical Society, has given a brief summary,† but without any illustrations, of some of the families and genera of corals of that group, describing six new genera. It is impossible to say how far such divisions are well grounded or not, until the details are given; and the very important changes which have been introduced in the classification of the coralline fossils, as more perfectly preserved or more numerous specimens have been examined, should render us extremely cautious in admitting any subdivisions which are not grounded upon sufficient data. In the group of corallines especially, it appears to me that great impediments have been thrown in the way of the progress of sound knowledge, by a heaping up of names of genera and species, most of them described from very small and, in many cases, imperfect fragments, which cannot possibly afford any information as to the habits of growth of the coralline, and but a very imperfect insight into its structure. I have had occasion years since to point out some instances of confusion arising from these causes, and am still even more convinced of the necessity of great caution, and the possession of good, and even numerous specimens, before venturing on any new classification of the forms found in the fossil state.

In connexion with Zoophytology in general, the extremely valuable, and ably illustrated papers of M. Milne Edwards and Jules Haime, which continue to enrich the pages of the *Annales des Sci-*

* Quar. Jour. Geol. Soc. London, Nov. 1849, page 332.

† Ann. Nat. His. May, 1849, page 388.

ences Naturelles, must be referred to as among the most important contributions to fossil Zoophytology, which have ever appeared.

The very remarkable and curious batrachians, known to geologists under the name of *Labyrinthodon*, have been beautifully illustrated by Burmeister, in a monograph on those found in the bünter-sandstein near Bemburg.

Dr. Lloyd has also described the remains of a new species, which he has named *Labyrinthodon Bucklandi*, from near Kenilworth, Warwickshire. The specimen exhibits a skull compressed between two layers of sandstone, and having twenty or more teeth in the maxillary bone. Dr. Lloyd thinks the bed in which this specimen was found is undoubtedly to be referred to the same subdivision as that from which Burmeister's specimens were derived—the bünter-sandstein; whereas those previously found in the same neighbourhood were from the white sandstone of Warwick, which has been rather uncertainly referred to the keüper.* Mr. Sanders, at the same meeting of the British Association, gave some reasons for considering that the beds in which the remains of the Thecodontosaurus and Palæosaurus were found at Durdham down near Bristol, belonged not to the lowest portion, but rather to the latest period of the new red sandstone.

In the first part of a paper, already referred to, by Professor M'Coy, we have some valuable additions to our knowledge of the structure and forms of fossil crustacea, from the newer secondary and tertiary rocks. In this communication, the Professor has formed eight new genera for the reception of these crustacea, and thirteen new species. Some of these being illustrated by well executed woodcuts, the paper forms an important addition to our knowledge of a group of fossils, frequently preserved with great perfection, and which have hitherto not received much attention from British palæontologists.†

Dr. Mantell has added considerably to our acquaintance with the structure of the wealden reptiles, in his description of some additional specimens of the *Iguanodon* and *Hylæosaurus*, the most important portion of which is the determination of the vertebral

* Athenæn. Brit. Ass. Report, 1849, page 992.

† Annals Nat. His. Sep. and Nov. 1849.

column, pectoral arch, and anterior extremities of the Iguanodon. The vertebral column presents the interesting fact of having the anterior dorsal and cervical vertebræ convexo-concave; that is, convex in front, and concave behind, (as in the remarkable reptile called *streptospondylus,)* but this convexity of the anterior side, or face of the body of the vertebra gradually diminishes, and it becomes flat in the middle and posterior part of the dorsal region. Dr. Mantell considers the vertebræ referred by Owen to Streptospondylus major, (British Association report on fossil reptiles,) to be in reality cervical vertebræ of the Iguanodon, and some of those referred to *cetiosaurus*, as being posterior dorsal, and lumbar vertebræ of the same reptile. The sacrum, the pectoral arch, and the humerus, are also described at length: and Professor Melville's able anatomical remarks are appended. It has thus been Dr. Mantell's good fortune, after the lapse of quarter of a century, to complete the description of the gigantic saurian, which he had himself first noticed from a few "isolated and water-worn teeth"—a well earned, and well merited reward of the untiring zeal and energy with which he has pursued his researches.*

M. Saemann, in some observations on the family of Rudista, has given the results of his careful examination of numerous specimens, (especially with reference to their internal structure,) of Sphærulites and Hippurites, and has perfectly established the existence of distinct hinges, and muscular attachment of a peculiar kind, which places the question of the classification of Hippurites, in which the structure of these parts was not previously known, beyond a doubt, and shows that they belong to the Ostracea, with which group Deshayes has previously ranked them.†

From M. Soriquet we have a complete list of all the Echinida found in the cretaceous group of the department de l'Eure, useful for comparison with other districts, all of these amounting to seventy-four species, having been determined on the high authority of M. Michelin. Of these seventy-four species, three only are stated to be common to the white chalk, and the *craie chloriteè*.‡

And from the Geological Survey of Great Britain, we have in the

* Phil. Trans. London, 1849, page 271.

† Bull. Soc. Geol. France, Feb. 1849, page 280.

‡ Bull. Soc. Geol. France, April, 1849, page 441.

first decade of fossils, beautiful figures and descriptions of a number of Echinoderms. Professor E. Forbes has here given all the known British silurian species of asteriadæ, some new forms of oolitic, and all the London-clay star-fishes; together with six plates of fossil Echinidæ. The extreme beauty and admirable preservation of the Echinidæ, are well known to every one who has ever examined a collection of oolitic or chalk fossils, and the importance of a careful investigation of their forms, and an accurate determination of the species, subject in several cases to much variation in size and form, cannot be too highly estimated. The fact that some even of the most ordinary occurrence have been described under seven or eight different names, is in itself sufficient to show the value of such a general review of the group.

Professor Owen has given a brief but very important description of some reptile remains, from the Greensand of New Jersey, discovered by Professor Henry Rogers. They consist of crocodiles of two species, belonging to the same genus, as existing crocodiles or alligators, and which Professor Owen has named *Crocodilus basifissus*, and *C. basitruncatus*: of remains of a mosasauroid reptile, allied very closely to the Leiodon, for which Professor Owen has proposed the name of *Macrosaurus;* of true mosasaurus remains of the species, *M. Maximiliani*: and of teleosauroid remains, referred to a new genus, *Hyposaurus Rogersii.** Although drawn up under most disadvantageous circumstances, resulting from the unfortunate loss of his original MSS. containing the detailed observations, a loss which every palæontologist must most deeply regret, this brief communication forms a very important addition to our knowledge of reptile life, during the earlier periods of the cretaceous epoch.

The fossil sharks of the United States, have been monographed with good figures, by Dr. Gibbes of Columbia, South Carolina.

Passing to the tertiary rocks, Dr. Carpenter, whose researches on the microscopic structure of shells are well known, has applied the same method of investigation to the examination of the intimate structure of the nummulina, orbitolites, and orbitoides, and has given a detailed and careful description of his results, accompanied by good figures.† His

* Quar. Jour. Geol. Soc. London, 1849, page 382.
† Quar. Journ. Geol. Soc. London, 1850, page 21.

observations entirely support the view that nummulina belongs to the foraminifera, as also the orbitoides of D'Orbigny; while he doubtfully refers the orbitolites to the *Bryozoa*. Whether this conclusion may be finally established or not, Dr. Carpenters' researches have laid before us some of the most beautiful structures as yet known, and we hope that with the experience he has already acquired in the use of the miscroscope, he may be induced to pursue such enquiries, and bring the same accuracy of observation to bear on the minute structures of other organic forms.

The Palæontographical Society have, during the past year, issued a most valuable monograph of the chelonian reptiles of the London clay, drawn up by Professors Owen and Bell, illustrated by thirty-eight very excellent plates and some wood-cuts. In this monograph we have detailed descriptions of eleven species of Chelonia, eight of Trionyx, two of Platemys, and six of Emys, in all of twenty-seven species from this one formation alone, the eocene tertiary of England.

This publication, taken in connexion with the able paper by Professor Owen, in which he discusses generally, the homologies and development of the carapace and plastron of the Chelonia,* leaves little to be desired with regard to this family of fossils, and renders perfect up to the present time, our knowledge of the several species found in our eocene deposits.

From the same Society we have also the first part of a monograph on the mollusca belonging to the same geological formation, including the *cephalopoda*, drawn up by M. F. Edwards. Thirteen species are described and figured; a very large number of synonymes being reduced to this number. These two well illustrated monographs furnish an amount of information regarding the fossils of our eocene deposits, which could not have been obtained previously, except by minute, tedious, and detailed research.

Reuss and Von Meyer have jointly contributed a valuable paper on the tertiary fresh water formations of Northern Bohemia*—formations remarkable for the number of beautiful land-shells contained in them, all apparently new.

Mr. Carrick Moore† has described some tertiaries in the Island of Saint Domingo; noticing four species of foraminifera, and seventy-

* Von Meyer, Palæontographica, 1849.

† Phil. Transac. London, 1849, page 151.

seven of mollusca which occur in them, besides fishes' teeth, (*Carcharodon megalodon*, Agas) corals, and one echinoderm, (*Scutella.*) Of the shells, thirteen are identical with existing species, and two are doubtful—fifty-nine are considered new, and descriptions given, with figures of some. From a review of the whole evidence, Mr. Moore considers these deposits to be of miocene age. A very remarkable and interesting circumstance connected with these deposits, is the striking resemblance which many of the shells have to recent species which inhabit the seas of China, Australia, and the western coast of America. One is identical with an Indian Ocean species, (*Venus puerpera* Linn,) and another (*Phos Veraguensis*) is found in the bay of Veragua, on the eastern side of the continent. Now, the tertiary beds which flank the Cordilleras, have not one single species in common on the two sides.—(D'Orbigny.) In the North American miocene beds, all the species, which occur also recent, are without exception Atlantic species, while in this case we find two species, now found recent only in the Indian and Pacific Ocean, occurring in a fossil state in beds connected with the Atlantic. Mr. Moore accounts for this by pointing out the narrowness and lowness of the land in the Isthmus of Panama, which no where attains an elevation of more than 1000 feet; and thinking that a connexion between the two oceans might have existed here in the equatorial regions, long after a separation had taken place more northerly and southerly, where the range of the Andes presents points of 4,500 feet elevation and more.

A somewhat analogous case of the occurrence of fossil remains of peculiar character, pointing to former connexion of districts of the earth's surface, now, and long separated, is pointed out by M. Gervais, who announces the very interesting discovery of the remains of elephants and mastodons in Algieria. Of the elephant, the remains found are referable to the species *primigenius*, of which Sicily has hitherto been the most southerly limit; of the mastodon the remains are more nearly allied to the *M. brevirostre*, which is pliocene, than to M. angustidens, which is of miocene age. Many of the terrestrial and fluviatile remains of the south of Europe and north of Africa agree—the existing fauna and flora agree—and belong to the same centre of creation; and the finding in the fossil state, in caves in the south of France, of animals which still exist on the coast of Barbary, mixed with others which

† Quar. Jour. Geol. Soc. London, 1850, page 39.

belong to the basin of the Rhone, is another important fact, which, coupled with these recent discoveries of mastodon and elephant remains, is of peculiar value as bearing on the question of the former connexion of the south of Europe and the north of Africa during the recent portion of the tertiary epoch.*

The same author has carefully investigated the mammalia of the genera Palæotherium and Lophiodon, met with in the south of France. He has found that among these are several found in the eocene-beds of the Paris basin, as P. *magnum, crassum, medium, curtum,' minus. Anoplotherium commune*—the other species being principally new, and therefore of no value as evidence of age. From these facts, he concludes that the beds in the south of France are of the eocene period, and not miocene, as hitherto supposed. He thinks that the genera Paloplotherium, (Owen,) and Plagiolophus, (Pomel,) have no sufficient grounds, and are in reality Palæotheria. With regard to Lophiodon, after pointing out some distinctions in their character, which he thinks sufficient to warrant a new arrangement of them, he asserts, that the Lophiodons, and the animals found with them, constitute a distinct population, their remains being found in very varied mineral beds, clays, sands, limestones, &c. ; but though difficult to decide exactly, he is inclined to think them all eocene.†

M. De Christol has considered the general classification of the Pachyderms, and divides them into two great groups, according as they have molar teeth, with or without cement. The acementodont pachyderms do not differ from the others in this respect only ; but this is considered the most essential distinctive point. The differences are fully pointed out, and the author concludes from the examination of the two parallel series, into which he divides the whole order, that in all the families of the order of pachydermata, the acementodont group is more ancient than the cementodont.‡

M. Christol§ has also announced the finding, in the marine sands of Montpelier, (in which the metaxytherium cuvierii occurs,) of several bones of the limbs of an ape, (*Pithecus maritimus*—Christol,)

* Comtes Rendus, tom xxviii., 12th March, 1849, page 362.
† Com. Rendus, tom xxix., Oct. 8, 1849, page 381,
‡ Comtes Rendus, tom xxix., page 363.
§ Bull. Soc. Geol. France, tom vi. page 169.

also a felis with cutting, and strong canine teeth, to which he has given the specific name of *Felis maritimus*, and some other interesting remains.

Messrs. Dubreuil and Gervais have discovered in the salt-water molasse of Castries, in the department of Herault, the nearly entire coronoid bone of a dolphin, nearly as large as the *delphinus rissoanus or griseus* of the Mediterranean, but differing entirely from them, from another dolphin found in the blue molasse of Vendargues, from the squalodon of Bourdeaux and of Malta, and from all known delphini, by its teeth, which are very broad as compared with their length, from which circumstances the authors have given it the name of *Delphinus brevidens.* In the same rock, they have also found the *Myliobates micropleurus* (Agas.)*

Giebel† has given a list of the animals, whose remains are found in the cave called Sandwicker-höhle, and the occurrence of a bird's egg in the tertiary limestone of Weissenau, near Mayence, is stated by Becker.‡

Professor Nillsson of Lund's valuable researches, in the history of the recent and extinct bovine animals of Scandinavia, have been given to the English reader in the Annals of Natural History,§ and will be found particularly interesting to the Irish observer, from the comparative abundance in this country of the remains of some of the species described.

The Rev. W. Smith has described || the occurrence of an earth very rich in diatomaceæ, on the banks of Lough Mourne, near Carrickfergus, in which he has noticed no less than fifty-five species in sixteen genera. He also briefly notices the difference in the character of the species observed in this earth, and those in another deposit from the shores of Lough Reavy, in the adjoining County of Down; the species in one indicating level pastures, surrounding the lake, while in the other they are of a sub-alpine character, and he points out the value of such enquiries to the geologist, who may, from these minute and microscopic remains, be able to argue as to the

* Comtes Rendus, January, 1849, page 135.

† Neues Jahrbuch. Leon. ünd Bronn, 1 Sept. 1849, page 56.

‡ Do. Do. Do. page 69.

§ Ann. Nat. His. Oct. Nov. Dec. 1849.

|| Ann. Nat. His. Feb. 1850, page 121.

physical conditions of the surface in the vicinity of which the deposits have been formed.

Though not distinctly bearing on Palæontology, the researches of Mr. Edmonds, junr., on the shells found beneath the surface, and in the sand hills near Penzance, are still not without their interest to the geologist, as establishing the fact of changes in the distribution of species, occurring in such very recent periods. He finds that out of twenty-seven species, the remains of which he has discovered in abundance, there are no less than five which do not exist at present within ten or twelve miles of the locality; nearly one-fifth of the entire number, which, so far as that immediate place is concerned, may be considered extinct at present. The fact of even this local disappearance of species is important.

Again, as bearing on the laws of the present distribution of shells, a brief paper* by Captain Thomas Hutton, on some land and fresh-water shells from Affghanistan, offers some points of great interest. Among twenty-four, which he found, four are stated to be British or north European species, viz.—*Succinea putris*,
„ *Pfeifferi*,
Limnea peregra,
„ *truncatula*,
while some others are so closely allied, that he is inclined to think them only varieties of European species. If the identity of those mentioned be fully established, the fact is a remarkable one, for it must be remembered, that these are terrestrial and fresh-water molluscs, not marine.

We have to express regret, that the Ray Society has not, during the past year, issued any work to its subscribers.

The application of mineralogical studies to the more accurate description and examination of mineral aggregates, has engaged the attention of several geologists and chemists. To M. Delesse,† we are indebted for a memoir on a porphyritic rock with a base of felspar, which occurs in the (transition ?) group of Chagey, in the department of Haute Saone. This rock is a green porphyry, the base of which

* Jour. Asiatic Society, Bengal, July, 1849, page 649.

† Bull. de la Soc. Geol. de France, tom vi. page 383.

is a felspar, occurring in crystals, generally green, but of which the colour is often nearly as marked as that of the paste, so that the porphyritic structure of the rock is not always well characterized. On exposure, the first effect produced, is to give a red colour to the felspar, after which it kaolinizes. Its density (mean) is 2.736, and its hardness less than 6. The crystals appear to be macles, but are not well defined, the felspar belonging to the last crystalline system. Its composition was found to be—

Silica, ...	59.95	61.71
Alumina, ...	24.13	25.44
Peroxyde of Iron,......	1.05	
Protox of Manganese,	traces	traces
Lime, ...	5.65	4.79
Magnesia, ...	0.74	2.98
Soda, ...	5.39	2.74
Potash,..................	0.81	
Water, ...	2.28	2.34
	100	

Taking away the water of this felspar, we find that its composition is nearly that of *oligoclase;* but if on the contrary, we admit that water plays the part of a base in this felspar, and if it be further supposed that three atoms of water replace one of magnesia, according to M. Scheerer's ideas, the formula of this mineral would then be very nearly that of *Andesite.*

The density of the mass of the rock was found by M. Delesse to be higher than that of the contained felspar, being 2.759. The magnetic force is also high, being equal to 473: that of steel being represented by 100.000. The loss, by heating, of the mass, was more than that of the constituent felspar. An analysis of a portion of the paste, which appeared poorest in felspar, gave the results in the second column. These analyses give, then, extreme limits between which the chemical composition of the porphyry is confined, and they show that the extent of these limits is very slight. These results are analogous to those obtained by the same author for the porphyry of Belfahy; and he considers them common to all porphyries, having as a base, a felspar of the sixth system, associated with a certain quantity of Silicate of Iron and Magnesia. He considers this porphyry as a metamorphic rock, resulting from the action on the transition schists of a dyke of porphyry, similar in composition to that of Ternuay, which occurs near Chagey.

To the general proposition of M. Delesse, that the water which he finds in these felspars is water of combination, M. Deville objects, that the specimens examined were not transparent, and had not that purity which was essential before admitting them as a type of a new species of felspar, although he admits that the water exists. M. Durocher also objects, referring to results which he had previously obtained, in which he found that silicates, supposed anhydrous, even hyaline quartz, contain generally a 500th, or even a 50th part of water, which remains at a temperature of 100°. Felspars also contain more water in proportion as they are less transparent, are opaline or milky, or are less distinctly cleavable. He thinks that a case of diaphanous and colourless felspar, with brilliant faces, and constant angles in the crystals, is the only one which would justify a specimen being taken as the type of a new species, and supposes that in most cases the water which the felspars do contain, may be accounted for by a mixture of foreign substances, especially of hydrated silicates, analogous to zeolites. M. Durocher also thinks, that the perfect type of chemical purity cannot be met with in pyrogenous rocks, since their elements have been separated from a general magma, and have crystallized in contact one with the other. The pure minerals are met with in druses and veins; here we frequently find the summit of the crystal quite different from the base, and crystals showly forming from an aqueous solution, acquire a greater purity, than those which crystallize from a state of igneous fusion. In the latter case the reciprocal, or mutual interlacing of the crystals, show that they have crystallized nearly at the same time; and consequently the isolation of the particles of different natures could not, as M. Durocher supposes, be perfect. Experiments also proved to him, that several silicates, felspar among the number, when exposed for a long time to moist air, take up or absorb a small quantity of water, which is not parted with at 100°.

These objections have elicited from M. Delesse a general discussion of the question of the presence of water of combination in felspathic rocks. The fact of water occurring in such rocks is unquestionable; but the question is, is it in the state of combination or not? Is it cotemporary with the formation of the rock, or posterior to it? If posterior, it may be either—1st, hygrometric, or 2ndly, derived from a pseudo-morphosis, or a decomposition.

The large amount, from 1 to 3.15 per cent. proves that it is not hygrometric water; nor is it water absorbed in the quarry; which would be given off, when dried. If due to a decomposition, then the loss by heat would be greater or less in proportion to the amount of the drying; but this was not the case, as the loss of the felspars was the same, with very slight variation, both before and after desiccation for many hours, in a sand-bath below 100. Felspars also, in the first stage of decomposition, or rubefaction, sometimes contain less water, but never more; when kaolinized they contain much more, but then they lose their crystalline form, and break up. The hardness and cleavage of the felspar remaining constant, show also that there has been so pseudomorphosis. Admitting, therefore, that the water is not posterior to, but cotemporary with the formation of the rock, two hypotheses still remain.

1. Is this water derived from an intimate mixture of some hydrated mineral? or

2. Is it water of combination essentially belonging to the mineral in which it is found?

The first hypothesis has been generally admitted up to the present. The water in basalts and traps has thus been generally attributed to a certain quantity of zeolite. In some cases this has been considered to be Thompsonite, in others a mixture of nepheline and mesotype, in others, different again; and thus, although basalts are remarkably constant in their aspect, the zeolite mixed with them would appear very variable. M. Delesse had already proved that the melaphyres contain not less water than the basalts;* but the best characterized melaphyres contain no zeolites at all; and where the latter do occur, they are found only in druses and cavities. The minerals, however, which occur in these druses, are quite different from those found in the paste, and their occurrence in one place by no means proves their occurrence in the other; and in reality, none of the minerals found in these druses occur in the paste, (such as quartz, chlorite, epidote, carbonate of lime, zeolites.) Again, if zeolites form a portion of the paste, when it was subjected to the action of acid, a jelly of silica would

* Annales des Mines, tom xii., 4e serie.

result, and readily, owing to the minute state of division of the silica, but this is not the case. Basalts, thus attacked, do occasionally give a jelly, but this may be from a mixture of peridote. The mere fact of a rock being attackable by acid, without leaving a jelly of silica, does not at all prove the existence of zeolites. Supposing, too, for a moment, that the water is derived from such a mixture of zeolites, and that these contain even so much as ten per cent., (as natrolite,) since the labrador-felspar of the melaphyres often has two per cent., occasionally four to five per cent. of water, there must be a mixture of one-fifth to two-fifths of zeolite. Nor is the felspar the only mineral which contains water—but the augite also. In the porphyry of Ternuay, an asparagus-green augite has 2.26 of water; or granting this hypothesis, is in other words mixed with one-fifth of zeolite, and yet these felspars and augites, have remarkably well defined cleavages, much too distinct and neat to be possible, if there were twenty to one hundred per cent. of foreign matter mixed with them. They are translucent, occasionally transparent, and have a uniform tint. Besides the felspars in the syenite of Ballon d'Alsace have 1.30 per cent. of water, and that in the granite rocks of the Vosges, and Brittany, and Normandy, nearly as much. Now, the presence of water in these felspars can be even less attributed to a mixture of zeolite in these granitoid rocks, than in the others.

Therefore, M. Delesse concludes, from the mode of occurrence of zeolites in rocks—from the absence of any siliceous jelly, when subjected to acid—and from the perfection of the crystals containing water, that it is impossible to admit that this water is derived from an admixture of any foreign substance; and that we are therefore compelled to admit that the water of felspathic rocks is water of combination peculiar to each of the minerals in which it is found.

Taking the whole series of unstratified rocks, the author finds that nearly all contain water of combination in different quantities. In granites and syenites it occurs, but in very small quantity, not more than one per cent. In porphyries, basalts, melaphyres, euphotides, &c., we have several per cent. Or taking the ordinary minerals which enter into their combination, we have for mica as much as several hundredths sometimes, but very variable. Amphibole and hypersthene contain a very small amount of water—sometimes more. Diallage sometimes three per cent. or more; augite 2.75—(the varieties containing most water generally have a clear green colour.)—the felspars vary much—orthose seldom has any: never more than a few thousandth parts; while felspar, of the sixth system—saussurite, labrador, andesite, oligoclase, even albite and pericline have several per cent., the amount varying inversely with the amount of silica. The author had previously pointed out the peculiar characters of these felspars. They have a fatty lustre, and waxy fracture; cleavage is less distinct, and their density is greater than when there is no water; and they are, further, much less resistant to acids.

These memoirs of M. Delesse, on the rocks of the Vosges district, although we must express a doubt that his conclusions have been drawn from too few and too individual cases fully to justify him in drawing such general conclusions as he has from them, are extremely important as giving the results of careful analyses, not only of the mass of the rocks, but also of the constituent minerals.

The same author has undertaken, and largely carried, out a perfectly novel kind of research into the magnetic force,* (le pouvoir magnetique) of minerals and of rocks; and these researches he has extended considerably during the year. He has examined the oxydes of iron, and finds that the force of oxydulous iron ($\dot{Fe}\ \dddot{Fe}$) varies from 64.121 to 15.750, being greater in proportion as the crystallization is more perfect. Of titaniferous iron, $\dot{Fe}$ ($\dddot{Fe}$, $\dddot{Ti}$) within even greater limits depending partly on the amount of titanium, as from 50.000 to 10.000. In chromate of iron it is much less, not being more than 136. Thus, the magnetic force in these oxydes is (all other things being equal) in proportion to the amount of the sesquioxyde of iron, it has its extreme limit in oxydulous iron, and diminishes through titaniferous iron, franklinite, chromate of iron, to spinelle and pleonaste.

Again, the same author states that the protoxyde of manganese has a force equal to 24

The red oxyde, 43

Peroxyde, 56

So that the force increases with the amount of oxygen—a paradoxical result. All the sulphurets, antimoniurets, and arseniurets, (excepting magnetic pyrites,) have a value less than 100—as also the

* Comtes Rendus, tom xxviii., page 227. Annales de Chimie, Jan. 1849, page 148.

phosphates and arseniates—in quartz it is little or none: felspar and mica also very slight. The author concludes from these researches, that as the magnet is known to have a certain influence on all bodies, as Faraday and Plücker have shown, so, that all bodies have a certain magnetic force, which, varies most materially, and in some degree with their crystalline state.

Applying the same method of research to the rocks,* the author gives the results of his examination of twenty-nine varieties of volcanic rocks, lavas, &c., of thirty-six varieties of basalts, porphyries, melaphyres, serpentines, chloritic rocks, &c.

The basaltic rocks—even those containing very little oxydulous iron—have a force two or three times greater than the mean force of modern lavas. The magnetic force of basalts ranges between 1,500 and 3,000; that of lavas between 350 and 1,500, but more generally between 600 and 900. Of serpentines the magnetic force is very variable. The amphibolic rocks have a very low force, even below 100, sometimes scarcely sensible—stratified rocks also, generally speaking, have a low force. This force does not depend on the presence or absence of oxydulous iron, but is a real physical quality, which all rocks possess in a greater or less degree; all varieties of the same rocks, no matter whence derived, agreeing very well in the magnetic force which they exhibit. M. Delesse thinks, that from such results, knowing the geological structure and constitution of a district, it would be possible to determine by calculation the deviation of the needle relatively to the meridian of that place.

As might be expected, when we remember the excitement caused by the first announcement of the discovery of considerable quantities of gold in California, and the sustained interest which the arrivals from that country have maintained, there have been, during the year, several analyses published of this gold; and the general question of its distribution and character has been discussed. M. Dufrenoy has given the results of a comparative examination of the auriferous sands of California, of New Grenada, and of the Ural Mountains. The little plates of gold from California are much larger than those from the Ural or from Brazil; and they are also distinguished by their reddish colour.

* Annales des Mines, tom xv., 4th series, page 497.

The gold sometimes adheres to white milky quartz, much rounded, and evidently having been subject to great friction; there are also schistose fragments, both of which facts shew that the original source of the gold is in granitoid schists. The general colour of the sands is black, from magnetic iron; there are besides titaniferous iron, oxyde of manganese, crystals of white zircon, (both ends perfect,) also quartz, (hyaline and smoky,) and some fragments of blue corundum. The crystalline state of the titaniferous iron and of the zircon, (which, though usually a rare mineral, is here abundant,) show that they have not travelled far.

The New Granada sands are more grey than black—they contain less iron—more zircon—the quartz is but little rolled; sometimes both extremities remain: the sand altogether is less rolled than that of California. In the Ural sands there occurs cymophane. Estimating the proportion of each of these by actual separation, there resulted for the sands from,

	California.		New Granada.	Ural.
Magnetic iron,...............	59.82		34.35	23
Titaniferous iron, Oligiste iron, and traces of Oxyde of Manganese,	16.32		15.0	50
Zircon,.........................	9.20		20.00	3
Quartz Hyaline, ...	13.70		25.0	14
Corundum, ...	0.67		7.0	Cymophane 10
Gold, ...	0.29	Various rocks,	4.65	

Though a rough approximation, this is sufficiently near. The sands of the Rhine gave very similar results with a slight variation. The author remarks on the absence of spinelle in the auriferous sands which he has found in stanniferous sands from several places; and asks, can we conclude that this mineral belongs to crystalline rocks of an earlier date than those containing gold?

M. Dufrenoy then enters on some calculations to show that the Californian gold region, even allowing the truth of the high estimates which have been made from first washings, is not much richer than the Ural, and that the discovery of gold there will not, therefore, in all probability, produce any important revolution in mining industry.

M. Rivol* has analysed several specimens of gold from California, and the mean of all his results gave—

Gold,	90.87
Silver.	8.60
Iron,	.10

Mr. Henry also, in March, 1849, gave analyses of Californian gold as below:—

Gold,	90.01	....	86.57
Silver,	9.01	....	12.53
Copper,	0.86	with traces of iron,	0.29
Iron,		....	0.54
	99.88		99.73

The specific gravity was 15.96.†

M. Teschemacher‡ also gives an analysis of Californian gold, of which the result was—

Gold, ...	90.63
Silver, ...	1.00
Oxyde of iron,	6.80
Copper, ...	0.66

The specific gravity was 16.33. If the iron, &c. be deducted, we have an alloy of gold 92., silver 7.

The question whether the gold and silver are combined in the atomic proportion has been entered upon by M. A. Levol,§ who gives numerous analyses which he had made during twenty years, without having this object in view; and from the discussion of his results, he thinks it established, that, generally speaking, gold and silver are found united in such proportions that they can be reduced to atomic formulæ, although at the same time they present themselves also in an almost endless variety of proportions.

The occurrence of gold, though in very small quantity, has also been proved,‖ in the copper mines of Chessy, (dept. de Rhone.) The ores here have, besides sulphur, iron, silica, and arsenic, some eight per cent. of zinc, and five per cent. of copper, and about $\frac{1}{10,000}$ of gold, which it is thought may be extracted profitably by the adoption of a peculiar process.

* Annales des Mines, tom xvi. page 127.

† Phil. Mag. March, 1849, page 205.

‡ Jour. Chemical Society, London, October, 1849, page 193.

§ Annales de Chemie, tom xxvii. page 311,

‖ MM. Allain et Bartenback, Comtes Rendus, tom xxix. page 153.

M. Daubree* has made some very interesting experiments on the artificial productions of minerals, adopting the same mode of research, as had already yielded such important results to Sir James Hall, Berthier, Mitscherlich, &c. He had been led to some considerations of this kind, by the study of veins of tin and titanium, and he had been convinced that fluoric acid played a very important part in the production of these veins. Besides tin, these deposits frequently contain fluo-silicates, such as mica, lepidolite, topaz; boro-silicates, as tourmaline and axinite; fluophosphates, as apatite; and the principal circumstances of the structure and composition of stanniferous veins, would be explained by supposing that vapours, containing fluoride of silica, of boron, and of phosphorus, came at a high temperature from below. To imitate this process was, therefore, M. Daubree's object; and he therefore caused two currents to pass through a porcelain tube, heated to a white heat; one of vapour of perchloride of tin, the other of vapour of water. Mutual decomposition readily took place, and the interior of the tube, towards the extremity, where the two currents entered, was covered with well formed, crystallized, and very brilliant crystals of oxyde of tin; the central and strongly heated portion had no deposit, and the other end only an amorphous deposit of oxyde of tin, which was also found abundantly in the tube of glass, united to that of porcelain. The crystals were colourless and transparent, except a few, which were brown, and they had all the adamantine lustre of natural crystals; and they differed only from the natural oxyde of tin in being colourless, having no oxyde of iron associated. In form they were right rhomboidal crystals, very flattened; while the natural crystals of oxyde of tin are derived from a right octahedron, with a square base. The oxyde of tin appears, therefore, a new case of dimorphism. This artificial oxyde of tin is also isomorphous with oxyde of titanium or Brookite; but native oxyde of tin is isomorphous with Rutile; and thus Rutile, Brookite, and Anatase, having been shown by Henry Rose, to be only titanic acid with oxyde of iron, it follows, from these experiments, that the two forms of oxyde of tin correspond with the two forms of oxyde of titanium. And this correspondence furnishes a new example of the close geometric relation

* Annales des Mines, tom xvi. page 129.

which generally unites the primitive forms of a dimorphous body, as in the case of carbonate of lime, of magnesia, &c.

The density of the natural or octahedral oxyde of tin is 6.80 to 6.96. The density of the artificial or Rhombic tin is 6.72. Similarly with Rutile and Brookite, the former has a specific gravity of 4.291; the latter of 4.128 to 4.167; so that the form of the square prism co-exists with some molecular condition, conferring a higher density than the form of the right rhombic prism.

Similar results were obtained by operating with chloride of titanium—very minute crystals of titanic acid being formed in the tube; these were two minute to measure, but appeared to be of the form of Brookite, that is of the same form as the artificial oxyde of tin. Similar results were also obtained from fluo-silicic and chloro-silicic acids, the deposits in both cases being silica, with a glassy structure and fracture: in the case of the fluo-silicic acid, it was fibrous. The crystals adhered very strongly indeed to the sides of the tube, as they do in nature to the rocks.

Having established these experimental results, the author proceeds to apply them to the explanation of his views in nature, and describing the structure and composition of veins in various countries, shows that there is a mutual interpenetration of the crystals of rutile, of fer-oligiste, and of quartz, which proves that they have been formed if not at the same moment, at least under the same conditions. This interpenetration is well known to mineralogists.

Knowing, then, that the fer-oligiste of volcanic countries is due to the decomposition of chloride of iron, by the vapour of water, a similar origin may be, he thinks, attributed to the fer-oligiste of the titaniferous veins; and that all these minerals result from the decomposition, by the vapour of water, of their respective chlorides or fluorides. The presence of fluoric combinations is supposed to confirm the supposition, such as fluor-spar, fluo-silicates, (mica) fluo-phosphates, (apatite) boro-silicates, (axinite, tourmaline.) We have beside, hydrated silicates, such as chlorite, and occasionally zeolites, tending to prove that water has had an important part to play in the filling of these titaniferous veins.

In a few exceptional cases, the fluoride of titanium has been, as it were, withdrawn from this decomposition, as in the Warwickite of New York, and the Eremite (of Dana) in Connecticut.

The author further presses the idea, that if this be the origin of such deposits, fluoric acid must have been more widely diffused, and have played a much more important part than is generally supposed. He thinks also that such experiments may tend to throw much light on the metamorphism of rocks.

In connexion with these researches of M. Daubree, we may mention an interesting paper on Arkansite, by Messrs. Damour and Descloizean. This mineral, it is known, presents an iron grey colour with a metallic lustre, similar to that of oxydulous iron. Its density is 4.030 in crystals, 4.083 in fragments. The crystals are generally dodecahedrons, with isosceles triangles, but the measurements show that they belong really to a right rhombic prism, modified.

On a careful comparison of their form, and its usual modifications, (the details of which are given) the authors were led to see that it was identical with the form of Brookite. Analysis also showed the close relation in composition. On the other hand, Brookite is well known to be totally different in external characters. It is found in very flat crystals, often small, transparent, of a red brown colour, with a vitreous fracture, and yielding a yellowish white powder, instead of cinder grey, as in Arkansite.

Now if a crystal of Brookite be placed for a few moments in the inner flame of a blow-pipe, it loses its transparency, and assumes the aspect of a little plate of iron. After this operation it has also a vitreous fracture and a metallic lustre, and its powder also becomes grey, exactly like the lustre and powder of Arkansite. The same is the result of heating it on charcoal; but it does not change its aspect when heated in a tube. These facts would all tend to prove that the crystals of Arkansite belong primarily to the species known as Brookite, but that they have been in some way subjected to a high temperature, with the disengagement of hydrogen, or bituminous vapour. Under this influence they have undergone a slight reduction, by losing a part of their oxygen, and have assumed a different external character without altering their form.

Rutile suffers the same change exactly, increasing in density. Now M. Ebelmen had already shown that titanic acid could be changed into sesqui-oxyde of titanium, by exposing it to the action of a current of hydrogen, at a high temperature.* The author therefore concludes that Arkansite is a compound of sesqui-oxyde of titanium and of titanic acid, arising from a chemical alteration of crystals, originally belonging to the species known as Brookite.

M. Whitney, in America, had also examined the Arkansite, and found its composition as above, thus upsetting the notion of Shepard, that it was a niobate; and also stated, that it had the crystalline form and density of Brookite.†

Professor Miller, of Cambridge, also examined the crystallographic identity of the two;‡ and Rammelsberg made the same statement, and gave the details of the measurement confirming it; and he also published careful analyses of the mineral, from which he came to the conclusion, that Arkansite had the crystalline form of Brookite, and the specific gravity of Anatase; it was therefore only a variety of Brookite.§

Bearing on the same subject, is the discovery of Woèhler, that the cubic crystals found in the slags of iron furnaces, and hitherto supposed to be pure titanium, really contain cyanide and nitruret of titanium, having eighteen per cent. of nitrogen, and four per cent. of Carbon.||

M. Damour has analysed a new specimen of the rare mineral Periclase, which was first discovered and described by Professor Scacchi, of Naples. The previous analyses had given only an anhydrous magnesia and oxyde of iron, and had excited considerable doubt as to their accuracy, it being difficult to conceive how such an oxyde of magnesium, with marked alkaline properties, should exist in nature in a state of purity, in distinct crystals, and yet not decomposed. The discovery of a considerable quantity of this mineral in a block, at Monte Somma, gave M. Damour an opportunity of examining it carefully. It is found disseminated, both in small irregular grains, and in cubes and well marked octahedrons, in a mass of white

* Annales de Chimie, tom xv. 3me serie, p. 385.

† Silliman's Journal, No. 21, vol. vi. page 433.

‡ Phil. Mag. July, 1849, page 75.

§ Ueber die identitat, &c., Poggendorff's Annalen, vol. lxxvii. page 586; see also Pogg. Annalen, vol. lxxii. pages 123, 302, and vol. lxxviii. page 143 for other papers on the same subject.

|| Comtes Rendus, tom xxix. page 505, 5 Nov. 1849.

lamellar carbonate of lime. The results of two analyses are given, (the processes employed being detailed at full,) and the mean of these yield—

Magnesia, ...	93.62
Protox of Iron,......	05.99
	99.61

The specific gravity is 3.674. Is then the protoxide of iron only an accidental colouring matter, or is it essential to the crystallization of the Periclase? If the latter, the formula representing Periclase, will be—

$$24\ \dot{Mg} + \dot{Fe} \quad \text{or}$$
$$24\ (Mg + Fe) + 25\ O$$

It appears most probable that in Periclase there is native magnesia crystallized, containing a small portion of isomorphic protoxide of iron, just as in Corundum we have alumina, in quartz silica. The gangue of the periclase is a mixture of carbonates of lime and magnesia, in the proportion of four of the former, and one of the latter.*

The same chemist has re-analysed the sapphirine, and found results quite confirming those of Stromeyer who first examined this mineral. The specific gravity was a little higher, being 3.473.†

We have had two valuable communications brought before this Society, during the past session, on the analysis of minerals. Mr. William Mallet has shown by a very careful, and well described analysis of Killinite, that the specimen on which he experimented, and which appeared a good typical specimen of the Killinite, differed considerably from those previously analysed, and presented the interesting fact of containing lithia to a sensible amount, and establishing its distinctness from Spodumene. For the details of this communication, I must refer you to the journal of the Society.‡

Another was from Mr. Sullivan, on the composition of some mica, obtained from the altered rocks in junction with the granite, at Glenmalur, in the County of Wicklow.§

* Bull. de la Soc. Geol. France, 5 March, 1849.
† Bull. Soc. Geol. France, 1849, page 315.
‡ Jour. Geol. Soc. Dublin, vol. iv. page 142.
§ Jour. Geol. Soc. Dublin, vol. iv. page 155.

For the knowledge of the processes adopted in the analysis, and the detailed numerical results, the accurate description of Mr. Sullivan must be consulted; but I may notice here the interesting fact established by this examination, that the mica, which was biaxial, contained 2.506 per cent. of soda, with only traces of the oxides of Chrome, with Fluoric, Boracic, and Phosphoric acids, (the latter possibly accidental.) Mr. Sullivan discusses the mode of occurrence of these, and has promised the results of the analyses of a more extended series of micas, on which he is engaged. The total absence of lithia in that examined is also deserving of notice.

Professor Silliman has shown by analysis that the Indianite of Bournon, the matrix of the Asiatic Corundum, is chemically the same as Anorthite.*

August Stromeyer† has shown the occurrence of oxide of nickel in Serpentine and talc:—

In the bright green serpentine, (precious) of Röraas, there was	0.45 per cent.
Sundal.........	0.304
In the dirty yellow common serpentine of Röraas,............	0.32
" " Saxony,..............	0.22
In the bright green talc of Röraas,..............................	0.40
Sell,................................	0.48
Throndjem,........................	0.23

Dr. Leeson has continued his researches on crystallography in a paper on Isormophism, and on a general simple law governing all crystalline forms, in which some new views are announced.‡

The recent statements by Malaguti, Durocher, and Sarzeaud,§ with regard to the presence of lead, copper, and silver in sea water, and of silver in organized bodies, must naturally excite attention. The water was from the sea at St. Malo, and the fuci examined from the same place; the ashes of these *(fucus serratus* and *ceramoides,)* contained $\frac{1}{100.000}$; the water only $\frac{1}{100.000.000}$ of silver; they state also that salt and all its artificial products contain silver. In the ashes of fuci they have found $\frac{18}{100.000}$ of lead, and a little copper; so that

* Silliman's Journal, Nov. 1849.

† Nyt. Magazine fur Naturvidenskaberne, Christiania, vol. vi. No. 1, 1849.

‡ Jour. Chem. Soc. of London, 1849.

§ Comtes Rendus, tom xxix. No. 26, page 780.

these metals also are concluded to exist in the medium in which these plants live.

The extreme caution requisite in such experiments, when the reagents used may possibly have been lying exposed in a laboratory used for general analysis, or have been subjected to other sources of impurity, is known to chemists; and an instance of it may be referred to in Mr. Arthur Phillips' analyses of the ashes of coal, (analyses undertaken with a view to test the truth of statements, made with regard to the occurrence of lead, and copper, in such ashes,) in which he found no traces of lead and copper, but on testing the distilled water of the laboratory found, that it darkened with sulphuretted hydrogen.*

Rammelsberg has issued a fourth supplement of his very valuable dictionary of the Chemistry of Mineralogy.† And Bischof has continued his very important contributions to the chemical and physical portion of geology, in which he discusses the history of Augite, of Diallage, Bronzite, and Hypersthene, of Augitic rock, of Olivine, and of Basalt.‡

During the year the Cavendish Society have issued two additional volumes, (two and three,) of Gmelin's Hand-book of Chemistry, a very carefully executed translation by Mr. Watts, who deserves much praise for the conscientious manner in which he has performed a task of no small labour, and has used his best efforts to bring up the information contained to the last moment.

The question of the origin and mode of formation of dolomites, has continued to engage the attention of several enquirers. Among others, Professor Favre of Geneva, has discussed the origin of the dolomites of the Tyrol,§ adopting as the basis of his hypothesis some experiments of M. Marignac. In these some carbonate of lime, and a solution of chloride of magnesium, were placed in a strong glass tube; the tube sealed hermetically, and subjected to a temperature of 200° cent. during six hours; the result was the formation of a dolomite, or a double carbonate of lime and magnesia, containing a larger proportion of magnesia than a true dolomite.

* Quar. Jour. Chemical Society, London, April, 1849, No. v. page 1.

† Handwörterbuch des, &c., Viertes supplem. Berlin, 1849.

‡ Bischof, Lehrbuch des Chem. ünd Physic. Geol. 11 band 3 heft.

§ Biblio. Univ. tom x. page 177; also Comtes Rendus, March, 1849, page 364.

Repeating the same process, but continuing the high temperature for only two hours, a limestone slightly magnesian was the result; showing that time was one circumstance important in the question. There would appear, therefore, to be requisite for the production of dolomite in this way—1st, lime; 2nd, sulphate of magnesia, and chloride of magnesium; 3rd, temperature of 200° cent.; and 4th, a pressure equal to 15 atmospheres, or from 450 to 600 feet of sea water.

M. A. Favre, adopting these results, points out the probable concurrence of all these circumstances in the case of the dolomites in the Tyrol. There are here, however, two kinds of dolomite, one compact, the other cavernous: the former, the author supposes to have been originally deposited; the other, to be the result of alteration—an alteration, which he thinks took place almost immediately at the time of their deposit; or, as it were, a nascent metamorphosis. He supposes, further, that the fact of the connexion between the occurrence of dolomites, and the eruptive porphyries is due, not so much to any subsequent change, but to the more abundant deposit or formation of magnesian limestone around these centres, from the reactions there occurring having produced the magnesian character, while ordinary limestone was being deposited in other parts. The saccharine and crystalline dolomites he views simply as the result of the fusion of a magnesian limestone, not of any sublimation of magnesia; while the sulphate of magnesia being decomposed by the carbonate of lime, and this reaction taking place when warm, the sulphate of lime resulting would be in the anhydrous state, and thus we have an explanation of the occurrence of anhydrite.

Mr. James Bryce, junr., has given the results of careful quantitative analyses of the altered dolomites of the Island of Bute, his description of which I had the pleasure of noticing in last year's address.*

These analyses, carefully executed by Dr. R. D. Thompson, fully bear out the unexpected and interesting facts stated by Mr. Bryce, that the igneous action in the cases referred to, has driven off the magnesia from the limestone; the portion altered by the dykes, containing a much smaller proportion of magnesia than that which is unaltered.†

* Jour. Geol. Soc. Dublin, vol. iv. page 103.

† Philos. Mag. August, 1849, page 81.

Relating to the application of geological principles to practical pursuits, there have been published, during the year, some few valuable contributions.

In a detailed communication* on the iron deposits of the departments of Aveyron, of Lot, &c., M. Coquand, enters on a minute description of the general mode of occurrence and character of the beds worked. The chief supply is derived from the jurassic group, consisting of *fer hydroxide compacte,* mixed with a considerable proportion of carbonate of lime, and *fer hydroxide oolitique,* (pisolitic iron.) The latter is the most abundant, and occurs not forming beds of any great or continuous extent of surface, but small well-marked islets, as it were, in which the richness of the mineral increases towards the centre, and gradually dies away towards the edges. These are quite free from phosphorus, sulphur, and arsenic, and yield iron of the best quality. They occur in compact masses in red clays; in rognons of a variable size, with rounded surfaces; in grains, cemented by a clayey paste; and in pisolitic grains, in the cracks of the secondary rocks. Besides these, there are deposits of iron hitherto called alluvial, (but which M. Coquand has shown to be tertiary,) some of which are remarkable, as being almost entirely beds of fossils, (as *Gryphœa cymbium,*) and as containing, derived from these organisms, two to three per cent. of phosphoric acid.

The author gives a very full account of the circumstances under which these deposits are found and worked; and enters at large upon the question of the age of the beds, in which they occur, showing that they rest unconformably upon the Eocene and Miocene, and that they form the upper portoin of the tertiaries of the south-west of France; and that this position, established stratigraphically, is confirmed by the fossils found in them.

From M. Durocher, we have obtained a detailed, minute, and valuable description of the metalliferous resources of Sweden, Norway, and Finland. His memoir, which, however, offers too much detail, to be analysed here, treats fully of the position, structure, character, and origin of the several veins or beds, and of the geological constitution of the rocks and country where they occur.†

* Bull. de la Soc, Geol. de France, March, 1849, tom vi. page 328.

† Annales des Mines, tom xv. 171.

M. Riviere, has given a description of the rocks, and contained metallic veins of the Rhenish provinces, in the district included between the neighbourhoods of Coblentz and Dusseldorf, on the right bank of the Rhine.*

The country is composed almost exclusively of grauwacke rocks, with here and there some tertiary deposits, and some igneous rocks. The metals occurring in the veins, are zinc, iron, lead, copper, silver, arsenic, nickel, &c.; principally iron, zinc, copper, and lead, chiefly in the state of sulphurets, and carbonates. It is stated that there are two principal systems of these veins, varying in composition, in direction, and probably in age. Now, the cleavage of the rocks is frequently not coincident with the bedding, and it is stated that the veins of the first system, composed of quartz, blende, galena, siderose, and traces of sulphuret of copper generally accompany the cleavage, and conform to it, while the others are more independent, and cut the bedding.

After a detailed account of the works undertaken in several of these mines, and of the extent, direction, and character of the several explorations, the author passes to some general considerations on metallic veins.

All veins of blende hitherto studied, are united by general relations. They are sensibly parallel, and have a mean direction of east north-east, and west south-west. At certain points they are nearly parallel to the cleavage of the greywacke, while at others they cut this at various angles, and have inclinations different from that of the grey-wacke. The cleavage in many cases is different in direction from the beds, so that when the veins appear to be sometimes parallel to the cleavage, it is because they have gone in the line of least resistance, or because the secondary fractures have been determined with greater facility in the direction of this cleavage.

The veins, then, being true veins, resulting from the cracks arising out of parallel dislocations, and their general directions corresponding to that of the enclosing rocks, these fissures are probably due to the same system of dislocation which has raised the grey-wacke. The ribboned character of the veins seems to shew that the filling in of them was subsequent, and at successive periods.

* Bull. de la Soc. Geol. de France, tom vi. page 171.

He thinks that veins having different directions may nevertheless be of competoraneous formation, and be of the same nature; and, while not altogether maintaining it in every case, he thinks the connexion between the age of veins and their composition, worthy of much more attention than it has hitherto received: believing, that there does exist some general relation between the direction of veins, (properly so called,) the nature of the materials of which they are composed, and the epoch of their formation. He gives many instances in support of this view, and concludes by maintaining, that the older, and transition rocks, are the natural locality of metals, and that they occur, in the other rocks, principally as the result of a displacement or change of their nature, more or less complete.

Among the more curious applications of geological investigations, we would refer to the interesting enquiries of M. Boubeé, on the geological conditions of the cholera.* At the first invasion of this fearful disease in 1832, M. Boubeé had remarked that several places were severely attacked, and others escaped; and he had consequently undertaken many researches to ascertain whether this fact had any connexion with the geological nature of the soil, &c., being the more induced to consider this, by observing, that in many countries where endemic diseases prevailed, the limits of the area over which they spread, are frequently marked out by the limits of the geological formations, so that each geological formation constitutes, as it were, a natural locality for peculiar morbid affections, such that the medical constitution of a country depends in some way on its geological and topographical constitution. He points out the remarkable influence which the nature of the soil has on the absorbent powers, and dryness of the ground—on the coldness or heat—on the nature of the gases evolved; and further, the nature and amount of the mineral or organic matter taken up by the waters used for drinking, cooking, &c. And referring to the cases of goitre, confined chiefly, as we pointed out last year, to countries where the waters used contain magnesia—to the greater prevalence of pulmonary pthisis in countries where the soil is calcareous—he states that the cholera has shown itself with much greater virulence in those countries which are occupied by easily disintegrated rocks, and in general terms, by

* Bull. de la Soc. Geol. de France, tom. vi. page 540.

tertiary or alluvial deposits, extending itself with less intensity in countries where the older and harder rocks exist.

In confirmation of this idea, numerous localities are referred to by the author, and the circumstances appear fully to support his hypothesis.

In fact this case is only one out of many which might be quoted as evidencing the importance of an accurate knowledge of the structure of any district, before determining on the measures desirable to be adopted for its drainage, improvement, &c., if already inhabited; or in the case of new countries, before determining on the locality and site of town or settlements.

Bearing on some of the most important questions in physical geology, we have had two short, but valuable papers, from Mr. Hennessy,* during the year. In one, "on the changes of the earth's figure and climate, resulting from forces acting at its surface," the author has pointed out how inexplicable the observed phenomena of the earth's figure, and of the variation of gravity at its surface would be on the hypothesis of the earth's primitive solidity; and in the subsequent one, "on the variation of gravity at the earth's surface," he further shows, that this hypothesis entirely fails to explain the secular refrigeration of the earth's surface, its observed ellipticity, and the variation of gravity.

Mr. Hennessy has also communicated to the Royal Irish Academy, (Proceedings vol. iv. page 333,) a valuable paper, "on the influence of the earth's figure, on the distribution of land and water, at its surface;" and a second part of his researches in physical geology to the Royal Society of London.

All these papers forming portions of the same general researches, I regret that the details of the latter have not yet been published; and I must, therefore, omit any general notice of the author's results, as it would be obviously unfair to enter upon such an examination with the data now before us. Among the geological results, however, which Mr. Hennessy thinks to be established by his investigations, we may mention one or two—that the stability of the axis of rotation of the earth will progressively increase, as solidification advances—that the thickness of the earth's crust cannot

* Jour. Geol. Soc. Dublin, vol. iv. pages 139 and 147.

be less than eighteen, or more than six hundred miles, (a result very different from that announced by other investigators;) and also with reference to the directions of great lines of elevations, depending on the action of the pressures of the shell, and nucleus at their surfaces of contact, that inasmuch as observation as yet has not proved the existence of a zone of mean pressure, the directions of these lines of elevation must be comparatively arbitrary.

We trust that Mr. Hennessy will continue these very important researches, and extend their application to the explanation of geological phenomena.

I alluded last year to the promised "Manual of Scientific Enquiry," intended to be published by the Board of Admiralty, for the use and benefit of the officers of the naval service. This work has since appeared, under the able superintendence of Sir John Herschel; and in addition to the subjects more immediately interesting to the geologist, (and which are ably treated by Mr. Darwin, in a valuable and very suggestive paper on geology, Mr. Mallet, our late President, on earthquake phenomena—a paper characterized by the ingenuity and simplicity of the processes recommended for observers, Sir Henry De la Beche, on mineralogy,) we have short papers on tides and tidal observations, terrestrial magnetism, hydrography, astronomy, zoology, botany, &c., which together furnish an amount of information regarding the principal points deserving of observation, and the best methods of observing, that cannot fail to contribute largely to the progress of knowledge.

The connexion also of physical geography, with geological structure, is daily becoming more acknowledged and insisted upon; and the republication, in an improved form, and in an English translation, of Humboldt's "Aspects of nature," may be regarded as one of the evidences of this. We have also had a translation of Guyot's lectures, entitled, "The Earth and Man," and containing some original and eloquently expressed views.

The constant recurrence in foreign works, in the accounts of travellers, or in the descriptions of geographers, of very different and very various standards of measure, for the notation of vertical heights, must have been a frequent source of annoyance to every student. Thus, elevations will be found stated in English, in Paris, or Berlin feet—in metres, &c. &c., so that long, and sometimes troublesome calculations are required before any comparative results can be obtained. The desirability of some general standard being adopted, is, therefore, too obvious to be questioned; and it is with great pleasure we would direct your attention to a valuable communication by Miss Colthurst, presented to the Royal Geographical Society by Mr. Greenough, in which she has adopted and carried out this idea of a common standard, to which the measures of different countries can be reduced. The standard assumed by Miss Colthurst is the geographical mile taken at the equator; this being a fixed quantity universally known, and dependant upon the figure of the earth itself. By dividing each of these miles into one hundred parts, each part is equal to 60⅘ English feet; and taking five miles, or five hundred of these degrees or divisions, Miss Colthurst has constructed a scale from which, by simple inspection, the relative values of any elevations expressed in English, French, Bavarian, Danish, Swedish, Dutch, Spanish, Austrian, or Prussian feet, or Roman or Portuguese Palms, can be ascertained, as well as their value in the natural scale, adopted as the common standard.

It only now remains to apply a similar process to depths below, as well as to elevations above, the same level; and a general, simple, uniform, and philosophical term will be had as the standard to which all vertical distances shall be referred; the advantages resulting from which would be so great, that its general adoption is much to be desired.

The application of physical observations of another kind to geological research has been pointed out by M. Daubree,* who has reduced his long continued observations on the temperature of springs in the valley of the Rhine, at various heights above the sea, and springing from various rocks. He states as among his results, that springs at the same altitude have nearly the same temperature—that the decrease of temperature corresponding to elevations is not uniform—that the excess of temperature above that of the air increases with the elevation as it does with the latitude—and that all those springs which have a mean temperature more than 2° cent., above that of the place whence they arise, are from faults, or lines

* Annales des Mines, tom. xv. 4e serie, page 459.

of dislocation. The author, from these facts, is led to think, that the thermometer would form to the geologist, as it does to the mariner, a most useful instrument, in deciding the presence or absence of any fault in this way.

I have thus, gentlemen, very briefly, and very imperfectly laid before you a sketch of some of the most important communications brought forward during the past year, tending to advance the progress of our study. It would be impossible within the limits of an address to give even the slightest outline of all that has been done. The literature of geology so rapidly increases, that I cannot pretend to have even the time or the opportunity, busily engaged as I am, of becoming acquainted with such publications, much less the ability of laying clearly before you their contents. It would, besides, be but idle presumption in me to lay claim to such acquaintance with the numerous subjects which tend to illustrate our widely extended science, as would enable me to apprehend their full value, and succinctly to extract it for your information. I trust I have, however, been able to indicate a few of the more important subjects on which the attention of geologists has been fixed during the year; to shew some, at least, of the additions which have been made to our knowledge, and thus, to satisfy you that geologists have not been idle; that geology has not halted in its advancing progress; and that deeply as we have drank at the well of truth, its sources are still unexhausted and inexhaustible. And I shall, in however slight a degree, still certainly, have contributed to such progress, if I have been enabled to indicate, at the same time, any of those points on which additional evidence or illustration may be derived from Irish geology, and have thus stirred up to emulation in the race some of those I now see around me.

But, before concluding, I must crave permission, warmly and heartily to express my sincerely felt obligations for the high honour conferred on me, by the appointment to preside over you, and more especially at a period so critical in the history of the Society. That it was so, has made me regret that you were not guided by some one of more experience, and having more leisure at his disposal; while at the same time, the difficulties of the post only rendered the selection to fill it the more honourable.

But, gentlemen, its duties never could have been discharged without the cordial and kindly support and aid I have received from each and every member of your Council and Officers, and of the Society. The same partiality which led to my selection, has favourably acknowleged my weak efforts for your benefit, and overlooked my deficiencies; and the heavy debt of gratitude, which I had already incurred during my intercourse of many years with the Society, has been only increased by the more marked kindness, (if such were possible,) I have experienced as your President. It is also a great gratification to me, that by your allowing me to resume my former position as Secretary, in which I feel that my services can be of more advantage to your Society, you have given me another proof that my efforts, however feeble, have been received with kindness, and that my willingness and anxiety to promote your interest is not doubted, whatever my ability to accomplish those wishes may be.

It is now, gentlemen, my duty to resign this chair to Colonel Portlock, whose name is essentially connected with the progress of Irish geology—a well known and long tried friend to the Society—and under whose able guidance we cannot fail to advance. With this conviction, gentlemen, of the advantage which must accrue to the Society from the change, the duty of resigning would always be a pleasant one; but it is to myself a source of peculiar pleasure, when I find in the successor you have elected, him under whom I myself first used the hammer; my former master, my former and my present friend, to whose kindness I have been much indebted, and to serve under whom again, will recall some of the fresher enjoyments of my earlier years.