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THE

CALCUTTA JOURNAL

OF

NATURAL HISTORY,

CONDUCTED BY

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List of Errata.

Page.	*line.*	
187,	5,	*For* 'Astrobola', *read* 'Astrabola'
188,	7,	*For* 'abreading', *read* 'abrading'
——	25,	*For* 'ignious', *read* 'igneous'
191,	25,	*For* 'an', *read* 'An'
——	26,	*For* 'observing during', *read* 'observing an instance of this during'
192,	1,	*For* 'pegmatic', *read* 'pegmatitic'
193,	4,	*For* 'was', *read* 'being'
196,	15,	*For* 'fissures', *read* 'fissure'
198,	3,	*For* 'were highly', *read* 'were in lustre highly.'
362,	18,	Omit, '*the identity of*',
603,	14 from bottom, *for* 'Sophophorus', *read* 'Lophophorus'	
——	12,	*For* 'Biverra', *read* 'Viverra'
——	10 from top, and also line 3 from bottom, *for* 'ignatius', *read* 'ignitus'	

Plate viii. *omit,* 'soil calcareous' on the uncoloured portion of the map.

THE CALCUTTA JOURNAL OF NATURAL HISTORY.

" Warum ich zuletzt am liebsten mit der Natur verkehre, ist, weil sie immer Recht hat und der Irrthum bloss auf meiner Seite seyn kann. Verhandle ich hingegen mit Menschen, so irren sie, dann ich, auch sie wieder, und immer so fort, da kommt nichts aufs Reine ; weiss ich mich erst aber in die Natur zu schicken, so ist alles gethan."—Goethe.

" Why I after all prefer dealing with nature, is, because she is invariably in the right, and the wrong must needs be on my side. When I on the contrary deal with men, then they are in the wrong, then I myself, then they again, and so on continually, and it comes to nothing after all; have I however once found out the ways of nature, then all is right."

THE usual apology for being without a periodical in the metropolis of British India exclusively devoted to objects of science is, *that it would not pay.* This may be the reason, the only reason, why we have not long since had several philosophical publications in Calcutta, eclipsing those of Edinburgh, London, and other European Capitals. Without insinuating the existence of any more immediate cause for the above defect in our periodical literature, we must be permitted for the honor of the City of Palaces to doubt the accuracy of the one assigned, as nowhere are persons more liberal with their money on all public occasions, when interests of far less moment are at stake than those of science.

Without however having any serious design on the pockets of the public, we are disposed to put its taste to the test; and although the task could hardly have devolved on worse hands, we are determined to devote our pages solely to several departments of science, which at present only meet with a casual place in the Journals of this Presidency.

Although our Journal will be devoted exclusively to scientific objects, and particularly to the various branches of Natural History, it is hoped that if the multitudinous applications of these to useful purposes, mental as well as commercial, be taken into account, there are few whose tastes and interests will not be sufficiently concerned to give it their support.

The great object of the publication will be less to afford amusement than instruction; and above all, it will be our ambition to make known the Researches of Naturalists in subjects connected with Indian productions. With this view we shall bring together such facts as may be collected from time to time, and endeavour to keep before the public the exact state of the several subjects of inquiry, and the claims of those who are employed in them Having ourselves experienced the disadvantages of many who labour in the cause of science in the recesses of an Indian jungle, we shall therefore be the better able, both as naturalists and men, to appreciate results attained under disadvantages which can only be understood by those who have been exposed to them.

To answer all the above purposes to the full extent of our wishes, it would be necessary that the Botanical, Zoological, and Geological departments of our duties should be conducted by separate individuals. It is to be regretted however that circumstances at present are not such as to allow us to carry this wish into effect.

It would be impossible to define exactly the different subjects which will legitimately come within the province of our Journal, so as to lay down any rules for the manner in which they are to be treated.

There are however some subjects, such as Topography, Geography, Meteorology, Statistics, &c. which though not strictly within the province of Natural History, are yet so intimately connected with it as to render it impossible to exclude them, and indeed when well executed they form works of the very highest interest, and will, together with journals and miscellaneous observations of naturalists, be always acceptable.

Geology is so connected with Natural History as to be almost identified with it, since a knowledge of living forms cannot be accurately appreciated without reference to those that have become extinct, nor these last, which we owe to the observations of geologists, without reference to existing species. Geological descriptions of districts will therefore form a much desired object of our Journal.

The philosophical subjects of comparative anatomy and physiology have hitherto been hardly entered upon in India, although the exuberance of both the animal and vegetable kingdoms afford facilities rarely presented in other parts of the world for researches of this nature.

On the subject of Natural History generally, it would be presumptuous in us to offer any suggestions to the class of contributors whose support we shall endeavour to merit, particularly as we are indebted ourselves to some of the friends in question for the advice we are about to offer, which is this,—That the subject should always be as fully treated as possible, whether it be the description of a species or of a group; its previous history, its rank, its characters, its distribution, and its uses should all be attended to where practicable. A subject so treated will always be more or less finished according to the capacity of the naturalist. It often happens however that in India the want of books prevents the naturalist from treating so fully of the historical part of his subject as could be wished, and of comparing the results to which he has been led with those of others. These are points however of comparatively less importance than such as depend on observation, as they may be supplied by those who have the advantage of libraries and leisure. Remarks on the characters, uses, distribution, and habits, can only be derived from observations on the spot, and if overlooked in the first instance may remain for years and even ages unknown.

Such is also the case with regard to the structure of animals and plants, such as are only met with stuffed or dried in collections, as well as that of testaceous animals; in all such cases observations, and when possible drawings, made on the spot will be invaluable.

While we would be thus minute regarding many points which persons ignorant of natural history would regard as trifling, let us not be careless of other important matters connected with useful properties which the naturalist is the most likely person to discover.

Thus the geologist should never lose an opportunity of casting as much light as circumstances will admit of on the important question of coal and various other minerals. There are other objects to which the mind of the botanist and zoologist should in like manner be constantly alive. The causes of diseases, as the Goitre, Guinea-worm, Elephantiasis, and other complaints, which there are good reasons for supposing depend on circumstances which come within the province of the philosophic observer of nature, also hold out much encouragement to hope for important results, without interfering in any way with the more immediate object of his pursuits.

Having thus alluded to the objects to which we are to devote our pages, we may observe, that although these will be open to all communications calculated to improve our knowledge of any fact, it will be our duty to point out frankly, when necessary, our own opinions as to the manner in which the subject appears to us to be treated.

As two other scientific Journals have possession of the field, perhaps a word or two on the cause of our appearance may be necessary. With the "India Review" we are not likely to interfere, as the object of that work is chiefly the diffusion of popular science. The other, the "Journal of the Asiatic Society," is too closely identified with that institution to suffer from so puny a rival, were we even ambitious enough to dispute its claims to public favour; our field is altogether distinct, and although a new one, we doubt not that the labours of naturalists are sufficiently important to entitle them to a separate and independent organ. Indeed it has often been to us matter of surprise, that departments of science so important as those of Geology, Zoology, and Botany, should have been so long without a Journal of their own in India. The consequence is, that neither the importance of those pursuits, nor that of the persons devoted to them, is at all understood; and naturalists at length find themselves without any individual connected with the periodical press, or with the learned Societies on this side of India, at all competent to meet their wishes or their views, far less to promote the object of their pursuits. Under these circumstances we have reluctantly deviated from the less obtrusive occupation we had prescribed to ourselves, and are prepared to use our best endeavours to secure for Natural History the advantage of a Journal hitherto much required in India.

The next subject on which we have to offer our remarks, is the means by which our publication is to be supported. As to matter we shall have no scarcity, as we trust we shall prove ourselves worthy of the confidence of most of the naturalists in India. The only difficulty we now experience, is to fix the rate at which we are to tax the pockets of our subscribers. We have no desire to profit by the work—our great object therefore is that its price should be as low as possible. On the whole, we consider that a subscription of sixteen rupees per annum will not only cover the expenses of the Journal but allow a certain sum to stand over for the publication of Transactions of an "Academy of Natural Science," as proposed in our first article, should that or any similar plan for the formation of a Society in India be eventually carried into effect.

With regard to the latter object, little more need be said than this—That if contributors of valuable articles will merely state whether they wish them to appear also in the *Actæ* of our new institution, their wish shall be attended to as soon as our subscription list will bear the extra expense. In this way we might soon hope to get up the name of the proposed Society by the publication of a volume of Transactions, after which its course would be smooth and simple. At some future period indeed the geologists, zoologists, and botanists might find that the interests of their respective pursuits would be better attended to in separate institutions, and declare their independence of the first Society of Naturalists ever formed in India, just for the reasons we now quit the Asiatic and other Societies in Calcutta. Instead of regarding such movements or dissentions with jealousy or opposition, they are always to be hailed as favourable signs of the progress of knowledge, and of the advancement of Society to that elevated state of civilization, in which the human mind is brought to bear independently on distinct objects of research.

Prospectus of an Indian Association for the advancement of Natural Science.

The additional interest that objects connected with natural history and geology has assumed within the last few years, renders it desirable, if not altogether necessary, to examine how far an institution solely devoted to such objects would be calculated to facilitate the cultivation of those sciences in India. It cannot have escaped those who are devoted to natural history that existing Societies are not adapted to promote that pursuit, as well from their paucity of means, as from their objects being chiefly directed to investigations in literature, agriculture, and medicine.

It appears also from the distance at which those naturalists are scattered over India who are competent to give a tone and character to the proceedings of a Society such as we allude to, that periodical meetings for the discussion of papers could not conveniently be held at any one place, and that in the absence of competent members, it were better that no such meetings were at all held.

With both these circumstances in view, it would be necessary in order to secure the efficiency and integrity of a Society of the kind proposed, to limit its business to such objects as should render meetings unnecessary.

The British Association as well as the Academia Naturæ Curiosorum, hold their meetings, the first in all parts of Great Britain and Ireland, and the second in all parts of Germany; and in as much as they are not confined to any particular town, assimilate to the character of the proposed Society for India. The only difference is, that here there could not conveniently be any meetings, as the cultivators of science are so few, and the nature of their various duties such as to prevent their assembling at any one place.

However agreeable it may be for men who are engaged in kindred pursuits to meet and discuss the several objects in which they are interested, yet this by no means constitutes an essential feature of the Societies in question, which must on the contrary depend entirely on the character of their transactions. With the exception therefore of the reading and discussion of papers, it would seem that we might possess Transactions, and by their means secure all the positive advantages which result from Societies such as those alluded to. The only officer that would be necessary on the spot would be a secretary, or agent, the latter term might be preferable, as implying a strict obedience to the wishes of those for whom he acts.

The elective body, or Committee, might consist of from eight to twelve names, such as would be a security for the character of the Society, and who would appoint annually three or four of their body as vice-presidents, to settle any doubtful points that might be referred to them by their agent.

It would not be advisable to have a larger number than from eight to twelve on the Committee at once, from the inconvenience that would be occasioned in deciding questions upon which it might become necessary to collect their opinions.

This last object could only be effected by means of circulars. The business of the Committee would be the election of vice-presidents once a year from among their number, as already stated, as well as to fill up vacancies in their own body; this, together with the occasional reference on matters of business would require, at some future time, the indulgence of the privilege of franking letters on the business of the Society to each of the members of the Committee, only however from one to another, which would enable them to keep up that intercourse with each other on matters of science which it is almost essential that the savans of every nation should possess to a certain extent, but in India more particularly, from the impossibility of their holding any other kind of intercourse. This would be almost the only privilege which it would be necessary to solicit from the government, and as it would not amount to the general franking of letters, except from one member of the scientific Committee to another, we might hope that an application to the above effect would not be denied longer than the benefit to be derived from it should be clearly proved; which naturalists can only do at a small sacrifice to themselves in the first instance in the shape of postage.

The next step would be to effect an improvement in the character of communications, and from the examples which would be afforded by the Society, authors would naturally be more careful in their publications, and more zealous in their works; the effect of which would be a gradual advancement to more finished and carefully digested papers than have as yet become frequent in India, in which specific subjects are taken up at the beginning and carried through to the close, with all the information to be had in the country made to bear upon them. For this remark on what should constitute the object of writers, we are indebted to our friend Mr. H. Walker. Let us see now how a spirit and example of this kind would operate. In the first place, those who devote themselves privately to the study of the productions of the country would be brought into communication with each other, and both the government and individuals could refer to their counsel and advice in all matters falling within the province of naturalists to decide.

In the next place, the labours of many regarding the application of the sciences to useful purposes would be brought to bear from a focus, and the investigation of minerals, plants, and animals would be conducted with more energy and effect than if left to depend on the isolated exertions of individuals, or mixed up, as at present, with other pursuits with which naturalists have no sort of connection.

Let us take the state of our knowledge on any one subject that should come within the scope of natural history, and we shall find how much the interests of the country, both as regards its intellectual and social improvement, depends upon its investigation: as, for instance, our coal fields, our tea plants, and our fisheries. In all these matters we have every thing to accomplish, and although from their importance, private enterprise and the isolated observations of individuals may in time effect much, still in a country where the mind requires to be as yet formed for all such inquiries, both energy and example are requisite for conducting researches successfully to practical results.

There are no instances of men stumbling at once on great practical results in any thing, nor are there any instances of nations changing their character suddenly from intellectual darkness to wisdom; these things are not the results of chance, or of sudden efforts, however they may be supported by wealth; but of sedulous and well directed exertion of individuals and the force of their example on communities.

Seeing therefore how much depends on the exertion of naturalists and the progress of their pursuits in India, it is reasonable to expect that something should be done to concentrate and give energy to their labours; but this is less a subject for the consideration of others than for that of naturalists themselves.

It is one of the peculiarities of men engaged in the prosecution of original inquiry, that they are contented to go on in silence with their pursuits, heedless of every thing but the subject before them.

There are however occasions when it becomes necessary to look around, and see if with very little inconvenience we may not materially improve, not only our own facilities, but the facilities of those who are to follow in our pursuits; and it is a duty which we owe no less to the government than to ourselves, to secure for those pursuits to which we devote a large proportion of our time, such facilities as may be compatible with the circumstances in which we are placed, so as to render our labours useful to the country.

The plan now proposed for the constitution of a Society strictly directed to specific objects connected with natural science, differs but slightly, we are informed by our friend Mr. Walker, from that of one of the oldest and most successful Societies in Europe, the *Academia Naturæ Curiosorum,* which may have arisen out of somewhat similar circumstances in Germany, during the latter part of the sixteenth century, at a period when too few naturalists were found in any one city to carry on the duties of a Society. That *Academy* exists only in its *Actæ,* or transactions; it has no meetings or local habitation, and its business, which consists merely of the publication of memoirs, is conducted by a temporary secretary in any part of Germany where the individual on whom that honor is conferred may happen to reside.

In principle this is precisely what is proposed, so that it is so far fortunate to have an illustrious and successful example of what some might otherwise regard as visionary and impracticable.

One of the first objections that will be urged against the proposed institution is, that it will have a tendency to injure other Societies now existing in India; but the same objection might have been urged against every Society that has sprung up since the time the first was formed.

Our own little experience in India enables us to state, that the greatest danger to which Societies are here exposed, is the patronage of objects which are foreign to the peculiar qualifications of their leading members. Each of our three Societies of Calcutta afford instances, which have fallen within our own observation, of the great and serious error of this. So far therefore from a Society exclusively directed to the promotion of natural history proving injurious to any of the other institutions already existing, we feel assured that the change would prove a great relief to some of them, especially as we are prepared to show several instances in which they have been called upon to make large sacrifices of funds for the purpose of promoting physical science, when the very effort was attended with opposite effects.

The next point which we have to consider, is the means of support for the proposed institution. As it is not proposed to have any monthly or other meetings, or to have any source of expenditure except that of the publication of transactions, those who subscribe can have little inducement beyond that of contributing to an object purely scientific.

If there be no transactions, there can be no expenditure, and if there be transactions, subscribers will have so much in return; but it is not merely to derive an equivalent in goods, nor even the pleasure of attending meetings, that induces persons to subscribe to Societies; they in general have far higher objects than the possession of influence, or the vanity of taking part in proceedings. It is reasonable therefore to suppose, that the list of subscribers to the Society would be sufficient to meet its expenses, beyond which there would be nothing more required in the beginning. A museum and a library might afterwards follow: the first object which from its nature would be impracticable in any Society not ruled by naturalists, would in this be a natural consequence requiring no effort. In proof of this we may say, that our residence is a perfect store-house of fishes, birds, and insects poured in from all quarters, so that if we had the means of preserving objects, as well as of collecting and describing them, we could soon form a museum that would be worthy at once of the patronage of the government, and of the character of naturalists now resident in India.

The only security for the propriety of the requisite small subscription would rest with the Committee, which would assume the management of the Society; but as this Committee would consist of men on whom the character of the Society would depend, and who should have devoted their studies expressly to those objects which it is intended to promote, there should be no hesitation on the one hand to incur the responsibility, nor want of confidence to confer it on the other. Could the difficulties attending this point be surmounted, it is evident that a Society would then be formed the sole management of which would be vested in the hands of men entirely devoted to its object.

The object of the proposed Society would be to collect a body of information regarding the natural history of the country, and to concentrate the labours of our naturalists, which have hitherto been interspersed throughout various publications, in a manner to render it difficult to refer to what really has been done.

The evil of scattered publication is in India the difficulty of obtaining books. If our naturalists for the want of any independent publication exclusively devoted to their own pursuits continue to send their communications to various Journals, and Societies here and in Europe, they must necessarily increase their own difficulties by the greater number of books which they will require to refer to. In consequence of this practice it already often happens, that to refer to a single paper on natural history it is necessary to purchase a volume of extraneous matter, and this evil must continue to increase until naturalists possess publications exclusively devoted to their own pursuits.

We have treated the subject of the proposed Society on distinct grounds, and altogether independent of a Journal, but we consider both to be indispensable to the advancement of natural history, and doubt not we shall live to see both flourish. The one as an independent advocate of truth, and the organ of those who are interested in the progress of natural history; the other, a repository in which the finished papers of naturalists in India may go forth to the world under the auspices of men practically acquainted either with their merits, or their defects.

The Silurian System. *By* R. I. Murchison, Esq. F.R.S., F.L.S.

Vice-President of the Geological Society of London, General Secretary British Association for the Advancement of Science, Member of the Royal Geographical Society, Honorary Member of the Royal Irish Academy, etc. etc. etc.

We propose in a series of articles to enter into an analysis of Mr. Murchison's great work on the Silurian System, for the perusal of which we are indebted to the liberality of our friend, and lover of science, Mr. J. W. Grant, C. S.; for its title alone would be enough to exclude it from all public libraries in this country. For the benefit of the uninitiated, we will first explain, that the author comprehends under the term *Silurian** those beds of ancient strata from the Old Red Sandstone down to the Crystalline, or primary rocks.

But the work is not confined to the investigations of these beds; before their difference from more recent deposits could be established, it was necessary to enter into an investigation of the latter as a preliminary object. The first views of Mr. Murchison on the subject before us were submitted to the first meeting of the British Association, since which time Mr. Murchison has been constantly engaged in following up the inquiry, and extending his observations, so that districts made subject to the investigation consist of the counties of Salop, Hereford, Radnor, Montgomery, Gloucester, Cærmarthen, Brecon, Pembroke, Monmouth, Worcester, and Stafford. And as the above counties contain some of our most important repositories of coal, much new information is afforded regarding them, which we shall endeavour to lay before our readers. But as this part of the work alone consists of nearly two hundred quarto pages, we shall be able to convey but a faint idea of its value.

* A geographical term derived from the *Silures*, whose power extended over the region where these rocks are best displayed, and the name of whose illustrious Chief, Caradoc (Caractacus) has been transmitted to us in a bold range of hills composed of one of the most important formations of the Silurian system.

Mr. Murchison begins the investigation by a description of the Oolitic beds which cross England from Dorsetshire to Yorkshire, forming the high districts of Oxfordshire and Gloucestershire, traces the limits of these beds, and points out the peculiar fossils by which the inferior part of the series is distinguished.

In a work devoted to philosophical objects, our readers will hardly be prepared to expect observations of so much practical importance as those which we are about to quote regarding the importance of geological science in guiding the operations of the practical miner, which we hope will have good effect in pointing out the error of being guided altogether by practical men in our investigations for coal. "In the vicinity of Burley-Dam some of the beds of Lias are so hard as to have induced Lord Combermere to quarry them for slating purposes, and others in the same vicinity being slightly bituminous have very much the aspect of Kimmeridge coal. The mineralogical characters of this formation so closely resemble coal shale, that those unacquainted with its stratigraphical position and zoological contents, particularly in Oxfordshire and other interior parts of the kingdom, have frequently sunk into it in search of coal." And a little further on, after enumerating the list of fossils in the lower Lias, Mr. Murchison observes, "it was gratifying to observe in this detached basin of North Salop shells identical with certain unpublished species first brought to notice by my visit to Brora, Sutherlandshire, the strata of which distant tract, containing a sort of coal, were by means of their organic remains identified with similar carbonaceous strata of the Oolitic System, in the eastern moorlands of Yorkshire. Had the Lias of this Salopian tract contained coal as good as that found in the Oolitic formations of Whitby and of Brora, it might have been questionable whether in a country so distant from any deposit of the old or true coal, it would have been worth extraction; but no trials have brought to light any portion of combustible matter, whether termed lignite or impure coal, worthy of the name of a bed. To convince the resident gentry and speculators of northern Salop who are not aware of the value of the evidence afforded by organic remains, of the hopelessness of their search after coal, I beg to repeat, that the black shale is *underlaid* by the saliferous marls of the New Red Sandstone. In addition to the instances already given, I may state, that the sinkings of Sir Corbet Corbet at Adderley, opposite Kent's Rough, and near the northern edge of the basin, proved this fact; for upon piercing the black shale to the depth of 300 feet, a brine spring was reached! Lastly, an examination of the annexed wood cut* and the map will show, that the basin not only rests upon marls and other strata of the New Red System, but is surrounded by them; and a reference to the general tabular view attached to this work will prove that the whole of the enormously thick system of new red sandstone (as fully expanded here as in any part of England) lies between the black shale and the true coal measures. If coal really passes beneath any portion of this country, it ought to be first sought for at points nearer to Oswestry, Wrexham, Shrewsbury, Wellington, Newport, and Madeley in Staffordshire; in short, towards the out crop of the coal measures which rise nearly on all sides from beneath the new red sandstone. Now as this tract lies in the centre of the circle above mentioned, it is necessarily the very spot in the whole area where the search for coal is most hopeless, being that were the overlying deposits are thickest."

25.—On another occasion Mr. Murchison observes, that he had learnt that sinkings for coal had been carried on for some extent between Whitchurch and Market Drayton; but on examining the district, he soon found that the black shale supposed by the inhabitants to be coal-shale, was nothing more than Lias, as was proved by an abundance of fossils, and separated from the coal measures

* We regret we have not the means of introducing this cut.

by the new red sandstone. Again,—" On Walliston Common, Salop, in one of the attempts to find coal the Lias was bored, after sinking 250 feet, to a further depth of 150 feet, making a total of about 400 feet. A little black lignite or jet was found, but nothing to justify the most remote probability of the formation containing coal." At the mouth of the trial pits Mr. Murchison collected twenty-six species of fossil shells, six of which proving the formation to be identical with the Brora beds, in which a lignite occurs. In numerous other instances Mr. Murchison points out the ruinous consequences of sinking for coal without the advice and opinions of scientific men. Speaking of a spirited undertaking of the Earl of Dartmouth, in which seven hundred feet of sandstone was penetrated at Christ-Church, Mr. Murchison observes, that it is impossible to mention the success that attended the enterprise, without congratulating geologists on the effect which their writings are now producing on the minds of practical men, since it was entirely owing to inferences deduced from geological phenomena that this work was commenced, whilst its success was derided by many of the practical miners in the adjacent coal field. The south-east parts of the county of Durham have been rendered by this means a great and productive coal field, in spite of the prejudices and predictions of the old school of miners, to whom such important matters used to be entrusted. See p. 58—66.

The practical importance of the subject being established on such facts as these, we need not apologise to our readers for devoting a larger space to the notice of this work than its title and scientific details would seem to demand in an Indian Journal. The truth however is, that Mr. Murchison's work is the best model that could be chosen by the Indian geologists who would render efficient service either to science or to the practical value of the minerals of the country. To those who have not paid much attention to geology, we would remark, that the true coal formations repose between two great formations of sandstones, named the New, and the Old Red—that the lower beds of the first, and the upper beds of the latter, may contain thin seams of poor coal, which, in order to appreciate properly when met with in an undescribed district, we should be able to refer to one or other of the two formations. If the thin seam of coal belong to the Old Red Sandstone, boring or sinking in search of a better bed would obviously be a waste of money, as we should rather direct our inquiries to overlying rocks, and if these do not occur, a further search for coal in the district would be useless. If, however, the coal seam belongs to the New Red Sandstone, our search should be extended to the older or underlying strata, not by boring, for then we might, like the gentlemen of Whitchurch and Market Drayton, have several thousand feet of new red sandstone between us and the coal, even if its existence were certain. It is only therefore where coal seams are met with in coal formations, that borings and sinkings should be resorted to.

Then the question arises, How are we to become acquainted with these important distinctions, on a knowledge of which the condition of society so much depends, especially in India? Fortunately for us, coal seems to be so abundant in India, that no great nicety is required to detect it; but to pursue the discovery, and to bring it into use, is another and more difficult task.

Mr. Murchison observes, that the Lias is succeeded in the descending series by beds of green and red marl, constituting the upper portion of the series of strata, called the New Red System, which includes all those beds of marl, sandstone, and limestone, which lie between the Lias and the carboniferous rocks, and which, from their development, are capable of being divided into formations by differences in lithological and fossiliferous characters. 1. Saliferous marls; 2. Red sandstone and quartzose conglomerate; 3. Conglomerate and magnesian limestone; 4. Lower red sandstone. The first of these is described as occasionally presenting the appearance of a greenish kind of marlstone included in beds of red or green marls, of different degrees of tenacity; sometimes the colour is almost a grass green, and at others as white as chalk. It passes occasionally into a slightly micaceous calcareous grit. It would be exceedingly difficult, however, to give a mineralogical description of a formation which Mr. Murchison traces throughout a large tract of England, always appearing under some new character. The salt springs at Droitwich, and other places, have procured for it the name it bears. Salt springs occasionally occur in other formations perfectly distinct. Mr. Murchison considers the "Keuper" of foreign geologists is equivalent to the saliferous marls, and refers to a section made by Professor Sedgwick and himself, on the continent, to prove the identity of the rock in the two remote localities, England and Germany.

The "Keuper," however, abounds in fossil plants as well as animals; and Mr. Murchison has never been able to detect any trace of organic remains in the saliferous marls of England. "The fossils of the overlying and underlying formations in England being of marine origin, there is little doubt that the red marl must also have been deposited beneath the sea. In Germany and in France this inference is established by the presence of marine remains, in the "Keuper," "Muschelkalk," and "Bunter" sandstein,—the three principal formations of the system; the first of which, as before mentioned, represents our saliferous marls. The second, or great calcareous formation, has not yet been discovered in the British isles; and the third is the equivalent of the massive beds of central sandstones. The numerous brine springs, as well as masses of rock-salt, which are contained in the red marl, seems to offer additional proofs of the marine origin of these deposits, since Dr. Daubeny has shewn that in many of these saline sources there is an admixture of iodine, a principle which is confined to the sea and its productions. This argument is not, however, to be considered decisive, but only as forming a portion of cumulative evidence, which taken in conjunction with that of the remains occurring in the deposits of this age on the continent, fortifies the conclusion, that our saliferous marls are of marine origin; for it might be said, that iodine and chloride of sodium have been derived in the first instance from the interior of the earth, and that the ocean may have owed its saltness to beds of rock-salt, as well as that rock-salt owes its origin to the evaporation of sea-water." Notwithstanding the difficulty of establishing the identity in remote quarters of the world, of rocks so vaguely characterised as the saliferous marls, yet when we have coal measures affording a certain fixed point, or land mark to guide us, we cannot be very far out in fixing upon the green marls, or often friable sandstone, which extend along the lower ridges of many parts of the great Himalayan chain, immediately adjoining the plains of Hindustan, as the Indian equivalent of the beds in question. Along the southern side of Assam we have the same rocks as well as brine springs, and an earthy limestone, probably equivalent to the English Lias. On the face of the Cherra mountain, the green marl rests unconformably on Old Red Sandstone, (or that on which the coal formation rests), and gives support to the deposits of sand in which the marine remains are contained. It is here by no means destitute of fossils as in other localities; on the contrary, we found in it six species of univalve shells, a small species of *Echinus* and a large spined *Cidaris*. In a note which we made on the characters of a fragment of rock brought away from a submerged reef near Arracan, by the hull of a ship which struck upon it, we pointed out the resemblance between its appearance and that of the green conglomerates in question.*

* Journ. Beng. As. Soc. 1838, p. 936.

A description of the salt formations at the head of the Indus, and their relative position to the coal measures recently found there by Mr. Jameson, will be the means of casting much important light on this subject in regard to India, and we have fortunately in the gentleman alluded to a geologist near the spot, fully alive to the importance of this and other questions of a similar nature. Another equally important question is the situation of the great repositories of salt in the vicinity of Ajmeer, and other situations in Central India, where salt lakes abound. Lieut. Fraser, of the Engineers, we recollect, sent us a fragment of rock-salt, which was found imbedded in a basaltic rock, when sinking a well at Mhow, about three feet from the surface. We have not heard that this curious fact has led to any further discovery or research in the neighbourhood alluded to.

The next beds of the New Red System described by Mr. Murchison, are the sandstone and quartzose conglomerates.* It is difficult to characterise these beds, otherwise than by the absence of saline impregnations, and occasional appearance of fragments of the older rocks, as in the last; fossils are said by Mr. Murchison to be rarely found in it in England, but in Ireland a profusion of small fish† were found in an equivalent rock at Rhone hill, near Dungannon. On the continent it is still more distinguished by numerous fossil plants, as *Equisetaceæ*, *Felices*, *Coniferæ Liliaceæ*, the whole of which are said to have a certain community of character peculiar to the age, and are very distinct from the plants of the overlying and underlying systems.

The third, and only other member of the New Red System hitherto detected in Great Britain, is the calcareous conglomerate, or lower new red sandstone, which in the central counties is equivalent to the magnesian limestone of the north-east, and the dolomitic conglomerate of the south-west of England. "They do not, however, contain solid beds of

* Called Bunter sandstein by the Germans, and Grés bigarrè by the French.

† *Pálœniscus catopterus.*

magnesian limestone, and very seldom so much magnesia as to entitle them to the name of dolomitic conglomerate, but are for the most part simply calcareous conglomerates, consisting of fragments of quartzy, silurian, and other rocks, as well as of carboniferous and other limestones enveloped in a calcareous matrix. In the Tortworth district, at the northern extremity of the Bristol coal field, the true dolomitic conglomerate is considerably developed, and has been fully described by several geologists. In the north of Gloucestershire, and south of Worcester, where the new red sandstone is conterminous with the old red, there are no distinct traces of this member of the series, unless we suppose that the few thin courses of slightly calcarious conglomerates which occur at intervals near the bottom of the sandy series, be its representative."

"In the great expansion, however, of the new red system in the north of Worcestershire, in Staffordshire, and Shropshire, there are calcareous conglomerates of considerable thickness, which, as they pass beneath the great masses of red sandstone already described, there can be no hesitation in referring also to the age of the magnesian limestone. They occur in great force in the north-eastern face of the Lickey. See the Memoirs of Mr. Horner, Dr. Bright, Mr. Warburton, Messrs. Buckland and Conybeare, and Mr. Weaver; Geol. Trans. vol. III. and IV. old series, and vol. I. of new series. This dolomitic conglomerate is also described in this work in the chapter on Tortworth, and the position is marked near the south-eastern extremity of the accompanying map, and Clent hills, and appear also on the northern end of the Lickey ridge of quartz rock, whence they range by Kenelms to Hagley. In this course they distinctly overlie a great formation hereafter to be described as the lower new red sandstone, and rise high on the sides of the trap rocks of the Clent hills. They here vary much in importance, particularly near St. Kenelms and Hagley, some masses having a thickness of fifty and sixty feet, others not more than six or eight; at Garnow Green, near St. Kenelms, there are extensive lime works in this rock, an account of which may suffice for those at other localities."

"The beds dip very slightly to the south, and are separated from each other by sandy marls and clay. The greater part of this rock is made up of angular fragments of a pre-existing, very compact limestone, which, from the corals and other fossils found in it, proves to be the carboniferous limestone. In some parts of the quarries the rock consists of concretions of marl and fragments of sandstone and grits, with coal plants, imbedded in a pink calcareous grit; but in others, of small pebbles of quartz and still older rocks, enveloped in a red ferruginous, earthy basis, penetrated in all directions by white, crystallized carbonate of lime. The matrix and cement are throughout very calcareous, and the colour of the rock varies with that of the ingredients, from a reddish tinge, to shades of yellow and white. This conglomerate follows all the sinuosities and promontories of the Clent hills, as is well seen between the hills of Romsley and Walton, where associated with the red sandstone, it enters into a deep recess. It also folds round Hagley park, (near the parsonage,) accommodating its outline to the form of the hills, where it has been described by the Rev. J. Yates, as a calcareous breccia, consisting of grains of quartz, decomposing felspar, and limestone. Transverse sections, from north to south, across the strata, are exhibited on the sides of the roads, which ascend to the Clent hills by St. Kenelms, or by Hunnington, and expose several lower calcareous courses, separated by argillaceous red marls and sandstone. Calcareous bands prevail so much in this district, re-occurring at intervals in the scarpments, through a thickness of many hundred feet, that if they were all included in this division, it would be impracticable to define with precision their limits, since they graduate into, and form a part of the lower red sandstone, which in its turn overlies and passes into the coal measures. It will indeed be shown in the sequel, that other calcareous beds, for the most part, however, of true *concretionary* structure, are even traceable down into the coal measures; and for this reason, I restrict the comparison with the magnesian limestone, or *dolomitic conglomerate*, to the mass of this rock which immediately lies beneath the central sandstones," (Bunter sandstein, or Grès bigarrè.)

"Calcareous conglomerates are to be seen at many points round the outline of the Dudley and Wolverhampton coal-fields, generally at some little distance from the edge of the coal-bearing strata, and always dipping away from, or overlying them."

It is impossible in a work composed almost entirely of important details, on which the principles of geological science so much depend, to offer any abstract or comments half so instructive as simple quotations from the observations of the author, especially as sandstones and rocks of the coal formation prevail very extensively in nearly all parts of India. It is extremely important, that the relative position of the sandstones and coal-bearing strata of India should be clearly described, and that all the points in which they differ from, or agree with, similar rocks in other parts of the world, should be investigated. In a private letter from our friend Mr. Jameson, we learn that he has observed extensive tracts composed of silurian rocks, and sandstone of the Old Red System, in the north-western parts of India. Under these circumstances, we feel assured that we can render no better service than by quoting largely from the pages of a work, which otherwise would, from its price, be little known in India.

The calcareous strata of the New Red System at Coton, where they are burned for lime, are described as coarse conglomerate, composed chiefly of fragments of carboniferous limestone, generally rounded and red on their exterior. Some of them are of an oolitic structure; others a compact limestone, containing encrimites, corals, and terebratulæ, and discoloured, partly by films of green carbonate of copper; secondly, conglomerate with fewer fragments of limestone but containing pebbles of quartz, old red sandstone, &c.; the whole cemented by pure white crystallized carbonate of lime. This conglomerate passes into a pink calcareous sandstone, with pebbles and minute fragments of jasper.

"In attempting to refer the fragments of limestone to the original rock, the oolitic structure distinctly proves that some of them have not been derived from any formation below the Old Red Sandstone, while the nearest known masses of a similar rock are in the carboniferous limestone of the Clee hills, twenty miles distant. The included fossils belong likewise to the same deposit, while the rolled condition of the fragments, accords with the idea of their having been drifted from the quarter alluded to. At Coal-Brook Dale coal-fields the conglomerate is not sufficiently calcareous to be burnt for lime, being chiefly composed of rounded fragments of sandstone and quartz, with some fragments of carboniferous limestone, in a base of quartzose and calcareous sand. Here, as in other localities before mentioned, the strata dip away from the adjacent coal-field, from which, as we shall afterwards perceive, they are separated by a great fault. The extensive denudation of the whole series of the New Red System between Newport and Shrewsbury, has obliterated all traces of the calcareous conglomerates, which are not met with again till we approach Shrewsbury where a small face of the rock can be seen, which was formerly quarried to burn for lime, but is rapidly lost, dipping to about 30° under the sandstone. To the north and west of this spot, the relations to the various members of the New Red System, which overlie the coal bearing strata of Poutesbury, are much obscured by a thick cover of coarse gravel and clay. In other situations north of the Severn, the calcareous conglomerate of the New Red System contains angular fragments of cream-coloured limestone, in a reddish sandy calcareous matrix, in which small cavities occasionally occur lined with crystals of dolomite. Limestone containing magnesia is abundant in some beds of mountain, or carboniferous limestone in the same vicinity, and that rock being of older date, may have supplied many of the enclosed materials, and much of the cement of this conglomerate."

Some fragments of limestone of large size, derived from the breaking up of a peculiar fresh water limestone intercalated between seams of coal, are also contained in it, as well as small round quartzose and other pebbles of more ancient rocks. Although Mr. Murchison observes it has been stated in the previous pages that no remains of shells have yet been detected in the overlying members of the New Red System in England, a considerable number of curious unpublished species have recently been discovered at Manchester in beds of the variegated marl. These shelly marls are considered by Professor Sedgwick to lie beneath the upper and central members of the New Red System, and Professor Phillips, who has recently worked out in some detail the relations of strata in the environs of Manchester, is of the same opinion. In a letter to Mr. Murchison, he describes these shelly marls as lying between the sandstone and quartzose conglomerates, *grès bigarrè*, and the lower beds of the New Red System, and observes, "I view them as attenuated and deteriorated magnesian limestone, the last term of the degradation of this rock;" it is therefore inferred that the Manchester shelly beds are of the same age as the calcareous and dolomitic conglomerates of Salop, Worcester, and Stafford, which are the equivalents of the magnesian limestone.

These marls are said by Mr. Murchison to be of great interest as links connecting the lower new red sandstones with strata of the same age in the north of England, which are known to geologists through the labours of Professor Sedgwick. Among the shells from the marls at Colyhurst Professor Phillips recognises *Axinus obscurus*, or a large variety of that species, as the most prevalent, associated with an *avicula*, not very remote from *A. sociales*, and many small undescribed univalves.

"Having now described the three upper divisions of the series in those districts where their characters and order of super-position are distinct, I might at once proceed to the examination of the subjacent sandstones where they are most expanded, as around the coal fields of the central counties. It is desirable however previously to invite attention to the prevailing characters of the lower portion of the system in Gloucestershire and the west of Worcestershire, where being little more developed the whole of its lower portion consisting of conglomerates and sandstone is so intimately connected that they can be considered only under one head."

The members composing the bottom of the system are occasionally difficult to identify in different localities, as their characters are mixed, sometimes calcareous, at others quartzose, and occasionally containing a great abundance of pebbles and fragments of trap rock, intermixed with sedimentary rocks of great antiquity.

Having traced the line of demarcation between the New Red Sandstone and the older rocks on which they rest, "I commence by pointing out the manner in which from small beginnings in the south their successive development is accomplished as we proceed northward. At Huntley soft red sandstones first appear rising from beneath the marls, and separating them from silurian rocks; and between that place and Newent, where the sandstone attains a considerable thickness, there are traces of quartzose conglomerates occasionally cemented by calcareous matter. These relations prevail for some miles to the north of Newent, the lower beds of the system overlying a thin zone of coal measure; but in approaching the Malvern hills, the sandstones are much more exposed, and the conglomerate near their base is of greater importance, and of different lithological composition. In the absence of natural sections, the presence of the sandstone above the conglomerate (Grès bigarrè), is clearly indicated by the "Rye Sand," or sandy loams, which uniformly give a dry agricultural character to the surface of all the tracts occupied by that member of the system. Between Huntley and Lynes Place are good sections of the sandstone arranged in fine-grained, friable, thickish beds, beds of deep red colours, and containing subordinate irregular courses of a small conglomerate, in which are fragments of the old red sandstone, and inferior rocks. Some of these conglomerates are slightly calcareous, others pass into mere grits, the whole resting upon and thinning out in light-coloured incoherent sand, and the line of separation is sometimes defined by the nature of the surface, at others by sections exhibiting thin patches of coal measures interpolated between the New and Old Red Sandstones." Clear junctions of the New and Old Red Systems are seen at Hoffield Camp, the first appearing as soft red sandstone, and the second, of brecciated conglomerate, of a deep red colour, containing fragments of syenite, varieties of silurian rocks, quartz rock, and old red sandstone.

"Almost adjoining the sandstone of Black's Well, and constituting the southern side of the gorge at Knightsford Bridge, through which the Teme escapes from Herefordshire into the plains of Worcestershire, is a remarkable cliff called "Rosemary Rock," the summit of which is about three hundred and fifty feet above the sea; at this spot the Old Red and New Red Sandstone are again conterminous, being separated by only an alluvial meadow. The northern face of Rosemary Rock is the finest vertical section of the coarse conglomerate near the base of the New Red, with which I am acquainted. The fragments vary from a large size to that of almonds, and are both rounded and angular; the greater number and largest, consisting of a purple coloured concretionary trap, hereafter to be described, which occurs in the hills of Barrow, Woodbury, and Abberley, the northern prolongation of the Malvern ridge. The other fragments are chiefly referrible to the Silurian System, and among them are quartz rock, indurated schist, and other altered rocks. The cement is partly calcareous, with a few veins of white calcareous spar. On a hasty inspection, this rock and others resembling it along this chain of hills, might be mistaken for the trap rocks, from which they have been partly derived, but the admixture of fragments of stratified rocks of the Silurian and Old Red Systems, distinctly proves its regenerated character. The summits of those hills lying to the north of the Teme, which are marked in the map as trap, exhibit on the contrary, no fragments except those of a peculiar rock, predomenant in this range and in the Clent hills."

At Collins' Green, conglomerates like those of Rosemary rock, associated with beds of deep red sandstone, rise to the same height as the ridge of silurian rocks, from the flanks of which they dip 20° to 25° south-east. In this conglomerate are also many portions of silicefied schist, quartz rock, and altered silurian rock. The silurian and trap rocks subsiding to the west of Martley, the New Red Sandstone is again conterminous with the Old; and with the depression of the older and intrusive rocks we find a corresponding absence of coarse conglomerate and trappean fragments ; the deep coloured thick bedded sandstone of Martley, being nearly free from all pebbles and foreign fragments. In the north-western parts of Worcestershire the New Red System begins to expand; and conglomerates, such as those described, are partially underlaid by soft red sandstone, both on the eastern flanks of Walsgrave hill, near the Hundred House, and at the termination of the Abberley Ridge. Thence to the north, the boundary line of the New Red Sandstone comes in contact with the stiff clays and flagstones of the Old Red, but within two miles of Bewdley it begins to flank the coal measures; and other examples of the angular, coarse, and trappean conglomerate, or breccia, occur, the fragments of trap having been derived, it is presumed, from Stugbury hill. A similar rock is found at Wars Hill, on the left bank of the Severn, also rising up on the edge of the lower New Red, where it is bounded by the Old Red Sandstone, the conglomerate being interposed between the intrusive rock and the soft sandstone of Kidderminster! The same conglomerate, subordinate to, and winding through masses of thick bedded sandstone, are instructively displayed at Winterdine, near Bewdley, and contain fragments of coal measure, grits, and concretionary trap, both of which rocks being in site adjacent to the conglomerate, are of angular forms, whilst the quartz and pebbles of older rocks, which have been transported from greater distance, are rounded. These strata are unconformable to the adjoining sandstone and grits of the coal measures, and pass beneath the Red Sandstone which forms the cliffs on the left bank of the Severn, and ranges to the town of Kidderminster.

"We may therefore proceed to the consideration of the structure of these tracts where natural sections exposing a full development of the lower members of the system, exhibit, besides the calcareous and other conglomerates before described, the Lower New Red Sandstone as a great and distinct subjacent formation of sandstone, marl, and shale, with subordinate courses of impure concretionary limestone, the whole passing down gradually into the carboniferous system."

4. Lower New Red Sandstone.—Foreign Synonyms: *Rothe-tode liegende* (Ger.) *Gres des Vosges couches inferieures.* (Fr.)

"When fully developed, as in the tracts of Worcestershire, Staffordshire, and Shropshire, where I shall now describe it, this formation differs essentially in lithological structure from any rocks we have previously considered. As a mass it may be said to consist of sandstones and grits, chiefly of a red colour, sometimes argillaceous, very frequently calcareous, associated with deep brown red shales and marls, occasionally spotted green. Grains of whitish, decomposed felspar are frequent in a matrix of dull red sandstone, iron in various states is here and there disseminated, and bands of impure concretionary and mottled limestone re-occur at various levels. Towards the base, many fragments of impressions of plants appear in beds of sandstone, which graduate into other and lower strata, containing thin seams of coal, from which there is a conformable descending passage into the true carboniferous system. In general these rocks contain much argillaceous matter, which on decomposing gives a striking resemblance in the surface of the country to those tracts which are occupied by the Old Red Sandstone; whilst some of the calcareous bands above mentioned are associated with hard flagstones. So completely, indeed, do these bands resemble the cornstone of the Old Red Sandstone, that they were formerly described from a part of this very tract as belonging to that formation. There is now, however, no doubt respecting their age, since besides their clear superposition to the coal measures, some of these beds contain fragments of mountain limestone, and sandstone with coal plants. This is one of the many proofs (ample testimony of which will be found throughout this volume,) of the danger of testing the age of rocks by any peculiarity in their mineral character, however striking: for the graphic description of the cornstone of the Old Red Sandstone, given by Dr. Buckland, is derived from specimens now proved to belong to the *New* Red System. I cannot, however, make this observation without remarking, that the mere lithological character of many of these beds might still mislead the most practised geologist, if he had not worked out the relations of all the other rocks of the district.* Upon the eastern face of the Clent Hills, the Lower New Red appears as a highly argillaceous Red Sandstone, underlying the chief bands of calcareous conglomerate of Frankley and Gannow Green, and dipping away from small patches of coal, on the north-eastern face of the quartz rock of the Lickey Hills, and at the southern end of the great Dudley coal-field. There is distinct proof in both tracts, that the Lower Red Sandstone is conformable to, and passes into underlying coal measures; but as the latter are of very poor quality, and are in fact mere layers of carbonaceous matter, they have in most instances not been wrought; whilst in others where they have, the works being abandoned, the relations are but little known. It is certain, however, that to the east of Rubury Hill the strata dip to the east at a slight angle, and pass with apparent conformability beneath the Red Sandstone. Between Hales-Owen and Hagley, at Wassall Grove and Lutley, poor coal seams are apparent in natural sections, forming the lowest portion of this system, or top of the carboniferous strata, and dipping beneath the conglomerate and Red Sandstone of the St. Kenelms and Clent Hills. Among the most instructive excavations opened in these rocks, are

* "In my own case, for example, I am bound to acknowledge, that misled by mineral characters in the first year of my survey, I laid down an adjacent tract of the Lower New Red as Old Red Sandstone; an error which I only rectified by working out the relations of all the surrounding rocks. Mr. Greenough in the table of superposition illustrative of his map, has noticed the occurrence of cornstones, both in the New and Old Red Sandstone. It may be stated, that the inhabitants make no distinction between the half-concretionary, half-conglomerate, calcareous masses in the New, and those in the Old Red Sandstone. In the country, however, of the Old Red Sandstone, the name of "cornstone" is restricted to the coarse, sandy, conglomerate-like masses, and is never applied to the large concretions of purer limestone"

those of the Quarry Hill, south of Hales-Owen, where thick bedded, red, gritty sandstones, both soft and hard, are extracted for troughs, slabs, and building purposes, and contain irregular thin seams, filled with minute fragments of coal; whilst lower beds rising from beneath, pass into layers of hard grey grit, in parts calcareous, their surfaces being covered with fragments of coal and impressions of stems of plants. From these beds there is a gradual passage into the coal tract of the neighbourhood of Hales-Owen. At Coleman's Hill and Hodge Hill, in the same district, there are other sections, the strata in which, though differing somewhat in mineral characters, belong to this lower division of the New Red System; and these also exhibit passages into the coal measures. At Coleman's Hill, the upper beds consist of yellowish, soft, gritty sandstone, containing some small, calcareous fragments, a few pebbles of quartz, blotches of red shale, and fragments of sandstone with impressions of stems of plants! This sandstone graduates into thick bedded calcareous grit, spotted with bluish grey, black, and yellow colours, and partially burnt for lime. The spotted appearance is due to fragments of coaly matter, mixed with imperfect concretions of crystallized carbonate of lime, and blotches of ochreous decomposing sandy matter. The sandstones of this age occupy a distinct ridge from Hodge Hill by the Two Gates, to near Hales-Owen. They are for the most part of a yellow colour, are very cellular, and are not unlike portions of this part of the system in the county of Durham, which Professor Sedgwick has identified with the Rothe-todte-liegende. I allude particularly to the soft, white, yellow, and red sandstones on the banks of the Wear, at Clack's Heugh, &c., near Sunderland. On the sides of the gullies poor and thin seams of coal are exposed; and one of them occurring in grey calcareous breccia, similar to that of Coleman's Hill, is made up of fragments of coal, sandstone, schist, and limestone, in a calcareous cement. In the bed of a brook under Wassall Grove, I observed a seam of this coal three or four inches thick, overlaid by what may be termed a *carboniferous cornstone*, somewhat resembling that of Coleman's Hill, and containing small interspersed fragments of bitumenized vegetable matter, rounded, and apparently water-worn, like the pieces of drifted wood seen upon the sea-coast. The calcareous bed passes upwards into thin bedded, brownish yellow sandstone, weathering to a reddish colour, in the fine natural sections seen as we descend."

"I. Mr. W. Hamilton, then Secretary to the Geological Society, accompanied me in one of my visits to the district around Hales-Owen, and he can bear witness to the quantity of impressions of stems, &c. of plants which we observed in the strata of the Lower New Red Sandstone. Specimens of these may be obtained in the Quarry Hill and Coleman's Hill. From these hills of yellow sandstones, to the edge of the great Dudley coal-field, whether from the Windmills and Two Gates, or from Hodge Hill, we find the following succession—

1st. Beds of incoherent soft yellow sandstone, with calcareous courses, and thin seams and fragments of coal.

2nd. Argillaceous strata, generally red, and of considerable thickness.

3rd. Sandstone, alternating with a peculiar trap-cuf. This rock sometimes assumes spheroidal forms, and will be further described in the chapter on Dudley. It contains quartz, pebbles, and fragments of coal plants, is often highly ferruginous, and passes down into strata containing small concretions of ironstone.

4th. Calcareous shale with seams of coal, which have been, and are still worked."

"It appears, therefore, that between Hagley and Hales-Owen, there are all the proofs of a Lower New Red Sandstone distinctly underlying the masses described in the previous pages, and passing down into carboniferous strata so gradually, that it is difficult to draw the line of separation, or define it with any accuracy upon a map. As this Lower New Red approaches the Clent Hills, it is inclined to the south, and is there surmounted by the calcareous conglomerate or central and upper strata of the New Red System. At whatever point we fix the limit between the overlying sandstones and the coal measures, it must be borne in mind, that the only carboniferous strata into which these beds graduate in this immediate neighbourhood, constitute the poor and slightly productive end of the Dudley field, and that speculations in search of coal seams, by sinking to great depths beneath the Lower New Red in this tract would be quite ruinous, since we know that the mineral thins out to mere shreds in its course to the south: further explanations of this point will be given in the account of the Dudley coal-field. In following the margin of the great Staffordshire coal-field, we invariably find that wherever gravel and superficial detritus does not obscure the relations of the strata, a zone of red sandstones, of considerable thickness, is interposed between the coal and the calcareous conglomerate. At the Stand Hills it is a hard, greyish, partially reddish, and slightly calcareous sandstone, with a few blotches of yellowish marl, and some veins of white carbonate of lime, passing upwards into a pebbly, deep red, soft sandstone. At the straits between Himley and Turner's Hill, it is a thick-bedded, deep red, soft sandstone, in parts slightly calcareous, full of irregular joints and those numerous transverse striæ or lines of false bedding so common in the New Red Sandstone, with occasional lumps of harder calcareous grit. At Sedgely, it is a hard, red, slightly calcareous sandstone, with spots of green passing upwards into red argillaceous marl. These localities are all on the west side of the fields, and the strata invariably dip to the west, or from the underlying coal measures! On the eastern side of the coal field these sandstones are much more obscured by coarse gravel, but in several situations they are seen to be overlaid by a red calcareous conglomerate, which also dips away from the coal-field, or to the east. The great thickness of these lower sandstones has been recently proved by the spirited undertaking of the Earl of Dartmouth," already alluded to, to sink through them for coal. "These workings descended through a variety of red and spotted sandstones, blotches deep red, and variegated marls, and thick courses of red calcareous grit, concretions of impure limestone (cornstone) and ferruginous deep red, hard, calcareous sandstone; the fissures in the rock being sometimes coated with crystals of coloured pink sulphate of barytes and sulphate of iron. At my last visit the shafts, then at a depth of two hundred yards, were passing through a light red micaceous sandstone, in which blotches of ferruginous marl were mixed with grains of carbonaceous matter. Some of the layers of this rock were separated by laminæ of black mica; concretions of calcareous sandstones as round as cannon balls, occurred at intervals, and altogether there was so much calcareous matter as to give the rock a very concretionary aspect. The reader will perceive that these are the very same strata which overlie the coal in natural sections at other places, and hence there could be little difficulty in predicting that coal measures would be found beneath them, particularly as it is well known that the coal seams of the adjacent field of Dudley do not deteriorate or thin out in the vicinity of these works, but are simply faults.

"The existence of the upper beds of coal having been ascertained by borings carried down to a depth of more than seven hundred feet below the surface, they (and the lower beds) have since been reached by sinkings, an account of which with a full description of the strata passed through, will be given in the chapter on the Dudley coal-field. In the eastern parts of Shropshire, between Enville and Bridgenorth, the Lower Red Sandstone occupies low terraces and depressions beneath the calcareous conglomerate, and at Shatterford is conterminous with a thin band of coal measures. The uppermost strata are so very similar to those of the great mass of rock above the calcareous conglomerate, that the description of the one may almost serve for that of the other. Thus, for example, in the cliffs opposite Bridgenorth, and in the mass of rock on which the town itself is built, the beds possess nearly all the characters of the sandstones in the higher parts of the system, being thick-bedded, soft, of a deep red colour, and traversed by innumerable lines of false bedding, which often meet in wedge-like forms.

"I may here remark, that whether considered in its central or in its lower member there is no system of rocks which occasionally offers greater difficulties for determining its real laminæ of deposit than the New Red Sandstone. Besides the joints or fissures, the diagonal lines of false stratification are sometimes so prevalent, that it is only by tracing at wider intervals the true laminæ of deposit, as marked by herbage or moss, that we can correctly ascertain the real dip of the strata. As these appearances sometimes re-occur from top to bottom of cliffs two and three hundred feet in height, and as the intervals between the true beds is often fifteen or twenty feet, it at first sight does not seem easy to assign an adequate cause for the accumulation of such a vast number of interjacent laminæ, parallel to each other in separate wedges, yet divergent from the lines of true bedding. Such appearances are to be found to a certain extent in rocks of all ages, and however difficult it may be to explain the precise method by which water can have deposited the grains of sand in these positions, we have positive evidence of precisely similar phenomena, not only in young tertiary deposits like the crag, but also in those accumulations of the modern era, which having been formed under the sea, have subsequently been raised up, and occupy low cliffs along certain parts of the coast of our island."*

* "See description of a raised beach on the north coast of Devonshire, by the Rev. Professor Sedgwick, and Mr. Murchison, Geol. Proceed. xi. No. 48. Mr. Lyell has given an ingenious explanation of the manner in which these transverse laminæ may have been formed by water, in showing how similar inclined planes of sand are accumulated by wind. Mr. De la Beche also throws light on the origin of this false bedding, Theoret. Res. in Geol. p. 88." It appears to us unnecessary to limit the cause of the phenomena alluded to, to the action of water alone; why might winds not also have been engaged in producing them as they are at present? The traveller on the Ganges and Bramaputra has frequent opportunities of observing the peculiar structure alluded to in sands of many miles in breadth on either side of the streams.—Ed.

To the south and north of Bridgenorth the lower beds of New Red, as exposed on both banks of the Severn, are similar in all respects to those described elsewhere, consisting of brownish, red, argillaceous and calcareous sandstone, flaglike calcareous grits, with occasional underlying, slightly red and yellowish sandstones, not unlike certain coal grits. Before, however, we take leave of this tract, a little more detail is called for, respecting the relations of the Lower New Red to the south of Bridgenorth, where the formation has been generally confounded with the Old Red Sandstone; though it is clearly separated on many points from that system by a zone of coal measures. Such is distinctly seen at Chelmarsh, where a ridge consisting entirely of the Lower Red Sandstone and associated beds of calcareous concretions, overlies in conformable opposition, and graduates downwards into strata, containing seams of coal. The descending order on the western slope of Chelmarsh Common is as follows:—

1. Red Sandstones passing into calcareous conglomerates, sometimes of concretionary structures.

2. Argillaceous marls and clay, with beds of whitish sandstone, occasionally with green grains.

3. First traces of coal measures, viz. dark and grey shale and light coloured sandstone, with seams of coal, too poor to be worked.

4. Top coal of this district twenty-two inches thick, the highest bed in use.

5. Calcareous concretions of grey and green colours, resembling certain varieties of the cornstone of the Old and New Systems; a band of this limestone is seen in the bed of the Borle Brook, dipping under the top coal.

6. Lower coal, two feet six inches thick, with associated measures, lies at some depth beneath the limestone, but is not now in work.

All these beds, from the lower coal to the overlying red and green sandstone with calcareous conglomerate, dip to the south-east, about four inches in a yard.

This is indisputably one of the clearest natural sections in the range of the Lower New Red Sandstone, exposing a passage downwards to the coal measures. As these argillaceous concretions are thus proved to belong to the Lower New Red Sandstone, we thereby determine the age of other sandstones, which distinctly overlying them, occur on both banks of the Severn, at Hagley, Stanley, and Alveley, and which most geologists, (myself included during my early examinations of this tract,) erroneously considered to belong to the Old Red Sandstone. Seeing the inter-stratification of so many beds of stiff red clay with calcareous concretions perfectly resembling the true cornstone of the Old Red, and also beds in which the surfaces are occasionally covered with large plates of mica, it was difficult to believe that these rocks did not really belong to that system. By attention, however, to the relations of these sandstones to the surrounding strata, it becomes clear that they belong to the New Red System; for besides the proofs of their superposition in this tract, they may be traced pursuing the same course, and uniting with the sandstones of Hagley, the Clent Hills, Hales-Owen, and the strata which surround and overlie the coal-fields of Coal-Brook Dale and Shrewsbury.

The Red Sandstone of Alveley, Hagley, and Stanley, which contains calcareous concretions or cornstones, (several masses of which are burnt for lime, is a thick-bedded sandstone, without mica, the lamination frequently marked by purple stripes, with here and there half-formed, small concretions of green and red marl. The coarser, or gritty beds are very largely quarried for grindstones, which are used at Birmingham in the manufacture of gun barrels. The grindstones are not unusually three and a half feet thick, by ten or twelve in diameter.* These grits are frequently calcareous, and are composed chiefly of grains of deep red quartzose sand, with white specks of decomposed felspar. Although, therefore, they do not much resemble the ordinary strata of the New Red Sandstone, they are unlike any beds in the Old Red System. And though it may be difficult, nay, in some cases impracticable, to distinguish the calcareous concretions of the one system, from the cornstones and limestones of the other, we have a safe guide in the order of superposition; and the absence of the fishes, and organic remains of the Old Red Sandstone, is negative evidence of some use in assisting the inquirer.

"In subsequent remarks upon the carboniferous deposits of these tracts, it will be explained how the coal measures which appear in patches in the bed and banks of the Severn, have been brought to light from beneath this cover of the Lower New Red Sandstone. This member of the system is developed on both banks of the Severn, north of Bridgenorth, or between that town and Madeley, leaving no doubt of its age since it is seen overlying, and dipping away from a thin zone of coal at Tasley and Coughley; and where some of the harder courses also contain calcareous sandstones.

A most instructive transverse section can also be made by passing from the high terrace of Apley to the lower ridges, in which are situated the park and house of Mr. Whitmore. The change observed in passing from the fine sandy and loamy soil of the upper and middle portion, to the cold argillaceous surface of the lower division of the system, is quite as marked, as the contrast between the agricultural surface of the New and Old Red Sandstones, where those systems are brought together in Gloucestershire and parts of Worcestershire. So complete is the resemblance between this lower member of the New Red and the Old Red Sandstone itself, that I confess it was only the clear order of superposition which convinced me, that this zone of sandstone and clay really formed part of the younger system. Near Apley Park Lodge, quarries

* "The stone was also formerly much extracted for the furnace hearths of blast-houses, but experience has taught the iron-masters, that many other sandstones are equally serviceable for that purpose. The coarser beds contain small fragments and concretions of marl. They are also used as building stones."

have been opened in this rock to the depth of thirty feet, exposing a hard greenish and deep red sandstone, in parts calcareous, in others slightly concretionary and conglomerated, the whole subordinate to stiff red, argillaceous marl or shale. Here, as at Cantern Bank, near Tasley, the beds lie conformably upon the coal strata, a band of which appears below in the bed of the Severn, while the superior face of the red rock dips beneath the overlying conglomerate of Apley Terrace. As Mr. J. Prestwich, to whose labours in this coal-field I shall have occasion to allude hereafter, has discovered plants in these Lower Red Sandstones, the analogy to strata of similar age near Hales-Owen, Hagley, Shrewsbury, and other places is complete.

" On following this rock to Coal-Port Bank, we there see it exhibited in deep vertical sections. Thick and thin bedded, red, argillaceous sandstones, yellowish and greenish grits, occasionally calcareous, with way-boards of argillaceous marl, constitute the upper cliff, dipping to the east 10° under an argillaceous cover, and resting upon thick bedded red sandstone, having a slight tendency to conglomerate structure. The other varieties of this rock contain rounded grains of quartz, and white specks, probably of decomposed felspar, with little iron pyrites in a calcareous paste, together with bands of coarse-grained, pebbly grit, and specks of chlorite, in a cement of white crystallized carbonate of lime. Some of the calcareous grits enclose concretions of green and red marl, thus resembling the impure cornstones of the Old Red Sandstone. Between Coal-Port and Madeley this sandstone is affected by powerful faults, to the chief of which I shall advert in a subsequent chapter; it being enough for my present purpose to state, that along the boundary of this field, as in Staffordshire, great dislocations equally affect the carboniferous strata and the Lower New Red Sandstone!* A transverse section from Sturchley to Shifnal, across Nedge Hill, like those previously cited, exposes sandstones and flaggy grits, both green and red, and thin courses of slightly calcareous conglomerates and flagstones, associated with much argillaceous marl; the whole passing beneath the younger group of Shifnal, &c. The country around Shifnal, Sheriff-Hales, and Crackley Bank, is covered with the quartz pebbles of the disintegrated conglomerate, beneath which a dark coloured, finely laminated, soft sandstone is seen at intervals; but these beds, as well as

* These are all elaborately described by Mr. J. Prestwich, in whose Memoir, preparing for publication in the Geological Transactions, will be found valuable details of the dislocations of the carboniferous and associated strata in this vicinity.

all those situated midway between Bridgenorth and Wolverhampton, and occupying points intermediate between the coal-fields of Staffordshire and Coal-Brook Dale, belong rather to the overlying or great central mass of sandstone. At Lilleshall, the same instructive section as that from Nedge Hill to Shifnal is repeated, with still greater clearness and fuller development. In the slopes of the hills below the terrace on which Lilleshall House is built, are stiff, argillaceous beds, which produce a cold and unmanagable soil. Other sandy beds, on the contrary, are quite incoherent and very largely micaceous, a rare feature in the supracarbonaceous strata. At Lilleshall Abbey, the lowest strata apparent on the surface are thick-bedded, light brownish sandstones.

"The junction of these with the underlying coal has never yet been ascertained, but there can exist no doubt of these being the true beds of passage into the carboniferous system. Portions of this sandstone are seen at one or two points along the northern flank of the Ketley portion of this coal-field, and they follow the outline of the promontories of the trap and silurian rocks near Wellington, but are for the most part in an incoherent and decomposed state, and the district is also much obscured by gravel. The Lower Red Sandstone reappears at Woxeter, Preston-Boats,* Shrewsbury, and other places on the banks of the Severn.

It dips away in slightly inclined masses from various small patches of coal at Pitchford and Uffington; also near Longnor, where the coal-bearing strata of Le Botwood pass gently beneath the red strata of Condover and Stapleton. In that district these red sandstones enter deeply into the recesses of the bays, or denudations which have been formed at the north-eastern extremities of the Cambrian rocks, in many situations resting directly upon their vertical or highly inclined strata; while in others, as in various hollows near Cound and Pitchford, they are separated from the old rocks by thin patches and broken zones of coal. In all such positions, even at the north-western end of the Lowley

* At Preston-Boats, the upper part of the old quarries exposes thin bedded, hard, slightly calcareous beds, with small concretions of dark green impure limestone, closely resembling certain cornstones of the Old Red Sandstone. In the lower part of the quarry the beds become thicker, and consist of sandstones of deep red colour, with a few blotches of marl. It is from beds of this age, that the Abbey Castle, and many ancient buildings of Shrewsbury have been constructed. Though I have looked in vain for any trace of organic remains in these calcareous beds, we should never despair of such a discovery, when we recollect for how long a period the existence of organic remains was unknown in beds of similar structure in the Old Red Sandstone.

and Caradoc ridge, these sandstones where not obscured by coarse drifted gravel, are soft thick bedded building stones, usually lying in slightly inclined strata. In a quarry at Condover, about thirty feet of these beds dipping very slightly to the north-east, are arranged in the following descending order.—

1. Gravel; 2. Thin-bedded Sandstone; 3. Red, argillaceous Marl; 4. Sandstone; 5. Argillaceous Marl as above; 6. Sandstone; 7. Marls as above; 8. Thick bedded Sandstone."

Numerous other details are given from various districts showing the connection of the lower beds of New Sandstone with the coal measures and the older rocks; frequent impressions and fragments of coal plants have been discovered in the beds which form a covering to coal-bearing strata; many of the impressions of plants are in an imperfect condition, but Professor Lindley had no hesitation in referring them to the carboniferous epoch. In coal-fields the junction of the New Red Sandstone with the coal-bearing strata is often obscured by superficial detritus, but where the rock is laid open it is sometimes a dark red, soft, thin-bedded sandstone, made up of black and white grains, in a thin paste, with a few harder concretions and some blotches of red marl; at other times it is harder, more siliceous, and intractable. Sometimes the dolomitic conglomerate, the red sandstone, and the coal beneath it are found resting upon the inclined edges of the Silurian rocks. In the western extremity of Shropshire the lower new red sandstone is directly superposed to the coal measures and the new pits at Drillt, to the east of Oswestry red sandstone marl and shale have been penetrated to a depth of 100 yards before the first traces of coal measures were perceived, when after passing through several layers of impure carbonaceous matter the usual coal seams of the Oswestry field were reached, and are now largely worked.

The following is a recapitulation of the different groups composing the New Red System in the districts examined by Mr. Murchison.

1. Saliferous and gypseous marls with beds of sandstone,

constituting together the equivalent of the "Keuper" formation of the continent.

2. Sandstone and quartzose conglomerates, representing the Bunter Sandstein and Grès Bigarrè.

3. Calcareous conglomerate, equivalent to the dolomitic conglomerate of the south-west, and the magnesian limestone of the north-east of England, shown by Professor Sedgwick to be the representative of rocks known in Germany under the names of Zechstein, Rauchwacke, &c.

4. The lower New Red Sandstone, overlying the coal-fields of Staffordshire and Shropshire, equivalent to the Rothe-todte-liegende, and probably the lower beds of the Grès des vosges.

Mr. Murchison concludes his account of the New Red System by observing, that a practical acquaintance with its lower beds "is of vast national importance; for as these sandstones are now proved to graduate into the coal measures, we need not despair of eventually finding some of the most valuable coal seams of the central counties extending beneath them." It is unnecessary to remind the reader of the importance of determining the nature and character of the vast tracts composed of sandstones on all sides of the great alluvial plains of India; and whether these rocks belong to the Old Red or the New Red Systems, or to both, considering the importance of this subject in regard to India, we are satisfied that Mr. Murchison's work affords by far the best examples of the peculiarities of these rocks, and of the methods for conducting our researches towards the discovery of their equivalent types in India; we shall therefore continue to follow him through the course of investigation he has pursued, and endeavour to exhibit the results of his researches in future numbers of our Journal. We may thus put the India geologist in possession of details and examples of the manner in which his inquiries may be conducted with effect, no where to be found but in the work of Mr. Murchison, which from its size and price could not have a very general circulation in India.

With regard to the purely scientific part of the details given by Mr. Murchison on the subject of the New Red Sandstone, that author observes, that his inquiries may "lead geologists to modify their previous theoretical views respecting the relations of the coal measures to the overlying rocks, founded on what must now be considered local phenomena, observed chiefly in the Bristol district and south-western parts of England; where because the New Red Sandstone reposes unconformably upon the carboniferous strata the belief became prevalent, that this arrangement was indicative of a general rupture, subsequent to the accumulation of the coal measures, and anterior to the deposition of the magnesian limestone and conglomerate. That such, however, has not been generally the case, has been established with regard to the north of England, by the writings of Professor Sedgwick; and the preceding facts teach us the same lesson in respect to the central counties: for it is clearly demonstrated, that beds of the age of the dolomitic conglomerate are there separated from those of the carboniferous system by an unbroken succession of intermediate strata of vast thickness, of which there are few or no traces in the south-western parts of the island.

"Notwithstanding, however, the distinctions which have been drawn between the different members of the New Red System in the central counties, a question it is feared might still arise among foreign readers, concerning the true equivalent of the Rothe-todte-liegende: for as most continental geologists conceive that formation to be essentially connected with porphyritic and other rocks of igneous origin, they can scarcely peruse the description of the trappean conglomerate without supposing that those masses may represent the German deposit. If, however, we are to understand the foreign synonym to express a series of strata, elaborated in such a manner, as in some cases completely to connect the carboniferous and overlying system; then it is clear we must consider the Lower New Red Sandstone to be its true and full equivalent, even should it not contain a single pebble of trap. That it contains few or no fragments of trap in the north of England, has already been proved by Professor Sedgwick, and the same fact is now established in the central counties. Whilst, on the other hand, the great trappean conglomerates have been shown to overlie this equivalent of the Rothe-todte-liegende, and to be on the same parallel with the dolomitic conglomerate. Referring to former opinions on this point, Professor Sedgwick has well observed, "In comparing the Bristol and Exeter conglomerates with the Rothe-todte-liegende, our geologists made use of the best evidence with which they were acquainted. But the New Red Sandstone group is now better understood ; and in future comparison with continental deposits of the same age, we should use as our types those sections which are most complete, instead of the Bristol or Exeter overlying groups, in which more than one half of the series is absolutely wanting.

"The trappean ridges of Malvern, Abberley, and Clent, will be described in the sequel; but in the mean time it may be observed, that as the red conglomerates on their flanks contain angular and rounded fragments of the trap composing those hills, the rocks from which such debris was derived must have been in existence before the conglomerate was formed. Now, the rupture between the New Red Sandstone and the carboniferous deposits, as marked by the dislocations along the line of the Abberley Hills, would certainly lead us to suppose, that the eruptions which gave rise to these hills took place, either during the accumulation of the upper coal measures, or of the Lower New Red Sandstone; for, without anticipating explanations which are to follow in the ensuing chapter, it may be asserted, that nothing is more consistent with modern and ancient analogies, than that such volcanic eruptions should have been mere local phenomena, which in the tracts where they prevailed (Devon, Abberley, Clent, &c.) may have occupied the place of the Lower New Red Sandstone, by interfering with its deposition, while in the tracts not visited by these outbursts, the formation would naturally be fully developed, and would there exhibit the unbroken connexion between the New Red and Carboniferous Systems which has been detailed in the previous pages."

Before going into the description of the coal measures, Mr. Murchison devotes a chapter to Trap Rocks. Ninety years have scarcely elapsed, he observes, since two French academicians collecting plants among the hills of central France, were astonished by discovering numerous cavities resembling the craters of volcanoes. From the lips of these cavities currents of lava, as fresh in aspect as if they had flowed yesterday, were traceable into the neighbouring vallies, following their sinuosities and stopping their ancient water-courses, and moulding themselves into the inequalities of the actual surface. To complete the analogy with active volcanoes, most of the mineral substances composing these lava currents were found to be similar to those of Vesuvius and Etna. When M. Guettard, one of the naturalists, first announced these discoveries, so unwilling were men of science to believe in phenomena of which neither history nor tradition had preserved a record, that scepticism long prevailed. More recent discoveries in Iceland, South America, and Asia Minor have brought to notice all the evidence that can be required to convince us not only of the similarity of modern and ancient volcanic eruptions, says Mr. Murchison; but also of the *great extent* to which such phenomena have prevailed. "But Auvergne is not merely replete with analogies of modern volcanic regions, it was further found to contain many rocks which though from their characters must have been formed from igneous agency, are yet in many lithological features dissimilar from modern lavas, whilst they resemble many of the so-called trap rocks"; thus a succession of periods of eruptions and of long intervals of repose have impressed on the various currents of lava and deposits from lakes and rivers, which in a succession of beds occur in central France, such character as to enable the inquirer to carry backward his researches from the connecting links of existing phenomena, into volcanic operations of high antiquity.

Mr. Murchison adduces the instance of Graham's island on the coast of Sicily, to prove the vast influence of volcanic agency and the manner in which the results are modified by the sea under our own observation Soundings had proved the sea to be 600 feet deep where the island rose to an elevation of 200 feet above the sea, measuring three miles in circumference; yet in three months from its first emergence it again disappeared, and a year after, when the spot was surveyed, a dangerous reef, eleven feet under water, was all that remained. Thus Mr. Murchison concludes that volcanic eruptions to the extent to which they must have existed in the early history of the planet could not have occurred without producing striking changes in physical geography.

The volcano and the earthquake are said by Mr. Murchison to be, the one a "safety valve" by which heated matter escapes at intervals from the interior, the other is the shock which lacerates the earth when the heated matter and its vapour is denied an access, and the task of the geologist is to read off the proofs of successive eruptions amidst the ruins they occasion.* Mr. Murchison then alludes to the observations of Hutton, Playfair, Hall, and others, to prove that syenites, porphyries, green stone, clink stone, and basalts are of igneous origin, but as this is now pretty generally allowed, we may pass over this part of the work. Mr. Murchison however adduces numerous circumstances, the result of his own researches, to prove that the basalts which have overflowed and dislocated the coal-fields must have been erupted subsequently to the period of the New Red Sandstone, while other great epochs of disturbance took place anterior to the deposit of the Old Red and Carboniferous rocks. The types of the Silurian system and the associated volcanic

* To afford an illustration of the manner in which geologists estimate the antiquity of rocks; let us suppose that fishes were buried in the ruins or debris of Graham's island, when the light materials of which it was composed, were scattered over the bottom of the sea, by the violence of currents. If by some future convulsion, that part of the sea should be raised up so as to compose dry land, and so many ages to elapse as to destroy all record of the change, except such as the remains of fishes imbedded in the rocks would afford, of the latter having been formed beneath the sea; the future geologist would then institute a comparison between the remains of the fishes, and such species as might live in his day; if he found them correspond, he would conclude the change from sea to land to have been comparatively recent, but if many of the fossils presented the characters of species unknown in his day as inhabitants of any part of the globe, he would conclude that they belonged to forms that have become extinct, and from all he could gather regarding the period of duration assigned to species, he would form his calculations as to the period in the earth's history at which Graham's island was overthrown.—Ed.

rocks have remained, says Mr. Murchison, so clear, that the geologist has in them a record never to be mistaken. Thus Professor Sedgwick has pointed out bands of prophyry interstratified with slates, the whole of which have been subsequently pierced by other intrusive masses of igneous origin, thus evincing two widely different periods of igneous action.

[To be continued.]

DR. WIGHT'S *Illustrations of Indian Botany.*

We have recently received the XIIIth No. of the "Illustrations of Indian Botany," by Dr. Wight, and the XIIIth and XIVth Nos. of "Icones Plantarum Indiæ Orientalis." The object of these works is, as our readers are aware, to supply the means of reference to the student in Indian Botany at the cheapest possible rate, consistently with due accuracy of the plates, which are necessarily very numerous.

The first is intended, as the author expresses it, to explain the principles of grouping plants according to their natural affinities, and illustrating these by figures of each group. The second is intended to afford figures of Indian plants described in the author's "Prodromus Floræ Peninsulæ Ind. Orientali," an octavo work in two volumes, containing more information on the subject of Indian Botany than all the costly quarto, atlas, and folio volumes that have been hitherto published, with this additional advantage—that it may be had for *ten rupees.* Even the "Icones" intended to illustrate the "Prodromus" appears in monthly numbers, each containing ten quarto plates, lithographed under the author's eye for *one or two rupees.* The grand object being to give to India, so far as the limited resources of a private individual will permit, that which England has so long enjoyed in "Smith's English Botany,"—a standard work of reference, at the lowest possible price.

With the "Prodromus" and the two works now in course of publication, the student would be in possession of a botanical library which would only require the addition of "Roxburgh's Flora Indica" to be nearly complete. The cost of the four books in question would we think hardly exceed 50 rupees, while they might all be packed in a writing desk of ordinary dimensions; so that whoever desires to make himself acquainted with Indian plants in India, where the knowledge is of most consequence, must be indebted to Dr. Wight for the means of accomplishing his object. We regret to see a list of subscribers to the "Icones" short of one hundred, even including the 50 copies taken by the Madras Government. This is perhaps owing to those only subscribing who have the author's "Prodromus," but surely there is no reason why we might not all have that work, while we could adduce a thousand reasons to prove its value to every one desirous of making himself acquainted with the plants of this country. Even without the "Prodromus" we can conceive the "Icones" would be highly useful, as with every number there is a closely printed quarto page or two, containing the characters of all the species figured.

In the present number of the "Illustrations" the author finishes the *Leguminosæ* and reviews the *Rosaceæ, Salicariæ, Rhizophoreæ, Combretaceæ, Memecyleæ,* and *Melastomaceæ,* &c. pointing out whatever of importance in their uses, or peculiar in their structure, that has fallen under his observations. To this number we also find a preface and introduction attached. In the first of these the author points out the object of the work, and offers some judicious observations on the advantage of the natural, over the artificial arrangememt of plants: and in the second, the author shows what the natural arrangement is at present in regard to Botany. On this subject we are scarcely entitled to form an opinion, but we congratulate Dr. Wight on his successful labours in the investigation of natural affinities, and trust that the support which the works in which he is now engaged will meet within India, may promote his fortune as much as they are sure to raise him in the respect and esteem of scientific men. We regret to observe subscribers are but few from this part of India, which we trust has been from some oversight, as we are acquainted with no books that ought to have a wider circulation in India, whether we regard the subject, the manner in which it is treated, or the claims of the author.

Meteorological Observations. By MR. J. M'CLELLAND.

During the hot weather in all parts of India that we have been in, subject to the influence of westerly winds, there is a remarkable haze which lasts from April till the rains set in about June. We have heard it ascribed to an electric state of the atmosphere by some, and by others to an unknown condition of the air indicative of sickness and approaching famine, especially if unusually intense or long continued.

The great fault of most persons in interpreting phenomena of this nature is, that they look too far for their causes. Heat and dryness may be favourable circumstances for the development of electric phenomena, but that the atmosphere is more charged with electric fluids during the hot weather than at other seasons, or that such is the cause of the haze, we have as little reason for supposing as we have in ascribing to it any mysterious influence over either our health, or the fecundity of the earth.

It is solely attributable to the high temperature of the air, and the geological structure of the tracts over which the prevailing winds pass, as is proved by the earthy precipitate from the atmosphere, which takes place at night, when the winds subside.*

After the first fall of rain, the peculiar effects above noticed disappear, the rain is ushered in with storms of thunder and wind, and the quantity that falls during the succeeding three months is never less than 25 inches, and often as

* Inquiries in Kemaon, page

much as 38 inches in the plains. In districts along the base of the mountain ranges on the Malabar and Malay Coasts, as well as along the whole North-eastern frontier, the fall of rain is greater, although the lower strata of air in which we live in Bengal is far more saturated than in districts where the fall of rain is greater. We cannot therefore calculate by means of rain-guages and other similar means, how the condition of a climate in regard to moisture affects its salubrity, and hence much of the mystery malaria presents to us. It may indeed be questioned, whether excessive humidity in low flat countries is not itself sufficient to develop similar effects on the constitution of man to those we refer to malaria, without resorting to any more active or mysterious agency. In India, it is after inundations and rains subside, that intermittents most prevail; is this universal? if not, what are the circumstances of exceptions? But let us satisfy ourselves that humidity itself is not the cause of intermittents, before we go further and ascribe them to more subtile agency. It would be very easy to argue one way or other on such a question, but we ought to discard opinions, and even all evidences short of direct inferences from such facts as are not opposed to other facts. We cannot gain a knowledge of the operations of natural causes without being acquainted with nature, and recording the results of observations as we advance. The investigation of the causes of endemic diseases and the physical effects of climate on the human constitution, is one of the most beneficent and profound subjects of inquiry; and though it concerns us more than any other question in which the mind can engage, yet it ever has been, and ever will be, more neglected than other subjects, simply because those who are most competent, have least leisure to investigate it; and it is unfortunately considered by philosophers to be exclusively the province of the physician, to whom they are consequently too much disposed to leave it.

The phenomenon of mists in Bengal depends on two causes; and the season during which they are liable to occur, is from the end of November to the beginning of April. The *mists* of November and December depend on different causes from those that give rise to the *fogs* of February and March. The first arise from the peculiar influence of radiation, and the second from diurnal variations in the winds.

During the day the surface absorbs heat from the clear rays of the sun in proportion to the degree of moisture contained on it. If the surface be arid, the absorption of heat will be great under the action of the sun's rays, but when these are withdrawn, the radiation and cooling will be equally rapid and great; hence the diurnal variations of dry sandy tracts, as the desert of Scind, will necessarily be great, but here the atmosphere and the surface are both dry together. In Bengal, on the other hand, where a larger proportion of the surface is covered with water and vegetation, the moisture of the air is greater and the dew-point consequently lower, and wherever this last happens to come within the sphere of diurnal variation, precipitation must take place.* Since the extremes between the lowest and highest diurnal temperature is greater on clear open spaces than in forests, it is in the former we commonly perceive a thin horizontal stratum of vapour suspended of a morning at sunrise over the surface.

Fogs, on the other hand, are more general, and arise from diurnal changes of the wind. The south-west monsoon generally sets in as a southerly wind about the beginning of March or the middle of February; it is naturally moist, and blows steadily during the day, when the temperature of the air, and consequently its capacity for moisture is greatest, subsiding gradually after night-fall; from this hour till sun-rise temperature gradually diminishes, and we find every thing enveloped in fog. Night fogs which are not uncommon about the change of the monsoon, when the winds are variable,

* The diurnal variation in Calcutta during the N.E. monsoon amounts to as much as 30°.

may be explained in the same way; the only difference is, that the necessary cooling before a fog can take place, is occasioned in this case by a light northerly wind of sufficiently low temperature setting in at night-fall, producing the same effect as radiation in reducing the temperature of the atmosphere.

Fogs during the day in the plains of India rarely happen, because the temperature of the atmosphere at the surface is such as to raise the dew-point above the influence of ordinary changes of temperature.

The diurnal variation of temperature in Calcutta during the north-east monsoon amounts to 30° Fahr. and the dense mists which float along the surface about sun-rise may be ascribed to the absorption of more moisture into the atmosphere from low tracts during the day when the temperature is highest, than can be held in an invisible form at sun-rise when the temperature is lowest, while these causes, together with others dependent on the state of the prevailing winds occasion mists.

Such changes are however only observed in the open air. In houses the variation of temperature is checked to within a range of 10° Fahr. and where houses closely adjoin each other, their effect is communicated to the open air so as to prevent the formation of mists and fogs in their immediate vicinity. In removing a thermometer from our house to the open air beyond its influence at sun-rise, we have found the mercury suddenly fall from 75° to 64° or from 64° to 50°, according to the season. It is only such houses as are built of brick or stone that display this effect in resisting diurnal extremes of temperature in Bengal. Forest trees however have a similar effect but in a minor degree, a fact the recollection of which might be useful in forming new stations where houses of the best description cannot be built at once, and fine forest trees often occur.

The diseases here most common to man during each of the *three* seasons, may be stated to be fevers during the rains, visceral and organic diseases in the cold, and epidemics during the hot months. The greatest proportion of sickness is probably during the rains, that of death during the cold months; cholera however has for the last three years been a regular attendant on the accession of hot weather. It is easy to see from the few facts thus thrown loosely together how much the study of meteorology, when directed to the natural history of the atmosphere might improve our knowledge of diseases. We know so little of the influence of external nature over the animal economy that we cannot be surprised that our knowledge of the cause of disease should remain nearly stationary, and that what we announce as discoveries to-day should be upset by some new opinion to-morrow. The difficulty is to make people sensible of the necessity of feeling their way with a view to the elucidation of some specific point.

Remarks on an undescribed species of Civet. By Mr. J. M'Clelland.

The zoologist has no greater difficulty to encounter in the mere descriptive part of his duty than in drawing just conclusions as to the specific value of characters in animals nearly allied to each other, and there is nothing of more importance to know, than the amount of variation nature is capable of assuming in a single form, and the circumstances to which such variations are due.

We should not generally lay any great stress on slight shades of difference in colour, but there are some groups in which the distribution of particular spots and markings on the external covering is of much more importance than in others. In the *Feræ*, or Cats, for instance, as well as in their corresponding types throughout the animal kingdom, we often observe each species distinguished not merely by the number, size, and colour of spots, but by the particular forms these assume on various parts of the body. It is curious also to observe this law of *isographism*, if we may use such an expression, the more constant in those species whose form and habits approach nearest to each other, and which it would consequently be most difficult to distinguish but for the constancy of some peculiar marks. Until the time of Buffon, the difference between the Civet and the Zibeth was unobserved, both being of nearly the same form and colour, but the number of dark marks on the tail being different in the two, might have earlier led to a comparison of the number and form of the vertebral bones of which the organ is constructed, when a difference we may presume would have been detected that could only be accounted for by the ordinary laws of variation in animals of distinct species. Strange to say, however, that long after the difference between the animals in question had been first suggested, naturalists preferred dealing in opinions to searching for facts; and so slow is the discovery of truth, that it required some thirty years to reconcile naturalists to what they had been unaccustomed to suppose in this instance.

The Civet *(Viverra civetta)* is most abundant in the hottest parts of Africa and in Abyssinia, where the animal is reared and an extensive trade carried on in *civet*, a peculiar odoriferous substance like musk, once very fashionable in medicine, and also as a perfume.

The Zibeth *(Viverra zibetta)* has been found in the Philippine Islands, from whence the animal figured and described by M. F. Cuvier seems to have been brought; but it is said also to belong to India, but on what authority I have not the means of ascertaining.

Colonel Sykes found *Viverra rasse*, Horsf. in the woods of the table lands east of the western ghauts,* and *V. indica*, a very nearly allied species to the latter, in the forests of the western ghauts. More recently Mr. Hodgson of Nipal mentions both these species as inhabitants of the Tarai.† The species figured in Hardwicke's Illustrations as *Viverra ben-*

* Proc. Zool. Soc. 14th Feb., 1832.

† Ib. Proc. 26th Aug. 1834.

galensis, Gray, seems to be *V. indica,* Geof. It appears probable therefore that naturalists have fallen into a mistake in supposing *V. zibetta* to be an inhabitant of India, i. e. Hindustan, and we shall probably be able to account for the manner in which the error, if it be one, has arisen.

In a collection of about 200 animals of different kinds recently formed by the plant collectors employed by our friend Mr. Griffith in the Kasyah mountains, is an animal which corresponds partly with *V. zibetta,* Gm. in the distribution of colour and size, but it has a shorter tail with only six complete broad black rings, and a broad black band passing below under the throat in addition to two black stripes on either side of the neck. As this animal corresponds nearly with the colour of the Zibeth, and is of the same size and form, we may presume that it has been supposed to be the same species. Without attempting to describe this animal fully, we beg to offer a few more remarks regarding its peculiarities.

Throat white, with black band passing from the ear backwards under the neck, a second interrupted black band on the side of the neck, and a third passing along either side of the nape and descending in front of the shoulder with a black streak along the spine, forming a short mane. There are six broad black rings encircling the tail. Head grey, with a dark spot on the base of the outer side of the external ear, general colour grey, darker above than below. The sides are streaked transversely, the streaks longitudinal on the hind quarters and shoulders, becoming closer and darker on the limbs, which are nearly black. The length of the tail is thirteen inches, length from the tail to the snout two feet nine inches. Height about thirteen and a half inches.

The tail of this animal is about the same length as that of *V. civetta,* but the black rings which surround it are broader, and this last peculiarity also removes it still farther from *V. zibetta;* in which the rings on the tail are more numerous and incomplete. It also differs from *V. civetta,* in having a white throat, and from *V. zibetta,* in the neck being crossed below by a black band. Should it prove a new species, as we have no doubt it will, we trust that its name may be connected with that of the distinguished botanist to whose liberality we are indebted for the first knowledge of its existence; and who, while employed himself in one extremity of India, can find means for supporting, and time for organising establishments for collecting natural productions in another.

The different animals of the Civet kind are in India called *Catàs;* there is one in Bengal, probably *V. indica,* Geof., which is very common, and has been known even to enter houses in Calcutta at night in search of poultry. A few months ago an instance of the kind occurred in a house surrounded by a high wall, and in which there were several dogs. The Catàs on finding itself pursued, entered a large pond, and appeared to rely with much confidence on its dexterity in the water for its safety.

On two undescribed species of Skate, or Raidæ. By Mr. J. M'Clelland.

We are acquainted with five species of *Raidæ* inhabiting the waters of Bengal, though nothing seems to have been written about them. Buchanan describes one, *Raia sancur,* without a caudal sting or spine; it ascends in the Ganges, he observes, as high as Cawnpore, and attains a great size; I have not yet met with the species alluded to by this author. I am therefore much inclined to suspect it to be the *Wolga tenkee* of Russel, a species whose tail is armed with a spine, but from the estimation in which this is held by the Hindus as a charm, it is generally removed before the fish is brought to market; should this conjecture prove correct with regard to Buchanan's species, it may become doubtful whether any species of stingless Raiæ (*Anacanthus*

Ehrenb.), inhabits India. Russel describes ten species, of which we have three in Bengal, namely, the *Tenkee kunsul,* Russ. *Isacurra tenkee,* id. and the *Wolga tenkee,* id. The following are two additional species to the three we have just mentioned, which all belong to Bengal.

MYLIOBATIS DUMER.

MYLIO. MACROPTERA, J. M. t. 11. f. 1.

A Myliobatis with an elongated depressed oval snout; the breadth of the body and pectorals equal to twice its length, and the length of the ventral fins at either side of the insertion of the tail equal to a third length of the body. Tail equal in length to twice the breadth of the body and pectorals. Dorsal placed at the base of the tail, and in front of a narrow pointed sting.

TRYGON ADANS.

TRYGON VARIEGATUS, J. M. t. 11. f. 2.

A Trygon with the upper surface of the body variegated like tortoise-shell, and covered with osseous tubercles, with one large tubercle on the back, and a serrated sting on the upper third of the tail; the tail is slender, without a fin, and equal to thrice the length of the body. Its breadth is about twenty inches. This is a very beautiful species, and is found in the Salt-Water Lake near Calcutta.

The first belongs to the singular group of *Skates* called Sea-Eagles, and is a good deal like the figure given in Hardwicke's Illustrations of Indian Zoology as *Myliobatis maculatus,* but the dorsal and ventral fins which are placed at the base of the tail are short and rounded, while in the species here described they are longer and angular.

The second is a very beautiful *Trygon,* or Sting-ray, of which we can find no account in authors, we have therefore described it as a new species.

DESCRIPTION OF PLATE. II.

FIG. 1.---MYLIOBATIS MACROPTERA; 1. a. Lower part of the head; 1. b. lower view of the ventrals and base of the tail.

FIG. 2.---2, a front view of the head, shewing the altitude and breadth of the body; 2. b. lower part of the head; 2. c. lower part of the body; 2. d. the osseous tubercles on the centre of the back, natural size.

Desiderata in the Entomology of India. By the Rev. F. W. Hope, F.R.S. &c. *privately furnished to* Dr. Cantor, *who has requested us to give them publicity.*

1.—Parasites of Birds, Lice, (*Nirmi*). Parasites of *Reptilia (Acari)* the name of the genus and species should be given on which they are found. Parasites of Quadrupeds, Ticks, &c.

2.—Endeavour to ascertain if the larger Beetles of India live more than one year; it is important also to ascertain the sexes of the *Atlas Beetles,* and the uses to which their horns are applied.

3.—Ascertain the names of the trees which yield *Resin Anime;* and if any other resins in India contain insects.

4.—Among *Coleoptera,* attend chiefly to the *Lamellicorn Beetles, Cetonia, Copris, Scarabæus,* and *Baprestidæ.*

5.—Ascertain by dissection of gigantic *Coleoptera* if the organs of hearing are in the basis of the antennæ as in *Crustacea;* collect the larvæ of all large *Beetles,* and try if they have the power of hearing.

6.—Send me an account of the habits of *Paussus,* and all the species you can obtain.

7.—Any species of insects infested with worms, should be noticed. The worms should have drawings made of them before put into spirits.

8.—All hermaphrodite insects to be noticed, as well as irregular copulation of different genera.

9.—All *Carrion Beetles* to be attended to. They are supposed to be *scarce* in India. The prejudice of caste and of religion will not allow many of the natives to touch a dead body of any animal.

10.—All species of silk-bearing insects used in commerce, with their local names and larva, eggs, &c. It is probable we may breed the Atlas Moths in England. Send Larvæ of any, placed in mould, when an opportunity occurs. Colonel Withill introduced alive into England *Bombyx Selene.* Any reports of the annual produce of silk useful.

11.—*Cochineal,* new species; intelligence wanted about its range. How many species in commerce in India. *Lac insect* also.

12.—*Bees.* All species of Bees to be collected. Any accounts of the produce of honey. The *native names* of Bees much wanted; any thing remarkable in the combs to be figured. All *parasite Beetles* found in Bees' nests much wanted. Imports and exports of honey and wax. What are the Bees which produce the wax of the Chinese candles? there are several sorts.

13.—*Ants.* Collect all species of Ants—males, females, and neuters. Ascertain if they *lay up* stores of grain, seeds, &c.; be careful in marking the species. What Ants will drive out the White-Ants? Are the different kinds employed by the natives, to drive out those which annoy them? Experiment on the formic acid. If the White-Ants' nests are ever used as ovens.

14.—*White-Ants.* Collect all species; attend to their parasites, particularly the *Beetles,* which attack them, and are found in their nests.

15.—What insects are eaten as food? Their Indian names. What *Locusts* are eaten, &c.?

16.—Mark those insects which cause any particular destruction of crops, and if the destruction is periodical.

17.—Mark all *luminous* insects. Ascertain if the *Lantern Fly* is *luminous*, it is disputed.

18.—What species of *Mygale* are in India? Their habits. What spiders yield silks, such as are found in commerce?

19.—What species of vesicatory insects are used in India? If any besides *Lytta* and *Mylabris*. If any insects are used medicinally. Their names.

20.—Record any instance of death occasioned by insects, by Bees, Wasps, Hornets, or by Flyblowing, &c. Any ailments produced by insects swallowed in the larva state, &c.

21.—Is *Resine Anime* a preservative against the attacks of insects? Said to be used in corking bottles. Is cloth *coloured by Indigo* ever attacked by the White-Ants and other insects?

22.—Any native remedies against Cockroaches? Collect all species of, and particularly all sorts of *Earwigs*.

23.—Native remedies used after the stings of insects, and the attacks of Gnats, Scorpions, Centipedes, &c.

24.—Note all insects infesting houses. Does any true *Ptinus* occur in the East Indies?

25.—Species of *Æstrus* attacking quadrupeds; collect them. Do any attack man in the East?

26.—Collect all Aquatic Beetles. Do the *Gyrene* of India emit a peculiar smell? Do the *Carabe* emit an ammoniacal odour?

27.—Collect all Land-Crabs and inland *Crustacea*.

28.—Observe particularly the insects which destroy corn, rice, and all stores. What checks are in use?

29.—Note any extraordinary migration of Caterpillars, and indeed of all other insects.

30.—The *Mole Cricket* of the East Indies. What are its habits?

31.—Note the appearance of the clouds of Locusts.

32.—What are the preservatives used by the Indians in guarding their feathers and shawls? Colocynth supposed to be used.

33.—What genera and species of insects are used by the natives, in necklaces and ornaments, &c.?

34.—The habits of the large *Stag Beetles.* Do they destroy leaves?

35.—Note all odorous smelling insects.

36.—Are Beehives in use in India? Send specimens of domestic Bees, if they are domesticated.

37.—Is the *Sherifah,* or Custard-Apple seed, injurious to vermin? Flies are reported never to settle on the tree or its fruits. Ants will attack both.

38.—From what quarters chiefly do clouds of Locusts come?

Proceedings of the Zoological Society.

November 27, 1838.---Lieut.-Colonel W. H. Sykes in the Chair.

Dr. Horsfield laid before the Meeting a series of Mammalia and Birds collected in India by John M'Clelland, Esq., Assistant Surgeon E.I.C.S., and proceeded to point out the characters of some which were undescribed.

A paper on the Fishes of the Deccan, illustrated with numerous coloured drawings, was read by Colonel Sykes.

"In submitting to the Society an account of the fishes of Dukhun," observes Colonel Sykes, "it will scarcely excite surprise, that out of 46 species described no less than 42 are new to science, since they are from a hitherto untrodden field, and from peculiar localities, on the great plateau of the Dukhun (Deccan), none of them coming from a less elevation than 1500 feet above the sea; many from near 2000 feet, and others from yet higher situations. The chief features in the collection are the paucity of orders to which the collection belongs, and the remarkable prevalence of the members of the families of *Siluridæ* and *Cyprinidæ*. There is but one apodal *Malacopterygian*, but 4 *Acanthopterygii*, and the whole of the rest of the fish belong to the order Abdominal Malacopterygians. Of the families there are only eight: *Percidæ, Scombridæ, 'Pharyngiens Labyrinthiformes,' Gobiadæ, Siluridæ, Cyprinidæ, Esocidæ,* and *Murænidæ*, comprising 15 genera and 9 sub-genera, including one sub-genus, which I have been compelled to add to the *Cyprinidæ*. An attempt has been made to methodize and distinguish the multitudinous members of the families of *Siluridæ* and *Cyprinidæ*. The fact is, the continued inosculation in the character of the teeth, of the *cirri*, of the spines (serrated or not) of the fins, the armature of the head, and the position of the fins in the *Siluridæ;* and the number of *cirri*, and form and position of the fins in the *Cyprinidæ*, together with the character of the mouth, produce such approximations in species to each other, and in individuals of one genus to another, that not only is there infinite difficulty in determining the genera of the fishes of these families, but their identity as species is occasionally not less difficult. Some of my *Siluridæ* do not exactly correspond with the generic characters of the genera of this family as now constituted, and I might have added to the number of genera; but to this I have an objection, unless as an evidently necessary measure. In the *Cyprinidæ*, however, I was obliged to set aside my repugnance, for three species were not referrible to any one even of the numerous sub-genera which Buchanan Hamilton wished to establish. It only remains to state that the whole of my fishes were drawn from absolute measurement, and have a scale of size attached to each figure; they were caught in the various rivers on whose banks I encamped, as individuals were required; so that my draftsman, who worked constantly under my own eye, never had to finish his drawings from shrivelled and discoloured specimens. I have to a great extent adopted the names by which the fishes are called by the Mahrattas as specific names, so that naturalists who travel the country can always obtain them.

Ord. ACANTHOPTERYGII.

Fam. Percidæ.

Ambassis, Agass.

Amb. Barlovi, Sykes. An *Ambassis* with the two back fins united, with the first ray indented on the edge, and containing 7 spines, and the second 14 spines; all the spines longer than the membrane, with 18 rays longer than the membrane in the anal fin, and with a short vertically compressed diaphanous body.

Closely allied to *Changa Ranga* of Hamilton. 'Fishes of the Ganges.' This fish is dedicated to our Secretary.

Fam. Scombridæ.

Mastacembelus, Gron.

Mast. armatus, Sykes. A *Mastacembelus* with the fins of the tail, back, and vent united, with thirty-nine to forty short sharp bony spines along the back, and two behind the vent.

This fish has not the exact generic characters of *Macrognathus*, *Mastacembelus*, or *Notacanthus*, and might probably constitute a genus between the two last.

Fam. 'Pharyngiens Labyrinthiformes,' Cuv.

Ophicephalus, Bloch.

Oph. leucopunctatus, Sykes. An *Ophicephalus* with from 51 to 53 rays in the dorsal, and 6 in each ventral fin, and with the rays of the dorsal and anal fins undivided; the pectoral fins ending in a central point, and the fish covered with white dots.

I have never known this remarkably fine fish crawl on shore or in the grass, as some species of the genus are said to do. It is excellent eating.

Fam. Gobiadæ.

Gobius, Linn.

Gob. Kurpah, Sykes. A *Gobius* with 7 rays in the first dorsal fin, 11 in the second, which is of similar size with the anal fin; 19 in the pectoral, and 10 in the anal fin.

In different individuals of this species I have found the number of rays in the fins slightly differ. Of a sweet flavour.

Ord. Malacopterygii Abdominales.

Fam. Cyprinidæ.

Cyprinus, Linn.

Cyp. Abramioides, Sykes. A *Cyprinus* with 20 rays in the dorsal, 8 in the anal, and 18 in the pectoral fins, without tendrils, with tuberculated nose, red edged fins, and with a red lunule on each scale.

This very fine fish is called Tambra by the natives, from the general prevalence of a copper colour over it. Attains the length of 21 inches and more: height 7 inches. Is excellent eating.

Cyp. Potail, Sykes.

A *Cyprinus* proper, deep and fleshy, slightly compressed without tendrils, with the dorsal fin of 13 rays, pectoral of 14, and anal of 9. Scales large and silvery; length 10 or more inches; height $3\frac{1}{4}$ inches.

Cyp. Nukta, Sykes.

A *Cyprinus* with two tendrils on the under jaw, and with two short horns or bosses on the space between the eyes, which together with the deflected upper lip are tuberculated; large scales.

In the judgment of my friend Mr. Yarrell, to which I subscribe, this very singular fish is considered a monstrosity of *Cyp. auratus*. Dr. Rüppell, who did me the favour to look over my drawings, expresses the same opinion. Found very abundantly in the Inderanee river 18 miles north of Poona. It is called Nukta (or nob) by the Mahratta fishermen.

Varicorhinus, Rüppell.

Var. Bobree, Sykes. A *Varicorhinus* with tuberculated nose, without tendrils; with 17 rays in the dorsal, and 8 in the anal fin; with the form of a tench.

It may be a question whether this is not a real Labeo of Cuvier, with long dorsal, no spines or cirri, and thick fleshy lips frequently crenated; size 6 inches by $1\frac{6}{10}$ high.

Barbus, Cuv.

Barb. Mussullah, Sykes. A *Barbus* with 12 rays in the dorsal, 8 in the anal, and 16 in the pectoral fins, with the mouth furnished with 4 very short *cirri*, and tuberculated nose; sometimes 3 feet and more long, and a foot high, and weighing 42 pounds.

Found in the Goreh river.

Barb. Khudree, Sykes. A *Barbus* with 4 *cirri*, blood-stained fins, large hexagonal scales, elongated body, and with 14 rays in the dorsal, 14 in the pectoral, and 7 in the anal fins.

Found in the Mota Mola river, 8 miles east of Poona.

Barb. Kolus, Sykes. A *Barbus* with 13 rays in the dorsal fin, 8 in the anal, and 10 in the ventral; with moderate-sized scales; with callous tubercles on the head, and a short *cirrus* at each corner of the mouth.

This fish shows the difficulty of drawing up generic characters to embrace all the species of a genus. Having only 2 *cirri*, it should not be a Barbel; but having *cirri* at all, it does not belong to the next genus *Gobio*;—moreover, it has a spine in the dorsal.

Chondrostoma, Agassiz, the first division of the genus *Leuciscus* of Klein. Dorsal fin in the centre of the back.

Chond. Kawrus, Sykes. A *Chondrostoma*, without lateral line, tubercles, or *cirri*, with 12 rays in the dorsal, 8 in the anal and 16 in the pectoral fins.

A sub-cylindrical fish found in the Beema river; grows to a foot in length, but is usually smaller. Proportion of length to height in one specimen, 6 inches by $1\frac{4}{10}$ inch.

Chond. Fulungee, Sykes. A *Chondrostoma*, with dorsal fin of 10 rays, anal 6, and pectoral of 10; of an elongated, not much compressed shape. Length about a foot; height 4 inches.

Chond. Boggut, Sykes. A *Chondrostoma*, without tendrils or tubercles on the nose, with 12 rays in the dorsal, 15 in the pectoral, and 8 in the anal fin; body of an elongated form. Length from 7 to 11 inches; height $1\frac{3}{4}$ to 2 inches.

Chond. Mullya, Sykes. A *Chondrostoma*, with a short, obtuse head, without tubercles or tendrils; sub-cylindrical body, with 11 rays in the dorsal, 14 to 16 in the pectoral, and 8 in the anal fins; a red process or protuberance on the snout between the nostrils. Length 5 to 6 inches; $1\frac{1}{2}$ to 2 in diameter.

Chond. Wattanah, Sykes. A *Chondrostoma* of an elongated form, without tubercles or tendrils, with the dorsal fin high, and having 11 rays: and 9 or 10 in the ventral, and 8 in the anal fin; sub-cylindrical form. Length $4\frac{1}{4}$ inches, height $\frac{3}{4}$ of an inch.

Found in the Beema river.

Chela, Buchanan Hamilton. A sub-genus of *Leuciscus,* with the dorsal fin very far behind over the anal; straight back, and nose on the level of the line of the back.

Chel. Balookee, Sykes. A *Chela* of the size of a minnow; back straight; body elongated; dorsal fin situated far back, and having 8 rays, 14 rays in the anal, and 12 in the pectoral fins. Length 3 inches.

Very sweet eating, the bones as well as other parts. Common in all the rivers.

Chel. Oweni, Sykes. A *Chela,* with straight back, elongated and vertically compressed body; dorsal fin situated far back, with 11 rays, 12 in the pectoral, and 19 in the anal fins, with scales so minute as to be scarcely discoverable. Length 5 inches; greatest size 7 inches.

Found in most of the rivers. The *Cyprinus Cultratus* of Bloch would appear to be the type of the sub-genus.

I have dedicated this fish to my friend Mr. Owen, the distinguished naturalist.

Chel. Jorah, Sykes. A *Chela,* with straight back, convex belly, dorsal fin far behind; size of a large minnow; with 10 rays in the dorsal, 12 in the pectoral, and 8 rays in the anal fin. Length about 4 inches, height $\frac{8}{10}$ths. of an inch.

Excellent eating. Found abundantly in the Beema river near Pairgaon.

Chel. Teekanee, Sykes. A small *Chela,* with nearly straight back; snout on the continuation of the line of the back; belly arched;

with 10 rays in the dorsal, 12 in the pectoral, and 14 in the anal fins. Length $2\frac{1}{4}$ inches, height $\frac{3}{4}$ inch.

Found in the Beema.

Chel. Alkootee, Sykes. An elongated, silver-white, slightly compressed, minute *Chela*, with the dorsal fin about 8 rays, very far back; ventral of about 7, and anal of about 10 rays, with burnished silver gill covers and black orbits; rarely more than an inch long, and not much thicker than a good sized crow quill.

This very beautiful fish has a sweet flavour.

Leuciscus, Klein. First division. The dorsal situated a little behind the centre of the back, above the space between the ventral and anal fins.

Leuc. Morar; Cyprinus Morar, Buchanan Hamilton. A *Leuciscus* allied to *Chela*, but with the dorsal fin a little behind the centre of the back, with 8 rays in each ventral fin, 12 in the anal, and 10 in the dorsal, and with the edge of the belly smooth. Length $4\frac{3}{4}$ inches; height $\frac{1}{10}$.

Differs slightly from Buchanan Hamilton's *L. Morar*.

Leuc. Sandkhol, Sykes. A *Leuciscus*, with nearly cylindrical body; dorsal fin of 12 rays, pectoral of 14, and ventral of 10 rays; gibbous head; 8 to 10 inches long by $1\frac{1}{2}$ to 2 inches high; eyes with whitish narrow irides. The dorsal in this fish is situated a little *before* the centre of the back.

Found in the Goreh river at Kullumb.

Leuc. Chitul, Sykes. A *Leuciscus*, with 14 rays in the dorsal, 14 in the pectoral, and 8 in the anal fins; of a reddish grey colour, and rounded head. Sub-cylindrical. Length about 5 inches, height $1\frac{1}{2}$ inch.

Found in the Inderanee river near Chakun.

It being found impracticable to arrange, in any of the sub-genera described, the following fishes of the Carp family, it is proposed to place them in a new sub-genus, which I will call by the native Mahratta name of Rohtee.

ROHTEE, nov. genus.

Carps with a lozenge-shaped body, rather long dorsal and anal fins, the former seated on the angle of the back with the first complete ray serrated posteriorly; scales minute.

Rohtee Ogilbii, Sykes. A *Rohtee*, with 12 rays in the dorsal, 9 in the ventral, and 17 in the anal fins; the body very compressed, and very high, with the back sloping to each end from the centre; head sharpish; pectoral fins, narrow acuminated. First complete dorsal ray, a strong bone, serrated behind. Length $4\frac{1}{2}$ inches, height $1\frac{1}{2}$ inch. A bony fish.

Found in the Beema river near Pairgaon. This fish is dedicated to my friend Mr. Ogilby, a distinguished member of the Society.

Roht. Vigorsii, Sykes. A *Rohtee*, with armed dorsal fin of 11 rays, ventral of 10, and anal of 28 rays; compressed body; high in the middle, and sloping to each end; head slightly recurved; eyes very large. Length, 6 inches; height, $1\frac{9}{10}$ inches; greatest length, 8 inches.

Found abundantly in the Beema river at Pairgaon. I have dedicated this fish to my friend Mr. Vigors.

Roth. Pangui, Sykes. A *Rohtee*, compressed, deep, angular-backed, with 12 rays in the dorsal, 14 or 15 in the pectoral, and 8 in the anal fins, and with the first 3 or 4 rays of the dorsal fin black at their tips; scales larger than in the preceding species. Length, 5 inches; height, $1\frac{1}{4}$ inch.

Found in the Baum and Beema rivers.

Roht. Ticto; Cyprinus Ticto of Buchanan Hamilton. A *Rohtee*, $1\frac{1}{2}$ inch long, with 4 to 6 black spots on the body; the 2nd ray of the dorsal toothed behind with sharp incurved teeth; with 10 rays in the dorsal, 8 in the anal, and 8 in the ventral fins; pectoral fins narrow, acuminate.

Found in the Mota Mola at Poona. This fish differs slightly from Dr. Buchanan Hamilton's *Cyprinus Ticto*.

Cobitis, Lin.

Cob. Rüpelli, Sykes. A nearly cylindrical scaleless *Cobitis*, not much thicker than a large goose-quill; from 2 to 3 inches long with 6 *cirri;* the lateral line marked with short brown bars, and the rays of the dorsal and anal fins similarly barred; dorsal fin of 13 rays, pectoral of 12, and ventral of 8 rays.

This fish is much esteemed for food. Found in the Beema river at Taimbournee and Mota Mola near Poona. I have dedicated this beautiful little fish to Rüppell, who did me the favour to look over my drawings, and at the same time gave me his opinion respecting the genera of the fishes.

Cob. Mooreh, Sykes. Differs from the preceding only in being of a smaller size, in having 12 rays in the dorsal, and 7 in the anal fin; the head is more obtusely pointed, and there are more dark blotches on it; the bars on the lateral line are differently arranged.

Cob. Maya, Sykes. Differs from the first species in having a spine under each eye, and in having a blunter head; 9 rays in the dorsal, 7 in the ventral fins.

Fam. *Esocidæ.*

Belone, Cuv.

Bel. Graii, Sykes. A *Belone* with the fin of the tail rounded and emarginate, with both jaws elongated into a quadrangular beak; with very minute scales; dorsal of 16 rays and anal of 16 rays; closely allied to the *Esox Cancila* of Buchanan Hamilton.

I have dedicated this fish to a gentleman well known for his contributions in natural history.

Fam. *Siluridæ.*

Schilbe, Cuv.

Sch. Pabo; Silurus Pabo, Buchanan Hamilton. A *Schilbe,* with the tail divided into 2 unequal lobes, both pointing downwards; with 4 *cirri,* 2 shorter than the head, and with from 68 to 70 rays in the anal fin. Length from 12 to 15 inches, height $2\frac{1}{2}$ to 3 inches.

Found in most of the rivers. Differs slightly from Buchanan Hamilton's *Silurus Pabo.* No second dorsal.

Sch. Boalis, Silurus Boalis, Buchanan Hamilton. A *Schilbe,* with the fin of the tail divided into 2 unequal lobes; with 4 *cirri,* of which 2 extend to the middle of the fish; all the fins unarmed; dorsal of 5 rays, pectoral of 15; ventral fins very small, of 9 rays; anal fin of 84 rays. Attains the length of 3 feet, and the weight of 8 lbs.

Found in the Mota Mola at Poona. Differs slightly from the *Silurus Boalis* of Buchanan Hamilton. No second dorsal.

Hypophthalmus, Spix.

Hyp. Goongwaree, Sykes. An *Hypopthalmus* with 8 *cirri*, all longer than the head, but not extending to the middle of the fish; with 7 rays in the dorsal, and 52 in the anal fin, with an extremely minute second dorsal; first ray in the pectoral, and first in the dorsal, spinose and serrated behind. Greatest length 28 inches: body vertically compressed.

Found in the Mota Mola near Poona.

Hyp. Taakree, Sykes. An *Hypophthalmus*, with 8 *cirri*, 2 of which reach to the ventral fins, 2 very minute near the nostrils, and 4 on the chin, nearly as long as the head; with the first dorsal and pectoral rays serrated on the posterior edge, with 8 rays in the dorsal and 50 in the anal fin. Length, 9 inches; height, 2 inches.

Bagrus, Cuvier.

Bagr. Yarrelli, Sykes. A *Bagrus*, with the first rays of the pectoral and dorsal fins terminating in long fleshy tendrils and serrated behind; with 8 *cirri*, two of which are as long as the head, thick, fleshy, and being lateral elongations of the upper lip; other *cirri* very short; head broad, covered with a granulated bony plate; the fish olive brown, marked with black blotches like a Dalmatian dog; 2nd dorsal fleshy, triangular. Length, 18 inches, but attains to a very great size; body not vertically compressed.

Found in the Mota Mola at Poona.

Bagr. Lonah, Sykes. A *Bagrus*, with 8 small *cirri;* flat, granulated head; first dorsal fin of 7 rays, and pectoral of 10 rays, the first ray of which is furnished on the posterior edge with long sharp teeth; anal fin of 10 rays; 2nd dorsal of a triangular form and fleshy: something resembling the preceding in colour.

Platystoma, Agassiz.

Plat. Seenghala, Sykes. A *Platystoma*, with the tail fin crescent-shaped, lobes unequal; with 8 *cirri*, two of which only are longer than the head, reaching to two-thirds of the length of the fish; the first ray of the pectoral and ventral fins serrated behind; head long, flat, spatulate, covered with a granulated bony plate. Dorsal fin of 8 rays; high, ventral fins, very far back, of 6 rays. Grows to a great size; flesh heating and soft.

Phractocephalus, Agassiz. *Pirarara* of Spix.

Phract. Kuturnee, Sykes. A *Phractocephalus,* with 6 *cirri,* 2 of which only are longer than the head; the first pectoral spine serrated on both edges; the 1st dorsal spine on the posterior edge only; these two spines terminating in a filament: the shoulder-bone elongated into a point behind. Greatest length, 6 inches; dorsal fin of 7 rays; pectoral of 9 rays; ventral fin small, of 7 rays; second dorsal replaced by a small adipose fin.

Phract. Itchkeea, Sykes. A *Phractocephalus,* with 8 *cirri,* 2 of which from the upper lip, extend to the end of the pectoral fins; the other 2 very minute, with the 4 on the chin nearly as long as the head; with the 1st ray in the pectoral fins only serrated; with 8 rays in the dorsal, and 12 in the anal fins; with a sharp prolongation of the scapula. Fish handsomely marked on the back with dark colours. Length, 2 inches.

This fish presents some slight deviations from the generic characters.

Phract. Gogra, Sykes. A *Phractocephalus,* with 4 shortish *cirri;* the plates of the shoulder elongated into acute, angular, broad spines, with a dorsal fin of 8 rays; first ray a bone serrated behind; pectoral fins of 10 rays, the first ray a broad compressed bone serrated on both edges; head flat and broad; second dorsal small, fleshy. Size 6 inches, but grows larger.

Pimelodus, Lacepede.

Pimelodus Seengtee, Sykes. A *Pimelodus,* with the caudal fin divided into 2 unequal sharpish lobes, and having 8 *cirri,* 2 of which reach to the tail fin, and 4 to the end of the head, and 2 are shorter than the head; the dorsal fin high and without spine, of 9 rays; 12 rays in the anal fin; the second dorsal adipose, and extending from the termination of the first dorsal to near the tail. Length of fish, 6 inches.

Ageneiosus, Lacepede.

Ageneiosus Childreni, Sykes. An *Ageneiosus,* without *cirri,* with the first ray of the dorsal and pectoral fins serrated on the *anterior* edge only; with 8 rays in the dorsal, and 42 in the anal fin; with two sharp lobes to the tail, the upper being somewhat the smallest. Length of fish, 18 inches; height, $4\frac{1}{2}$ inches, but grows to a larger size. Second dorsal adipose, minute.

Fam. *Clupeidæ.*

Mystus, Buchanan Hamilton; *Notopterus,* Lacepede.

Mystus Badgee, Sykes. A *Mystus*, with not less than 105 rays in the anal fin, 7 or 8 in the dorsal, and in the pectoral from 13 to 16, all unarmed; without apparent ventral fins, and with a single small dorsal; the anal and caudal fins uniting, and terminating in a point at the end of the body; posterior edge of the last gill plate crenated; scales minute. This remarkable fish belongs to the genus *Mystus* of Buchanan Hamilton, but not to the genus *Mystus* of Cuvier. Fish vertically compressed. Length, 11 inches; height 3 inches.

Ord. Apodes.

Fam. *Murænidæ.*

Anguilla, Cuv.

Ang. Elphinstonei, Sykes. An *Anguilla*, with the lower jaw the longest; with the back, tail, and anal fins united, and with a broadish, flat head; body dark green, blotched with black; with 2 short tubular processes, one on each side of the upper jaw. Attains the length of 3 feet, and diameter of 3 inches.

I have dedicated this fine fish to the Honourable Mountstewart Elphinstone.

In concluding my characters of the fishes of Dukhun (Deccan), I may be allowed to state, that I have found the number of *cirri*, whether in the *Siluridæ* or *Cyprinidæ*, insufficient as a *generic* character; different species of the same genus varying in the number of the *cirri*."

February 26, 1839.—Rev. F. W. Hope, in the Chair.

A communication from the Bishop of Down and Connor was read, giving an account of *Antilope Philantomba*, Ogilb. lately brought from Sierra Leone, by F. W. Mant, Esq. Also a communication by Lieut. H. K. Sayers, on the habits of another species of Monkey from Sierra Leone.

At the request of the Chairman, Mr. Ogilby proceeded to make some observations upon a new species of Monkey, now living at the Society's Menagerie, which he characterized as follows:

Papio Melanotus. *P. cinereo-brunneus; capite, dorso, lumbisque subnigris; cauda brevissima, nuda; facie, auriculisque pallidis.*

The specimen from which this description is taken is a young male, said to have been brought from Madras. It has at first sight a considerable resemblance to the common Barbary species *(Papio sylvanus)* both in general colour and in physiognomy, but differs materially in the blackish brown shade which covers all the upper parts of the head, neck, shoulders, and back. The face and ears are of a pale flesh colour, not unlike the shade which distinguishes extreme age in the human species; the naked part of the paws is dirty brown, and the temples are slightly tinged with a shade of scarlet, which the keeper informs me spreads and deepens when the animal is feeding. The tail is about an inch long, very slender, and perfectly *naked;* but whether the last circumstance be not accidental I shall not take on me to say; it *appears*, however, to be the natural condition of the organ. The general colour of the sides, under parts of the body, and extremities, is that pale olive brown so common among other species of this genus, such as the Bhunder *(P. Rhesus)*, the Maimon *(P. Nemestrinus)*, &c., and the hairs are equally without annulations. The individual has all the liveliness, good-nature, and grimace of the young Magot (*P. Inuus* and *Sylvanus*)*;* but, like that species, it will probably become morose and saturnine as it advances in age and physical development; qualities which, indeed, are common to all the Papios, and pre-eminently distinguish them from the Cercopithecs, Colobs, and Semnopithecs.

A paper, entitled "*Spicilegium Serpentium Indicorum*," was communicated by Dr. Theodore Cantor. This paper contains the following descriptions of

A. Venomous Serpents.*

Genus Trigonocephalus, Oppel.

Trigonocephalus erythrurus. *Tri. supra læte viridis, squamis ovatis carinatis subimbricatis, cauda cinnamomea, squamis lævibus rhomboidalibus tecta; abdomine flavo-viridescenti linea nigra serrata utrinque incluso.*

Scuta abdominalia 167.

Scutella subcaudalia 68.

Habitat. Delta Gangeticum.

Bright green above, with ovate keeled slightly imbricate scales; the tail cinnamon-red, with smooth rhomboidal scales; the abdominal surface greenish-yellow, inclosed on both sides by a black serrated line.

Trigonocephalus mucrosquamatus. *Tri. superne, griseo-brunnescens,*

* Dr. Cantor's original specimens, drawings, and descriptions are in the possession of the Radcliffe Library, Oxford.

annulis nigris albo marginatis, squamis ovalibus, semicarinatis, mucronatis, imbucatim tectus; subtus albidus, nigro punctatus.

Scuta abdominalia 218.

Scutella subcaudalia 91.

Habitat. Naga Hills, Assam.

Brownish grey above, with black white-edged rings, covered with oval, half-keeled, pointed, imbricate scales; whitish beneath, dotted with black.

Genus Bungarus, Daudin.

Bungarus lividus. *Bung. superne lividus, subtus albo-flavescens.*

Scuta abdominalia 221.

Scuta subcaudalia 56.

Habitat. Assam.

Blackish-blue above, yellowish-white beneath.

Genus Hamadryas,* Cantor.

Hamadryas ophiophagus. *Ham. superne olivaceo-viridis, striis sagittalibus nigris cinctus, abdomine glauco nigro marmorato.*

Scuta abdominalia a 215 *ad* 245.

Scuta subcaudalia a 13 *ad* 32.

Scutella subcaudalia a 63 *ad* 71.

Habitat. Bengal.

Hindustanee name: Sunkr-Choar.

Olive-green above, with arrow-shaped black stripes; beneath, glaucous marbled with black.

Genus Naja, Laurenti.

Naja larvata. *Na. supra brunnea, striis subflavis transversalibus variegata; disco annulo albo, larvæ haud impari, ornato, pone quem (a tribus ad quinque) annuli albi;---inferioris superficiei pars anterior annulis albis, nigro-cœrulescentibus alternis circumdata, pars posterior glauco iridescens.*

Habitat. Bombay, Calcutta, Assam.

Bengallee name: Doollah-Kewtiah Nag.

Brownish, with numerous faint yellow transverse stripes; the hood marked with a white ring, not unlike the form of a mask, behind which there are from three to five white rings;---the anterior part of the lower surface with alternate white and bluish-black rings; the posterior part iridescent-glaucous.

* Vide Proceedings of the Zoological Society, No. lxvi. p. 73.

A young specimen of this serpent lives at present in the Society's Gardens in Regent's Park. The artificial temperature, 62° Fahr., in which it is kept appears to agree very well with the serpent, which in one respect offers a striking difference from the habits of this genus when kept in captivity in India, for the keeper informs me that it feeds occasionally upon living frogs and earth-worms, and that it drinks milk; while those in Dr. Russell's and in my own possession in India, when deprived of liberty invariable refused to take any kind of food.

Genus Elaps, Schneider.

Elaps Bungaroides.* *El. superne lividus, striis sagittalibus albis cinctus; infra albus alterne lividus.*

Scuta abdominalia 237.

Scutella subcaudalia 46.

Habitat. Chirra Punji.

Black-blue above, with white arrow-shaped stripes; beneath, alternately white and black-blue.

Elaps flaviceps. *El. capite flavo, dorso nigro vitta serrata alba cœruleo pallide nitente utrinque circumdato, cauda flava linea nigra media divisa;—abdomine flavo linea nigra utrinque incluso.*

Scuta abdominalia 275.

Scutella subcaudalia 45.

Habitat. Malacca.

The head yellow, the back with a serrate band on each side, shining with a pale sky-blue colour; the tail yellow, divided in the middle by a blach dorsal line; the abdominal surface yellow, inclosed on each side by a black line.

On my late visit to Copenhagen, Professor Reinhard pointed out an undescribed species of Bungarus from Java, preserved in the Royal Museum of Natural History (MSS. Cat., No. 128), which exhibits the same distribution of colours as the *Elaps flaviceps*, viz. the head and tail of a light yellow, the back bluish-black, the abdominal surface light yellow, the scuta marked with a short black transverse band or check on each side.

Elaps nigromaculatus. *El. superne pallide brunneo-rubescens, maculis nigris alba-marginatis, lineis nigris junctis;—cauda fasciis daubus nigris*

* From its resemblance to *Bungarus cœruleus*, Daudin.

alba-marginatis cincla ; abdomine flavo albescenti, alterne livido, linea nigra serrata utrinque incluso.

Scuta abdominalia 238.

Scutella subcaudalia 24.

Habitat. Sincapore.

Pale reddish brown above, with black white-edged spots, united by black lines ; on the tail two black bands with white margins ;---the abdominal surface whitish yellow, alternately blue-black, inclosed on both sides by a black serrated line.

ELAPS FURCATUS,* Schneider, Var. *El. superne pallide brunneo-rubescens, linea dorsali subflava nigro serratim marginata, cauda fasciis tribus nigris cincta, abdomine flavo albescenti, linea nigra utrinque incluso.*

Scuta abdominalia 238.

Scutella subcaudalia 24.

Habitat. Sincapore.

Pale reddish brown, above with a light yellow dorsal line, with black serrated margins; on the tail three black bands; the abdominal surface whitish yellow, inclosed on each side by a black line.

March 12, 1839.---William Yarrell, Esq., in the Chair.

Mr. Ogilby communicated a portion of a letter which he had received from M. Temminck. It related to two species of Monkeys, *Colobus fuligenous* and *Papio speciosus;* the former M. Temminck considers identical with the Bay-Monkey of Pennant, and he states that this opinion is founded upon its agreement with a coloured drawing now in his possession; this drawing having been taken by Sydenham Edwards from the specimen of the Bay-Monkey formerly in the Leverian Museum, and which is the original of Pennant's description.

The *Macacus speciosus* of M. F. Cuvier is stated by M. Temminck to be founded upon an immature specimen of a species of *Macacus* which inhabits Japan ; the habitat of Molucca Islands given by M. F. Cuvier being founded upon error. The specimen was originally taken from Japan to Java, where it died ; the skin was preserved, and M. Diard having obtained possession of it, sent it to the Paris Museum; and as there was no label attached, M. F. Cuvier imagined it to be a native of the place whence M. Diard had sent it.

* Russel, II., No. xix.

Mr. Fox exhibited several birds, which he stated had formed part of an extensive collection made in Iceland by the Curator of the Durham Museum.

The second part of Dr. Theodore Cantor's paper, entitled "*Spicilegium Serpentium Indicorum*," was read. In this paper numerous new species of Indian serpents are thus characterized :---

B. Innocuous Serpents.

Genus Calamaria, Linne.

Calamaria sagittaria. *Cal. partim cinerea, partim ferruginea, serie dorsali punctorum nigrorum, nucha capiteque albicantibus, imagine sagittæ nigræ ornatis ; corpore squamis lævibus imbricatim tecto ; abdomine citrino, punctis lateralibus nigris, vitta livida utrinque incluso.*

Scuta abdominalia 224.

Scutella subcaudalia 69.

Habitat. Bengal, Tirhoot.

Partly ash-coloured, partly rusty-brown, with a series of black dots along the back ; the head and neck whitish, with an arrow-shaped black mark ; covered with smooth rhomboidal imbricate scales ; the stomach of a citrine colour, with lateral black dots, and a blue black band on either side.

Vernacular name, Doblee.

Calamaria monticola. *Cal. olivaceo-fusca, collari læte flavo, linea dorsali albicante, abdomine citrino.*

Scuta abdominalia 125.

Scutella subcaudalia 44.

Habitat. Naga Hills in Assam.

Dark olive-brown, with a bright yellow collar and a whitish dorsal line ; beneath of a citrine colour.

Genus Coronella, Boie.

Coronella albocincta. *Cor. viride-canescens, fasciis transversalibus albis nigro marginatis, quorum intervalla nigro punctata ; scutis abdominalibus albo-flavescentibus, alterne fuscis.*

Scuta abdominalia 181.

Scutella subcaudalia 65.

Habitat. Chirra Punji, Assam.

Greyish-green, with white transverse bands, edged with black, the intervals dotted with black; the abdominal scuta alternately yellowish-white and deep brown.

Assamese name, Patdei-hee.

Coronella violacea. *Cor. violaceo-rubescens, squamis albo-marginatis, subtus margaritacies.*

Scuta abdominalia 196.

Scutella subcaudalia 38.

Habitat. Rungpore.

Reddish-violet; the scales edged with white; beneath pearl-coloured.

Coronella cyclura. *Cor. viridè-canescens striis nigris obliquis interruptis, abdomine margaritaceo, vittâ tristè cinereâ utrinque incluso.*

Scuta abdominala 179.

Scutella subcaudalia 43.

Greyish-green, with black oblique interrupted stripes; the abdominal surface pearl-coloured, with a deep ashy-grey band on either side.

Vernacular name, Tukkr-Bora.

Genus Lycodon, Boie.

Lycodon atro-purpureus. *Ly. atro-purpureus albo nigroque marmoratus, abdomine margaritaceo.*

Scuta abdominalia 257.

Scutella subcaudalia 91.

Habitat. Mergui, Tenasserim.

Deep purple, marbled with white and black; beneath pearl-coloured.

Lycodon subfuscus. *Ly. subfuscus, abdomine albo flavescenti.*

Scuta abdominalia 245.

Scutella subcaudalia 78.

Habitat. Bengal.

Light brown; yellowish white beneath.

Vernacular name, Chittee.

Genus Coluber, Boie.

Coluber dhumna. *Col. olivaceo-viridis, squamis nigro-marginatis, abdomine margaritaceo, scutis scutellisque nigro-clavatis.*

Scuta abdominalia 187.

Scutella subcaudalia 119.

Habitat. Carnatic, Orissa, Bengal, Nepal, Assam, Arracan, Tenasserim.

Olive-green; the scales edged with black; the stomach pearl-coloured, edged with black.

Vernacular name, Dhumna or Dhameen.

Coluber porphyraceus. *Col. læte porphyraceus, lineis nigris transversalibus albo-marginatis, pone quas lineæ duæ nigræ dorsales, æquidistantes; subtus læte flavus.*

Scuta abdominalia 213.

Scutella subcaudalia 64.

Habitat. Mishmee Hills, Assam.

Bright porphyry-red, with black transverse lines edged with white, the posterior portion of the body with two black parallel dorsal lines; beneath light yellow.

Coluber quadrifasciatus. *Col. superne læte brunneo-viridescens fasciis dorsalibus* iv. *nigris, albo interruptis; infra flavus.*

Scuta abdominalia 248.

Scutella subcaudalia 82.

Habitat. Assam.

Above light greenish-brown, with 4 black dorsal bands interrupted with white; beneath yellow.

Coluber curvirostris. *Col. supra partim læte olivaceo-viridis, punctis et lineis obliquis albis nigrisque, partim æneus; abdomine subfusco.*

Scuta abdominalia 220.

Scutella subcaudalia 85.

Habitat. Bengal.

Above bright olive-green, with white and black dots, and oblique bronze-coloured lines; beneath light yellow.

Vernacular name, Tukkr-Bora.

Coluber reticularis. *Col. superne brunneo-nigrescens, annulis albidis reticulatis, contiguis et lineis ejusdem coloris transversalibus ornatus, cauda brunnea nigrescenti, alterne griseo-flavescenti; infra griseo-flavescens nigro-maculatus.*

Scuta abdominalia 229.

Scutella subcaudalia 75.

Habitat. Chirra Punji.

Blackish-brown, with whitish confluent netted rings and transverse lines of the same colour; the tail alternately blackish-brown and yellowish-grey; beneath yellowish-grey spotted with black.

COLUBER BIPUNCTATUS. *Col. supra triste vinoso-purpureus squamis albo bypunctatis, subtus albo-cœrulescens.*

Scuta abdominalia 181.
Scutella subcaudalia 52.

Habitat. Bengal, Assam.

Deep claret-purple above; each scale with two white dots; beneath bluish-white.

COLUBER MONTICOLUS. Hodgson. *Col. superne luteo-rubescens fascus-transversalibus nigris, scutis abdominalibus albo-flavescentibus nigro marginatis.*

Habitat. Nepal.

Reddish dun-coloured above, with black transverse bands; the abdominal scuta yellowish-white, with black margins.

Subgen. HURRIAH, Daudin.

HURRIAH SANGUIVENTER, (COLUBER SANGUIVENTER, Hodgson.) *Hur. superne vinoso-purpureus æneo nitens, abdomine sanguineo.*

Scuta abdominalia 207.
Scuta subcaudalia 14.
Scutella subcaudalia 85.

Habitat. Nepal.

Above claret-purple, with metallic lustre; beneath blood-coloured.

Genus HURPETODRYAS, Boie.

HERPETODRYAS PRIONOTUS. *Her. supra fusco flavescens, nigro-punctatus, fasciaque dorsali serratâ nigricante; abdomine flavo, fascia serratâ nigricante utrinque incluso.*

Scuta abdominalia 153.
Scutella subcaudalia 65.

Habitat. Malacca.

Above yellowish-brown, dotted with black, and with a serrated blackish dorsal band; the abdominal surface yellow, with a blackish serrated band on either side.

Genus PSAMMOPHIS, Boie.

PSAMMOPHIS CERASOGASTER. *Psam. fulvus aureo pallidè nitens, squamis hexagonis rhomboidalibus summis carinatis, cœteris lœvibus tectus; abdomine ceriseo, linea lœte flava utrinque incluso.*

Scuta abdominalia 149.
Scutella subcaudalia 60.

Habitat. Bengal, Assam.

Yellowish-brown, shining with a pale gold colour, with hexagonal rhomboidal scales, the uppermost of which are keeled, the rest smooth; the abdominal surface cherry-coloured, with a bright yellow line on either side.

Vernacular name, Lal Mitallee.

Psammophis nigrofasciatus. *Psam. superne subflavo-rubescens fasciis latis transversalibus nigris, lineisque duabus barbatis dorsalibus ejusdem coloris, interstitium quarum nigro partim punctatum; abdomine albido.*

Scuta abdominalia 245.
Scutella subcaudalia 75.

Habitat. Sincapore.

Light-reddish-yellow above, with broad transversal black bands, and with two barbed dorsal lines of the same colour; the interval between these dorsal lines dotted with black; the abdominal surface whitish.

Genus Dendrophis, Boie.

Dendrophis Boii.* *Den. superne nigro-brunnescens, vitta dorsali subfuscâ, abdomine albo-flavescenti vittâ ejusdem coloris utrinque incluso, rostro subobtuso.*

Scuta abdominalia 186.
Scutella subcaudalia 129.

Habitat. Bengal, Ceylon.

Brownish black, with a light brown dorsal band; the abdominal surface yellowish white, with a band of the same colour on either side; the rostrum subobtuse.

Vernacular name, Kalla Lawrýnca or Nawdunga.

Genus Dipsas, Boie.

Dipsas ferruginea. *Dip, supra ferrugineo-brunnea, nigro alboque rarè maculata; abdomine ferrugineo-flavo, albo nigroque maculato.*

Scuta abdominalia 171.
Scutella subcaudalia 57.

Habitat. Assam.

Rusty-brown, with a few black and white spots; the abdominal surface rusty-yellow, dotted with white and black.

* Chrysopelea Boii, Dr. Andrew Smith.

DIPSAS MONTICOLA. *Dip. supernè tristè fusca, striis aliquot nigris obliquis; infra flavo-brunnescens.*

Scuta abdominalia 193.
Scutella subcaudalia 82.

Habitat. Naga Hills (Assam).

Dull dark brown above, with a few black oblique stripes; beneath brownish-yellow.

Genus TROPIDONOTUS, Kuhl.

TROPIDONOTUS QUINQUE. *Tro. supernè griseo-brunnescens, nuchâ numero Quinque* (V.) *nigro inscriptâ, fasciisque duabus nigris dorsalibus, albo punctatis; abdomine flavo-albescenti, fasciâ nigrâ utrinque incluso.*

Scuta abdominalia 259.
Scutella subcaudalia 97.

Habitat. Mergui.

Brownish-grey above, with the cypher V in black on the neck, and with two dorsal black bands dotted with white; the abdominal surface whitish-yellow, with a black band on either side.

TROPIDONOTUS MŒSTUS. *Tro. supernè tristè olivaceo-nigricans, subtus flavus.*

Scuta abdominalia 138.
Scutella subcaudalia 77.

Habitat. Bengal.

Dull blackish olive-colour above; yellow beneath.

Vernacular name, Kalla Mittallee.

TROPIDONOTUS SURGENS. *Tro. læte olivaceo-viridis, abdomine flavo linea nigra serratâ utrinque incluso.*

Scuta abdominalia 148.
Scutella subcaudalia 23.

Habitat. Bengal.

Bright greenish-olive; the abdominal surface with a serràted line on either side.

Vernacular name, Bahr.

TROPIDONOTUS PLUMBICOLOR. *Tro. supra plumbeus, fascia sagittatâ occipitali nigrâ et albâ fasciisque nigris serratis transversalibus, squamis alte carinatis tectus, mento albo, abdomine plumbeo.*

Scuta abdominalia 162.
Scutella subcaudalia 51.

Habitat. Malwa (Saugor).

Lead-coloured above, with an occipital arrow-shaped black and white band, and with black serrated transversal bands, covered with sharply-keeled scales, the chin white; the abdominal surface lead-coloured.

Genus Cerberus, Cuvier.

Cerberus cinereus. *Cerb. supernè cinereus fasciis nigris transversalibus, subtus albicans fasciâ nigrâ undulatâ.*

Scuta abdominalia 143.
Scutella subcaudalia 59.

Habitat. Bengal.

Ash-coloured above, with black transverse bands; beneath whitish, with a black undulated band.

Vernacular name, Jal Ginthea.

Genus Homalopsis, Khul.

Homalopsis olivaceus. *Hom. supernè olivaceus lineis nigris inter squamas variegatus, abdomine albicante, lineâ mediâ nigrâ diviso, vittâ albo-virescenti utrinque incluso.*

Scuta abdominalia 167
Scutella subcaudalia 71.

Habitat. Bengal.

Olive-coloured above, variegated with black lines between the scales; the abdominal surface whitish, divided in the middle by a black line, and with a greenish-white band on either side.

Vernacular name, Metillee.

"The descriptions and figures of these serpents were made in India in 1835, 1836, and 1837. For the specimens from Assam I am indebted to the kindness of the eminent botanist Mr. William Griffith; for those from Chirra Punji, to the friendship of Mr. J. W. Grant, of Calcutta. I have also to acknowledge the liberality of Mr. Hodgson, the Hon. Company's Resident at the court of Nepal, who allowed me to publish the undescribed specimens in his collection of Nepalese serpents."

Ninth Meeting of the British Association for the advancement of Science.

Thursday, August 29.

Section A.—Mathematical and Physical Science.

The Secretary read the report of the Committee, consisting of Sir J. Herschell, Mr. Whewell, Mr. Peacock, and Prof. Lloyd, appointed to represent to Government the resolutions adopted by the Association in August 1838, at Newcastle, recommending that Magnetic Observatories be established in various parts of the British dominions, and that a naval expedition be fitted out for the purpose of determining, by observations, the magnetic direction and intensity, in high southern latitudes, between the meridians of New Holland and Cape Horn.

The successful result of the exertions of the Committee, and the admirable Report drawn out by the Royal Society, for the guidance and instruction of the officers engaged in the expedition, and which we so lately published (*Athen.* Nos. 616, 617), have so far anticipated the interest which would otherwise have attached to this paper, that we are reluctantly compelled, in the present crowded state of our columns, to pass it over.

'On certain Points in the Wave-Theory, as connected with Elliptic Polarization, &c.' by Prof. Powell.---The object of this communication is to lay before the Section a general statement of some material conditions which involve in a common relation the theory of dispersion, of the wave-surface, and of elliptic polarization. These have been the subject of some difference of opinion, and are still involved in considerable difficulty and apparent contradiction; a brief and clear statement of those points may, perhaps, tend to their better elucidation and ultimate solution. All the investigations set out from these equations of motion:---

$$\text{(A)} \begin{cases} \dfrac{d^2\xi}{dt^2} = \Sigma \begin{cases} \phi(r)\ \Delta\xi \\ +\psi(r)\ \Delta x[\Delta x \Delta\xi + \Delta y \Delta\eta + \Delta z \Delta\zeta] \end{cases} \\ \dfrac{d^2\eta}{dt^2} = \Sigma \begin{cases} \phi(r)\ \Delta\eta \\ +\psi(r)\ \Delta y[\qquad\qquad] \end{cases} \\ \dfrac{d^2\zeta}{dt^2} = \Sigma \begin{cases} \phi(r)\ \Delta\zeta \\ +\psi(r)\ \Delta z[\qquad\qquad] \end{cases} \end{cases}$$

By certain developements of $\Delta\xi\ \Delta\eta\ \Delta\zeta$, these forms involve as factors of products such as

$$\Sigma\ [\psi(r)\Delta x\ \Delta y]\ \&c.$$

If these sums are $=o$, the expressions are brought into forms in which they are directly integrable, and we have for solutions:---

$$\xi = \Sigma\ [\alpha \sin (nt - k\rho)$$
$$\eta = \Sigma\ [\beta \sin (nt - k\rho)$$
$$\zeta = \Sigma\ [\gamma \sin (nt - k\rho)$$

which are shown to involve such a relation between n and k, as gives the formula for the dispersion.

This condition, which I call (B), reduces the equation (A) to the form---

$$\text{(C)} \begin{cases} \dfrac{d^2\xi}{dt^2} = \Sigma \left\{[\phi(r)+\psi(r)\Delta x^2]\Delta\xi\right\} \\ \&c. = \qquad \&c. \\ \&c. = \qquad \&c. \end{cases}$$

And it corresponds to the supposition that the molecules are so arranged with respect to the axes $x\ y\ z$, that the sums with opposite signs destroy each other. It is on this supposition alone that all the principal investigations proceed, from which the theory of dispersion is derived. And in all these investigations we consider a rectilinear displacement or vibration, which may be generally in any direction, and whose resolved parts in the direction of the three axes are ξ η ζ respectively. This may apply to all cases of unpolarized or plane-polarized light. But for elliptically (including circularly) polarized light, it is necessary to consider, not a rectilinear, but a curvilinear displacement or vibration, which is the result of *two* virtual rectilinear displacements acting at right angles to each other, and in a plane transverse to the direction of the ray, and one always in a phase retarded behind the other by an interval (b). In this case, therefore, it is necessary to proceed by making one of the coordinate axes (as x) coincide with the ray, and $\xi = o$, $\Delta\xi = o$, &c., while the other two in y and z coincide with the components, which give the elliptic vibration, and are of the forms—

$$\eta = \Sigma\,[a \sin (nt - kx)]$$
$$\zeta = \Sigma\,[\beta \sin (nt - kx + b)]$$

This case, I believe, was first considered by Mr. Tovey. Pursuing the investigation thus, taking the axes generally as in any direction whatever, with respect to the arrangement of the molecules, it appears from Mr. Tovey's paper, ('Journal of Science,' No. 71,) and from the somewhat simplified form in mine ('Phil. Trans.' 1838, part 2,) that in the case of elliptic polarization, the condition (B) cannot hold good; while for common or plane polarized light it must hold good. The distinction therefore between the different states of light as to polarization, depends on this characteristic or criterion, which I call (E). The discussion between Mr. Tovey and Mr. Lubbock ('L. & E. Phil. Mag.' Dec. 1837, Jan. 1838,) seems to turn upon these propositions:—1. That every system of molecules (constituted as supposed in all these investigations) has at every point three axes of elasticity, whatever be the peculiar arrangement of the molecules. 2. That if we take these axes for the axes of co-ordinates, then the equations of motion are reduced to the form (C), or the condition (B) holds good. 3. This form of the equation is necessary for the investigation of the wave-surface: or at least, so much so, that without it the deduction is immensely complicated. At all events, the universal existence of such axes is essential to the nature of the wave-surface. Now, since these considerations are essential to the application of the theory to all media, it follows that in all cases there are certain axes in reference to which the condition (B) holds good. This, then, appears at direct variance with the distinction established above, or the criterion (E). And if we set out with equations (C), and pursue a train of deduction similar to Mr. Tovey's or mine, we find corresponding formulæ, but from which the conclusions in question cannot be derived. It appears, then, essentially important, that this discrepancy should be cleared up, and the fallacy, if any, detected.

'On the Temperature of the Earth in the Deep Mines of Lancashire and Cheshire,' by Mr. Eaton Hodgkinson. These experiments were made with thermometers belonging to the Association, and in the prosecution of them the author has been very greatly assisted by the proprietors of pits and others connected with them, who have kindly undertaken to observe the results themselves---thus saving the author the trouble, in some cases, of going more than once into the mine. The object of the experiments was to forward the views of the Association---which were, to obtain, from observations made in various places, and at different depths, some additional knowledge of the internal temperature of the earth. In the salt mines of Messrs. Worthington and Firth, at Northwich, in Cheshire, latitude about 53° 15′, a thermometer placed in a bore hole, 3 feet deep in the rock, 112 yards below the surface, indicated a temperature of 51° to 51½° Fah., and varied little or nothing between summer and winter. In the deep coal mines of Messrs. Leeses, Jones, & Booth, near Oldham, a thermometer, placed in a bore hole as before, 329½ yards below the surface, varied from 57° to 58½° Fah., from observations made for a whole year, by Mr. J. Swain. In the Haydock colliery, 201 yards deep, about eighteen miles west of Manchester, and differing from it but little in latitude, the temperature varied considerably, both in the same hole and in different ones, but approached to 58°. The cause of these anomalies the author has not discovered. The experiments were made for him by Mr. William Fort. Other experiments are in progress. The latitude of Manchester is 53° 30′, and the mean temperature of the air there is 48° Fah., from Dr. Dalton's experiments.

Prof. Stevelly asked Mr. Hodgkinson, whether it was possible that water could have access to those parts in which his thermometers had been placed, particularly those placed in the stratum next under the coal, at the floor of the mine?---Mr. Hodgkinson thought not.---Prof. Stevelly said, that the reason why he inquired was, that there were certain kinds of coal, which when exposed to the action of water developed much heat. This was the case with all coals which contain pyrites. The substance of which the floor of the mine was composed, though nearly as hard as a metal, had such an affinity for moisture that even the hygrometric moisture of the air would decompose it, and of course develope more or less heat.---Prof. Forbes said it had been clearly established that coal mines were improper localities for making observations on subterranean temperature.

The President said, that as the Report which was next on the list was nearly allied in subject to the one at present under consideration, it would perhaps be convenient to permit it to be read, and to discuss both at the same time.

'Report on Observations on the Temperature of the Earth at different depths, made near Edinburgh, by Prof. Forbes.---These observations were commenced in Feb. 1837, and have been regularly continued since. They were instituted at the expense of the British Association;

and the result of two years' reductions was presented to the Section.* The object was to ascertain the conducting power for heat of different soils, and the measure of the sun's influence at different depths under similar *external* circumstances. The stations and soils were,

Observatory.	*Experimental Garden.*	*Craigleith.*
Trap Tufa.	Pure loose sand.	Compact coal-formation sandstone.

At each station four thermometers were sunk to the depths of 3, 6, 12, and 24 *French* feet respectively, the tubes of each being carried above the surface, so as to be conveniently exposed side by side. The readings were made every week, and corrected for the temperature of the stem and scale, and the results were projected in the form of curves, from which the following deductions have been made:—

I.—Annual Report.

	3 Feet (French).			6 Feet.			12 Feet.			24 Feet.		
	Trap.	Sand.	Sand-stone.	Trap.	Sand.	Sand-stone.	Trap.	Sand.	Sand-stone.	Trap.	Sand.	Sand-stone.
1837. Fahr.	18.95	19.65	17.25	11.9	14.95	13.9	5.5	7.55	9.4	1.45	2.1	4.1
Cent.	10.53	11.23	9.58	6.61	8.30	7.72	3.05	4.19	5.22	0.80	1.16	2.28
1838. Fahr.	17.7	20.33	18.52	11.2	14.57	14.25	5.05	7.1	9.3	1.25	1.88	3.83
Cent.	9.83	11.30	10.29	6.22	8.10	7.91	2.80	3.94	5.16	0.70	1.05	2.13

These numbers involve the data for computing the Conductivity of these several strata; for the range in each case is found (as theory indicates) to diminish in geometrical progression, as the depths increase arithmetically, and the common ratio of the progression depends on the value of $\sqrt{\frac{\text{Specific heat}}{\text{Conductivity}}}$, which is the value of B in the following formula $\Delta_p = A + Bp$.

Where Δ_p is the range, and p the depth from the surface. To obtain the value of B, the above ranges were projected, and logarithmic curves drawn through the points, so as to satisfy approximately the observations at each station; the result is shown for the year 1838 in the subjoined figure, from which it will be seen that the experiments are perfectly consistent with one another, although (as at first sight might be expected) the amount of the range does not follow the same order of magnitude in the three soils at different depths.

The values of B, thus deduced, are—

	Trap.	Sand.	Sandstone.
In 1837......	—.0545	—.0440	—.0316
In 1838......	—.0641	—.0517	—.0345

* Some account of the first year's experiments has already been presented to the Royal Society of Edinburgh, and printed in their Proceedings.

The difference of these numbers, such as it is, is evidently not attributable either to errors of observation or to the inadequacy of the experiment to afford consistent results; a comparison of the curves for two years, in which every observation is projected, shows the most minute general conformity in their flexures and intersections. It is rather probably to be attributed to the observations having been commenced too late in the winter of 1836-7 to obtain the true minimum for that period, from which circumstance the superficial range would come out too small, and B would therefore be diminished, as it is in each of the three cases.

From the observations of 1838 we deduce farther this important result, that the oscillations of annual temperature would be reduced to $\frac{1}{100}$ of a Centigrade degree (or virtually extinguished) at a depth of

49 feet in trap tufa.
62 feet in incoherent sand.
91 feet in compact sandstone.

The differences in the value of B determined by various observers (varying in the results quoted by M. Quetelet in his excellent memoir on this subject, from — .0526 to — .0384) do not depend upon difference of geographical position, but on the various constitutions of the soil operated upon, a circumstance hitherto wholly neglected.

II.—Epochs of Maximum and Minimum Temperature.

	3 Feet (French).			6 Feet.			12 Feet.			24 Feet.		
	Trap.	Sand.	Sand-stone.	Trap.	Sand.	Sand-stone.	Trap.	Sand.	Sand-stone.	Trap.	Sand.	Sand-stone.
Minimum :												
1837	Mar. 31	Mar. 23	Mar. 20	Apr. 9	Apr. 5	Mar. 26	May 6	Apr. 30	Apr. 10	July 26	July 12	May 18
1838	Feb. 26	Mar. 3	Feb. 23	Mar. 14	Mar. 19	Mar. 3	Apr. 20	Apr. 22	Mar. 20	July 18	July 8	May 12
Maximum :												
1837	Aug. 6	July 31	Aug. 5	Sept. 2	Aug. 24	Aug. 19	Oct. 17	Oct. 6	Sept. 11	Jan. 8	Dec. 30	Nov. 11
1838	Aug. 8	Aug. 6	Aug. 16	Sept. 6	Aug. 31	Aug. 23	Oct. 19	Oct. 14	Sept. 19	Jan. 5	Jan. 4	Nov. 2

These dates, derived by graphical interpolation, are only approximate.

The progressive retardation of epochs as we descend is too evident to require to be pointed out. The maximum occurs $5\frac{1}{2}$ months after that of the air in the two first-named strata, whilst the conducting power of the sandstone is so superior as to accelerate this epoch by seven or eight weeks, compared with the trap or loose sand. Were this result deduced from thermometers placed at one depth only, its exactness might be doubted. It is derived, however, also from the intermediate ones.

By a simple graphical method it is easy to deduce approximately the rate *of propagation* of heat downwards in each of these soils, resulting from the whole observations taken together. The observations at different depths confirm one another; but the minimum in 1837 was, as already stated, too imperfectly observed for the upper thermometers to be of much service. The remaining observations afford the following results:—

Soil and Locality,	Time of propagation of heat through One foot (French), deduced from			
	Maximum, 1837.	Minimum, 1838.	Maximum, 1838.	Mean.
Trap (Observatory)	7.5 days	6.5 days	6.8 days	6.9 days.
Sand (Exp. Garden)	7.1 —	5.8 —	6.8 —	6.6 —
Sandstone (Craigleith)	4.9 —	3.6 —	3.6 —	4.0 —

These results confirm the relation of conducting powers indicated by the constant B already found; but the numerical comparison of these independent results is a matter of extreme complication—(see Poisson, *Théorie de la Chaleur*, chap. xii.)

The President congratulated the members on the results likely to flow from experiments conducted on so well-digested a system. Any person who was conversant with the writings of Fourier, and other foreign writers on this branch of mixed mathematics, must be aware how necessary it was to be in possession of a sufficient store of well-ascertained facts, on which any theory, if it be sound, must rest and be dependent. The facts now collected were almost as complete as could be expected or desired; that those are not merely accidental variations of temperature which are indicated, must be observed on the most superficial examination of the three curves. The general conformity, while the thermometers, of whose indications they were as it were the types, were placed at such distances and in substances differing so materially in structure and physical character, together with the reproduction of curves in successive years so coincident in their general characters, were circumstances tending to stamp with the character of truth the results, and to show the soundness of the system on which these researches had been conducted. Theory had long been in advance of practical knowledge on this subject, but practice was now coming up and beginning to take her proper place as the handmaid and sure assistant of theory. Heretofore, the scale upon which experiment had been performed on the conducting power of the several substances of which the crust of our earth is composed, were on so small a scale that the analyst scarcely knew whether he was safe in using their results. In every point of view, then, they were most important.—Mr. Snow Harris observed, that an inspection of these curves would lead to the conclusion that, as the depth increased, their curvature diminished, and that therefore at some certain depth they would turn into straight lines, and the temperature at that depth become constant.—Prof. Forbes said that not only did this appear obviously from an inspection of the curves, but also the formulæ which he had investigated and placed on the board indicated it.

'On the Progress of the Meteorological Observations at Plymouth, with the Barometer and Thermometer,' by Mr. Snow Harris.—The pressure of our atmosphere, as indicated by the barometer, being affected in these latitudes by many accidental circumstances, it is not without difficulty we are enabled to trace the great periodical variations, and exhibit them as they would appear in an undisturbed state. It is only by a careful and extensive series of observations, such as those now in progress in various places under the direction of the British Association, that we can hope to examine successively great periodical variations in atmospheric pressure, and bring them under the dominion of general laws. The great periodical variation, as shown by the horary oscillation, observed by Humboldt in the tropics, and by other philosophers in different parts of Europe, is undoubtedly a phenomenon of high interest in meteorology. In discussing the hourly observations with the barometer at Plymouth, Mr. Harris has shown that this phenomenon is distinctly traceable amidst a vast mass of accidental fluctuation. He exhibited the mean hourly pressures for the years 1837 and 1838, and the mean of the two years, and showed that a double wave was apparent, when these points were connected by a continuous line. The points in the waving line thus produced had been each determined from 730 observations; the whole number of observations from which the mean pressure had been deduced being 17,500. The following general results were then mentioned:—The mean height of the barometer at the Plymouth dockyard, 60 feet above the level of the sea, and at a mean temperature of 60° of Fahrenheit's scale, was from the latest results 29.8967. It occurred in the mean hourly progression four times in the day, viz. at 2, 20, and 8, 10, A.M.; 12, 30, and 6, 15, P.M.,—at which times the waves crossed the mean pressure line. The difference on oscillation from 5 to 10 A.M. amounting to .0113 of an inch, between 10 A.M. and 3, 30, P.M. amounted to .0118. The hours of greatest pressure were 10 A.M. and 9 P.M. The hours of least pressure, 5 A.M. and 3 P.M. Of the diurnal semi-waves, the ascent in the morning is the least, and the ascent in the evening the greatest. Of the descending branches of the curves, that during the day is less than that during the night. The times of the oscillations differ. The wave by day, viz. that between 5 A.M. and 3, 30, P. M. being ten hours and a half. That by night, viz. between 3, 30, and 5 A.M. being thirteen hours and a half. The size of the daily wave, therefore, so far as the observations hitherto proceeded, was less than that of the wave at night. Mr. Harris proceeded then to discuss the observations as applied to the different seasons, of spring, summer, autumn, and winter, and showed that the general hourly progress of the pressure was greatly interfered with at particular periods; the wave of autumn being that which coincided most nearly with the general curve. Of the different monthly pressures, October and December were the greatest, November and February the least, January and September the two nearest the mean.

Mr. Harris now proceeded to discuss the supposed Influence of the Moon on the Barometer, and with this view had reduced about 4,000 of the observations, so as to show the pressure at the time of the moon's southing, and for each hour before and after; but he could not discover any differences which could be supposed to arise from the moon's influence. He was therefore disposed to agree with the conclusion lately arrived at by Mr. Lubbock, from a discussion of the Barometric Observations at the Royal Society---viz. that no lunar irregularity is observable from this method of discussing the observations---that, if at any time established, it must prove extremely small. He could not, however, avoid mentioning, as a singular coincidence in the results of the two years, that taking the mean pressures about the four periods of the lunar changes, it appeared that the pressure was less at the new moon, and that it increased up to the last quarter, when it was the greatest. The first object being to arrive at certain great periodical variations, those had been principally kept in view; hence, mere accidental disturbances remained as yet unconsidered. Mr. Harris, however, had observed, as a very general result, that when the pressure decreased at night, whilst the temperature increased, the succeeding weather was always disturbed and uncertain---in winter, gales of wind from the S.E. and S.W., with rain; whilst, on the contrary, a decreasing temperature, with an increasing pressure, was generally followed by fair weather, with winds varying from N.W. to N.E. The observations hitherto made with the dry and wet bulb thermometer had not yet been reduced. Of the ordinary thermometer, more than 50,000 hourly observations were now completed. Mr. Harris had received two very interesting communications on the Hourly Changes of Temperature, which enabled him to contrast the curves of Plymouth and Leith with those of Frankfort Arsenal, near Philadelphia, and three places in Ceylon. The Association was indebted to Major Ord, R.E., for the latter, and to Capt. Mordecai, of the United States' Corps of Ordnance, for the former. Hourly observations had been obtained by these gentlemen, similar to those which had already appeared in the Transactions of the Association, and which fully confirmed the results arrived at by Sir D. Brewster, to whom the scientific world is indebted for the first perfect series of hourly observations of the thermometer, and also the results of those arrived at by Mr. Harris in the discussion of similar observations carried on at Plymouth, at the request of the Association. Mr. Harris here exhibited, under the form of curves, the mean hourly progress of the temperature at these different places. It appeared, from these observations, that the line of mean temperature at the three stations in Ceylon, between 6° and 8° N. lat., was crossed between 9 and 10 A.M., and at 9 P.M. The mean temperature at these stations being 74° at Kandy, and from 80° to 81° of Fahrenheit at the others, which did not materially differ from the times at Leith, in which the mean temperature is 48°, and the lat. about 55° N. At the Frankfort Arsenal, the line of mean temperature is crossed also about 10 A.M., but differed at night, being between 7 and 8 P.M.; whilst at Plymouth, the line of mean temperature was crossed soon after 8 A.M., and 7 A.M. by the latest observations. The little comparative mean range of the thermometer at Leith and Kandy, and in Ceylon, gave great similarity to the curves indicating the march of the hourly temperature in these places.---The author concluded with some general remarks on this subject.

Prof. Forbes and Prof. Whewell pointed out the necessity of reducing the observations to 32° of Fah.---Mr. Harris stated, that the temperatures at which the observations were made had not greatly differed, but that, before the Report appeared, the observations should be revised and reduced.

'On a New Calorimeter, by which the Heat disengaged in Combustion may be exactly measured, with some Introductory Remarks upon the Nature of different Coals,' by Andrew Ure, M.D.---In these researches, which are still in progress, the first point (said Dr. Ure) which I seek to ascertain is the proportion of volatile and fixed matter afforded by any kind of fuel---as, for example, pit-coal---when a given weight of it is subjected, in a retort or covered crucible, to a bright red heat. The result of this experiment shows how far the coal is a flaming or gas coal, and what quantity of coke it can produce. The second preliminary point of importance which I determine with regard to coals, is the amount of sulphur they may contain: a circumstance which has not hitherto been made the subject of precise investigation, in this country at least, but which is of great consequence, not only as to their domestic use, but to their employment by the iron-master and the manufacturer of gas. That good iron cannot be made with a sulphureous coal, however carefully coked, has been proved in France by a very costly experience. In general, when a coal leaves 15 or 16 per cent. of ferruginous ashes, we may conclude with certainty that it contains sulphur in corresponding proportion; for this substance exists always, I believe, in pit-coal, in the form of pyrites, but often disseminated or combined, so as to be invisible, unless by microscopic means. The most ready and exact method of determining rigidly the quantity of sulphur in any compound, is to mix a given weight of it with a certain weight of carbonate of potassa, nitre, and common salt, each chemically pure, and to ignite the mixture in a platinum crucible. A whitish mass is obtained, in which all the sulphur has been converted into sulphate of potassa. By ascertaining, with nitrate of baryta, the amount of sulphuric acid present, that of sulphur becomes known. By such a process, applied to different samples of coals, sent to me for analysis, I obtained the following results:---

Gas coals No. 1	Sulphur in 100 parts	3.00
2	....	3.90
3	....	2.42
4	....	3.80
5	....	2.50
6	....	5.20
7	....	3.40
8	....	3.50

Coals for puddling cast iron to be converted into steel:

1,	hard foliated, or splent, sp. grav.	1.258	0.80
2,	ditto	1.290	0.96
3,	ditto	1.273	3.10
4,	cubical, and rather soft	1.267	0.80

The presence of much sulphur in a gas coal is a great evil, because it affords, in its decomposition, so much sulphuretted hydrogen, as requires an operose process of washing or purification, which impoverishes the gas, and impairs its illuminating power by the abstraction of its olefiant gas or carburetted hydrogen. Hence I found, in a specimen of coal gas, as generated in the retorts of one of the London gas companies, no less than 18 per cent. of olefiant gas; but in the same gas, after its purification from sulphur, I found only 11 per cent. With a coal, such as No. 4 of the second series given above, at least 10 per cent. of the light might be economized. The apparatus which I employ consists of a large copper bath, capable of holding 100 gallons of water: it is traversed, forwards and backwards, four times, in four different levels, by a zig-zag horizontal flue, or flat pipe, nine inches broad, and one inch deep, ending below in a round pipe, which passes through the bottom of the copper bath, and receives there into it the top of a small black lead furnace. The interior furnace, which contains the fuel, is surrounded, at the distance of an inch, by another furnace, which case serves to prevent the dissipation of heat into the atmosphere. A pipe, from a pair of double-cylinder bellows, enters the ash-pit of the furnace at one side, and supplies a steady current of air to keep up the combustion, kindled at first by half an ounce of red-hot charcoal. So completely is the heat which is disengaged by the burning fuel absorbed by the water in the bath, that the air discharged at the top orifice has usually the same temperature as the atmosphere. In the experiments made with former water *calorimeters* the combustion was maintained by the current of a chimney, open at bottom, which carried off at top a quantity of heat very difficult to estimate. My experiments have been directed hitherto chiefly to a comparison of the heating powers of Welsh anthracite, Llangennech, and a few other coals. I have found, that the anthracite, when burned in a peculiar way, with a certain small admixture of other coals, evolves a quantity of heat at least 35 per cent. greater than the Llangennech does, which latter is reckoned by many to be the best fuel for the purposes of steam navigation. One half pound of anthracite, burned with my apparatus, heats 600 pounds of water 10° Fahr., viz. from 62° to 72°, the temperature of the atmosphere being 66°; so that there is no fallacy occasioned either by the conducting powers of the surrounding medium, or by a chimney current. We thus see that one pound of anthracite will communicate, to at least 12,000 times its weight of water, an elevation of temperature of 1°, by Fahrenheit's scale. For the sake of brevity, we may call this quantity, or energy, 12,000 unities of heat. One pound of Llangennech, in the same circumstances, will afford 9,000 unities: one pound of good charcoal, after ordinary exposure to the air, affords 10,500: perfectly anhydrous charcoal would yield much more: one pound of Lambton's Wall's-end coals affords 7,500 unities. It deserves to be remarked, that a coal, which produces in its ignition much carburetted hydrogen and water, does not afford so much heat as a coal equally rich in carbon, but of a less hydrogenated nature, because, towards the production of the carburetted hydrogen and water a great deal of latent or specific heat is required: indeed, the evaporation of unburnt volatile matter from ordinary flaming coals abstracts unprofitably a very large portion of their heat, which they would otherwise afford. Hence, those chemists who, with M. Berthier and Mr. Richardson, estimate the calorific powers of coals by the quantity of carbon which they contain, or the quantity of oxygen which they consume, have arrived at very erroneous conclusions. The amount of error may be detected by experiments on the cokes of flaming coals. M. Berthier examines coals for their proportion of carbon, by igniting a mixture of each, finely pulverized, with litharge, in a crucible, and estimates 1 part of carbon for every 34 parts of lead which is reduced. I have made many researches in this way with both charcoal and anthracite, and have obtained very discordant results. In one experiment, 10 grains of pulverized anthracite from Merthyr Tydfil, mixed with 500 grains of pure litharge, afforded 380 grains of metallic lead; in a second similar experiment, 10 grains of the very same anthracite afforded 450 grains of lead; in a third, 350 grains. In one experiment with good ordinary charcoal, fresh calcined, 10 grains, mixed with 1,000 of litharge, afforded no less than 603 grains of metal. The crucible was, in each case, covered and luted. My future researches, which are intended to embrace every important variety of fuel, natural and artificial, will be made with an apparatus somewhat modified from that here described. Three furnaces will be inclosed within each other, with a stratum of air or ground charcoal between each, so as to prevent all loss of heat into the atmosphere, and thereby to transfer the whole heat disengaged by combustion into a large body of water, of a temperature so much below that of the atmosphere at the beginning of the experiment, as it shall be above it at the conclusion.

'On a method of filling a Barometer without the aid of an Air-pump, and of obtaining an invariable level of the surface of the Mercury in the cistern,' by Prof. Stevelly.—Prof. Stevelly said that it was very difficult to fill a barometer tube so as to be quite free from air and moisture. Mr. Daniell, in his Meteorological Essays, proposed to fill the barometer under the exhausted receiver of the air-pump, and actually had the barometer of the Royal Society so filled by Mr. Newman, under his own superintendence; but although an expert London working optician might be found capable of executing successfully such a tube, yet few in the country could hope for such an advantage; and, in fact, although he had attempted the process at Belfast, he had never succeeded. After some consideration, the following simple mode of using the torrecellian vacuum of the tube itself, instead of the air-pump, in filling it, occurred to him. He heated the mercury as hot as it could be used, and filled the tube, in the common way, to within half an inch of the top; then worked out, in the usual way, all air bubbles, as perfectly as possible; filled up the tube to the top, and inverted it in a cup of hot mercury, when it, of course, subsided, in the upper part of the tube to the barometric height; he then placed his finger on the mouth of the tube, under the mercury in the cup, and lifted it out; and, still holding his finger tightly over the mouth of the tube, laid it flat on a table, when the mercury in the tube soon lay at the under side of the tube, leaving the upper part along the length of the tube void. Upon then turning the tube slowly round, still keeping the finger on its mouth, every spark of air was gathered up. He then placed the tube in an upright position, with its mouth upwards, and, placing a funnel of clean dry paper about the upper part, an assistant filled the funnel slowly, with hot mercury, so as to cover the fingers. Upon slowly withdrawing the finger, the mercury went gently in, and displaced almost perfectly the atmospheric air which had gathered into the void space. By renewing the process which succeeded the previous washing of the air out of the tube, once, or at most twice, a column of the most perfect brilliancy was obtained. He had mentioned this simple method to Dr. Robinson, of Armagh, who suggested that, to get rid of the damp and greasiness of the finger, it would be better to cover the mouth during the process with clean and dry caoutchouc; and this was found a decided advantage. The method of procuring an invariable surface in the cistern was equally simple. From the imperfection of his sight, it was an object of much interest to him to have as few readings or adjustments depending on sight as possible. He proposed, therefore, to divided the cistern into two compartments, by a diaphragm of sheet iron or glass, brought to a sharp edge at top. Into one of these compartments, the barometer tube dips; in the other is placed a plunger of glass or cast iron, which can be raised or lowered by a slow screw movement. To prepare for an observation, the plunger is first screwed down, by which it displaces the mercury in one compartment, and raises its surface in the other above the edge of the diaphragm; upon raising it slowly again, the mercury drains off to the level of the edge of the diaphragm, thus, at every observation, reducing the surface to a fixed level.

SECTION B.---CHEMISTRY AND MINERALOGY.---Thursday.

'Notice of some Experiments upon a new Compound, called Iodosulphuric Acid, upon the true constitution of Chlorochromic Acid, and upon Chromamide,' by Mr. Lyon Playfair.---The object which I proposed to attain (said the writer) in commencing these experiments, was to discover some mode of isolating hyposulphurous acid. The experiments are still unfinished, but I will here notice the results already obtained. The best method of studying this subject appeared to be, to examine the characters of those compounds which have an analogous constitution. Chlorochromic acid, according to MM. Walter and Regnault, may be viewed as a compound of a hypothetical radical, "chromous acid," united with an atom of chlorine. If hyposulphurous acid also be considered as a combination of sulphurous acid with sulphur, both of these acids would belong to the same class. But as the opinions of chemists are much divided respecting the true rational composition of chlorochromic acid, Mr. Playfair was anxious to ascertain which view was the most correct. For this purpose, the behaviour of the solid compound of chlorochromic acid and ammonia was examined. By various tests applied to it, it did not appear to contain chromic acid. Now, if chlorochromic acid be really a salt, the bichromate of the perchloride of chromium, it ought to contain chromic acid; in short, it seems to be a peculiar compound, chromamide united with muriate of ammonia, and analogous to the sulphamide of Regnault. Chlorosulphuric acid is a compound which did not suit my purpose, on account of its never being obtained free from a foreign substance---the *liquor* of the Dutch chemists. It therefore became necessary to discover a substance of an analogous constitution, and which might be obtained with more ease, and with more purity. For this purpose, two equivalents of iodine were mixed with one of sulphite of lead, and the mixture was subjected to distillation: a dark red fluid passed over. This method, however, does not yield it of sufficient purity, being contaminated with iodine, which it retains in solution. A better method, therefore, consists in dissolving iodine in pyroxylic spirit, and sending a steam of sulphuric acid through the solution until it be completely saturated. By evaporation, distillation, and allowing the substance thus procured to remain over sulphuric acid, it may be obtained in a state of absolute purity; its taste is extremely acid, and when it is dropped upon the cuticle, a disagreeable obstinate sore is occasioned. I hoped that hyposulphurous acid might be isolated in a similiar manner, and, upon trying the experiment, with the substitution of sulphur for iodine, a yellow liquid of an acid taste, distilled over; but it speedily decomposed with the deposition of sulphur. A sufficient quantity was not obtained for analytical investigation. There are many other modes suggested by the properties of iodosulphuric acid, some of which I hope may succeed. I have merely stated the method of obtaining iodosulphuric acid, but the same process is applicable to many others of a similiar class, whose properties I am at present investigating. The circumstances which led me to enter into these experiments, were to remove the objections which the opponents of isomorphism have urged against that theory, on account of the great dissimilarity, both in chemical and in physical characters, which exists between the chromates and their corresponding sulphates. By boiling a sulphate of the oxide required with chromate of barytes, soluble salts may be obtained, isomorphous with the sulphates, and, in general, affecting the same number of atoms of water. The insoluble chromates, generally described in systematic treaties on chemistry as neutral chromates, are of a very interesting constitution, but their analytical developement is extremely intricate, from the fact of there being several of each oxide. There are many other points connected with this subject, with which I cannot detain you.*

'A new theory of the Galvanization of Metals,' by Prof. Schönbein, of Basle.—The Professor began by stating, that the discovery of the chemical power of the voltaic pile, made in the beginning of the present century by British philosophers, drew the attention of the scientific world to the relations which exist between chemical and electrical phenomena; indeed, only a few years after this important fact had been ascertained, Sir Humphry Davy and Berzelius did not hesitate to establish the theory which has since been generally adopted—viz. that chemical and electrical forces are essentially the same. Prof. Schönbein considers, that the results of recent experiments are opposed to the theory. The facts which he brings forward in opposition to it are as follows:—1. A piece of iron was voltaically associated with a piece of zinc, and each of these metals was put into a separate vessel, filled with common water. The vessels did not communicate with each other. In the course of a few hours after the immersion of the iron, light flakes of oxide of iron made their appearance round the metal, and, after a couple of days, the latter was corroded to a considerable degree. The same result was obtained when the iron was plunged into water, and the zinc made to rise above the level of the fluid, so as to prevent the latter from being in the least contact with water. According to Prof. Schönbein, a piece of iron, when immersed in water without any voltaic association, was as much corroded as under the circumstances detailed. 2. Two pieces of iron were made, one of them the positive, the other the negative pole of a voltaic pile, which consisted of ten pairs of copper and zinc, and was charged with water holding 5 per cent. of common salt in solution. Each of the polar wires was put in a separate vessel, filled with common water. Under these circumstances, both wires were equally attacked and corroded in the same manner as if a single piece of

* The young chemist whose name is already associated with original researches came to Calcutta in 1838, but was induced to return by the same ship that brought him out. Europe undoubtedly presents a wider field to philosophical minds, but settle where he may, Mr. Playfair will rise to the first eminence in his profession.

iron had been put into water, for, after the lapse of a couple of hours, the polar wires were seen to be surrounded by light flakes of oxide of iron. 3. A piece of iron being voltaically associated with zinc, was exposed to the action of the atmosphere. Having left this voltaic pair for some time to itself, the iron part of it appeared to be covered with a thin layer of rust, and on comparing it with a piece of iron which had also been placed within the atmosphere during the same space of time, no evident difference could be detected between the states of the surfaces of both pieces. 4. A piece of iron wire was connected with each of the poles of a voltaic pile, without making the wires touch each other. Being exposed to the action of the atmosphere under these circumstances, both polar wires appeared, after some time, equally effected by rust, and as much as another piece of iron which was not connected with a pile. 5. A piece of iron, being voltaically associated with zinc, was placed in common water, so that both metals were deposited in the same vessel. Although this voltaic pair has been kept in water for twelve months, the iron part of it does not appear to be in the least degree oxidized, its surface being perfectly brilliant. 6. A piece of iron wire was connected with each of the poles of a pile, and each of these pieces made to plunge into a separate vessel filled with common water, the vessels being connected by means of a piece of platinum. That portion of the negative polar wire which was immersed in the water did not rust at all, as long as there was a current passing through the arrangement. 7. Copper being intimately associated with zinc, and brought into an aqueous solution of chloride of sodium (in such a manner that each of the metals was plunged into a separate vessel), was soon chemically affected,—provided that the vessels did not communicate with each other. 8. The same experiment was made as in the preceding case, with the difference, however, that both metals were plunged into the same vessel. Under these circumstances, the copper piece was not in the least corroded by the salt water, whatever the length of time was during which the metals were immersed. 9. A piece of copper was connected with each of the poles of a voltaic pile, and put into a vessel containing an aqueous solution of common salt. Both pieces were attacked by the fluid just in the same way as if they had not been attached to a voltaic arrangement, provided the vessels did not communicate with each other. 10. The experiment was made as in the preceding case, with the difference only, that the vessels were made to communicate with each other by means of a piece of platium. The positive polar wire quickly underwent oxidation, while the negative one remained untouched. If an aqueous solution of common salt was made use of as the exciting fluid in the pile, and the latter left unclosed, the copper pieces of the voltaic pair rather readily entered into oxidation, while they were not all chemically affected when the pile was closed. 11. A piece either of copper or of iron was connected with each of the poles of a pile; two tumblers were filled, partly with mercury, partly with water, or with a solution of common salt, and the vessels made to communicate with each other by platinum, so as to make each extremity of the latter enter into the mercury of either vessel. Things having been arranged in the manner described, the polar wires were each introduced into one of the tumblers, so that the free end of each wire was made to plunge into the mercury. Under these circumstances, both polar wires appeared to be equally affected---that is, they were precisely in the circumstances as if they had not been connected with any voltaic arrangement. From these facts, Prof. Schönbein infers---1st, That neither common nor voltaic electricity is capable of changing the chemical bearings of any body, and that the principles of the electro-chemical theory, as laid down by Davy and Berzelius, are fallacious. 2nd, The change which certain metallic bodies, when placed under the influence of a current, seem to undergo with regard to their chemical relations, is due to the production of some substance or other, and its deposition upon those bodies by the agency of a current of electricity. 3rd, The condition, *sine qua non*, for efficaciously protecting readily-oxidizable metals against the action of free oxygen dissolved in fluids, is, to arrange a closed voltaic circle, which is made up, on one side, of the metal to be protected, and another metallic body more readily oxidizable than the former, and, on the other side, of an electrolyte containing hydrogen, as water.

Prof. Shepard, of the Medical College, South Carolina, gave an account of the analysis of a Meteorite, in which he had detected chlorine and silicon.

'On the Composition of Idocrase,' by Mr. T. Richardson.---The composition of the Silicates has attracted a considerable share of the attention of chemists, but until the discovery of the doctrine of Isomorphism, this department of mineralogy might be said to have remained stationary. It is however remarkable, that, even with the advantages of this beautiful law, many of the formulæ of minerals are very incorrect representations of their constitution, as, for example, in the received formula of Petalite, there is a difference of six per cent, of Silica between the result of the analysis and that computed; and this is only one among many instances which might be adduced. Idocrase is even in a worse state than this, for Berzelius says, (Die Anwendung Lothrohres, p. 218,) that the formula is not known with certainty, although Prof. Johnstone, in his report on Dimorphous Bodies, has assigned to it the following formula in common with the Garnet---viz.

$$\dot{Ca}_3\,\dddot{Si} + \left\{\begin{array}{l}\dddot{\overline{Al}}\\ \dddot{\underline{Fe}}\end{array}\right.\ \dddot{Si}$$

The subject has moreover been lately involved in greater obscurity, by the publication of M. Ivanoe's analysis in Poggendorff's Annalen, which differs from all the analyses hitherto made. With the view then of assisting in explaining these descrepancies, I have made the following analyses of Idocrase from different localities, with specimens selected from the cabinet of Mr. Hutton, of Newcastle-on-Tyne. It is needless to give the detail of the analyses, which were made with every care :--- No. 1. was a specimen of Idocrase from Egg, in Norway; 2. Idocrase from Slatoush, in Siberia; 3 Idocrase from Piedmont; 4. Vesuvian from Monte Somma: 5. Egerane from Eger, in Bohemia.

	1	2	3	4	5
Silica	38.75	37.45	39.25	37.90	38.40
Alumina	17.35	18.85	17.30	18.10	18.15
Protox. Iron	8 10	7.75	7.62	4.89	7.40
Protox. Manganese	,,	trace	3.50	,,	trace
Lime	33.60	35.25	32.25	34.69	33.09
Magnesia	1.50	1.35	.47	3.23	3.02
	99.30	100.35	100.30	98.86	100.06

The result of these analyses is, that the composition of Idocrase may be represented by the formula,

7 $(FO, MO, CaO\ MgO)_3 SiO_3 + 5\ Al_2\ O_3\ SiO_3$ which may also be referred back to the fundamental formula of the Garnet, 3 RO, $SiO_3 + R_2\ O_3\ \ SiO_3$. This result however, suggests the idea, that by attending more to the exact representation of the analytical results in the formula, some new light may possibly be thrown on some points in Isomorphism.

'Experiments on Fermentation,' with some general remarks, by Dr. Ure.*---A dispute having taken place between some distillers in Ireland, and officers of Excise, concerning the formation of alcohol in the vats or tuns by spontaneous fermentation, without the presence of yeasts, the Commissioners of Excise thought fit to cause a series of experiments to be made upon the subject, and they were placed under my general superintendence. An experiment was made on the 6th of October, 1837, with the following mixture of corn.

2 Bushels of Barley weighing	100lb.	5 oz.
½ Bushel of Malt	21	7
½ Bushel of Oats	20	12
Total, 3 Bushels, weighing	142	8

The bruised corn was wetted with 26 gallons of water at the temperature of 160° F., and after proper stirring, had 8 gallons more of water added to it at the average temperature of 194°. The mash was again well stirred, and at the end of 45 minutes the whole was covered up, having at that time a temperature of 138° F. Three hours afterwards, 16 gallons of wash only were drawn off; being considerably less than should have been obtained, had the apparatus been constructed somewhat differently, as shall be presently pointed out. The gravity of that wash was 1,060; or in the language of the distiller, 60 degrees. After a delay of

* From the pressure of business before the Section, Dr. Ure did not read this paper, but gave merely a summary of its contents.

two hours more, twenty additional gallons of water at the temperature of 200° were introduced, when the mash was well stirred, and then covered up for two hours, at which period 23 gallons of fine worts, of specific gravity 1.242, were drawn off. An hour afterwards 12 gallons of water at 200° were added to the residual grains, and in an hour and a half 11 gallons of wort, of the density 1.033, were obtained. Next morning the several worts were collected in a new mash tun. They consisted of 48 gallons at the temperature 80°, and of a specific gravity 2.0465, when reduced to 60°. Being set at 80°, fermentation soon commenced; in two days the specific gravity had fallen to 1.0317; in three days to 1.018; in four days to 1.013; and in five days to 1.012; the temperature having at last fallen to 78° F. The total attenuation was therefore 34½ degrees, indicating the production of 3.31 gallons of proof spirit; while the produce by distillation in low wines was 3.22; and by rectification in spirits and feints it was 3.05. The next experiment was commenced on the 12th of October, upon a similar mixture of corn to the preceding. 48 gallons of worts of 1.043 specific gravity were set at 82° in the tun, which next day was attenuated to 1.0418; in two days to 1.0202; in three days to 1.0125; and in five days to 1.0105: constituting in the whole an attenuation of 32½ degrees, which indicates the production of 3.12 gallons of proof spirits; while the produce of the first distillation was 2.93 in low wines; and that of the second in feints and spirits was 2.66. In these experiments, the wash when fermenting most actively, seemed to simmer and boil on the surface, with the emission of a hissing noise, and the copious evolution of carbonic acid gas. They prove beyond all doubt, that much alcohol may be generated in grain worts, without the addition of yeast, and that also at an early period; but the fermentation is never so active as with yeast, nor does it continue so long, or proceed to nearly the same degree of attenuation. I was never satisfied with the construction of the mash tun used in these experiments, and had accordingly suggested another form, by which the mash mixture could be maintained at the proper temperature during the mashing period. It is known to chemists, that the diastase of malt is the true saccharifying ferment which converts the fecula or starch of barley and other corn into sugar; but it acts beneficially only between the temperatures of 145° and 168° F.* When the temperature falls below the former number saccharification languishes, and when it rises much above the latter it is entirely checked. The new mash tun was made of sheet zinc, somewhat wider at bottom than top; it was placed in a wooded tun, so much larger, as to leave an interstitial space between the two of a couple of inches at the sides and bottom. Through this space a current of water at 160° was made to circulate slowly during the mashing period. Three bushels

* M. Raspail's observations upon diastase are entirely erroneous; and cannot be allowed to invalidate the facts adduced by Payen, Persoz, and Guerin Varry. In fact, were Raspail correct, wheat flour boiled with water should immediately form sugar.

of malt, weighing 125 lb. 3 oz., were wetted with 30 gallons of water at 167°, and the mixture being well agitated, the mash was left covered up at a temperature of 140° during three hours, when 19 gallons of fine worts were drawn off at the specific gravity of 1.0902, or 90.2 degrees. Twenty gallons more water at 167° were then added to the residuum, which afforded after two hours 28 gallons of wort at the gravity of 1.036; 12 gallons of water at 167° were now poured on, which yielded after other two hours 15 gallons at the gravity 1.0185. Forty gallons of fine worts at 1.058 gravity, and 68° temperature, were collected in the evening of the same day, and let into the tun with 5 per cent. of yeast. The attenuation amounted in six days to 54 degrees. The third wort of this brewing, amounting to 15 gallons, being very feeble, was mixed with 7 gallons of the first and second worts, put into a copper, and concentrated by boiling to 11 gallons, which had a gravity of 1.058 at 60° F. They were separately fermented with five per cent. of yeast, and suffered an attenuation of 48½ degrees. The produce of spirit from both, indicated by the attenuation was 5.36 gallons; the produce in low wines was actually 5.52, and that in spirits and feints was 5.33, being a perfect accordance with the Excise tables.

The next experiments were made with a view of determining at what elevation of temperature the activity or efficiency of yeast would be paralyzed, and how far the attenuation of worts could be pushed within six hours, which is the time limited by law for worts to be collected into the tun, from the time of beginning to run from the coolers. When worts of the gravity 1.0898 were set at 96° Fahr., with 5 per cent. of yeast, they attenuated 26.9° in six hours; worts of 1.0535 gravity set at 110° with 5 per cent. of yeast, attenuated 16° in about 5 hours; but when worts of 1.0533 were set, as above, at 120°, they neither fermented then, nor when allowed to cool; showing that the activity of the yeast was destroyed. When fresh yeast was now added to the last portion of worts, the attenuation became 5.8° in 2 hours, and 28.4° in 3 days; showing that the saccharine matter of the worts still retained its fermentative faculty. Malt worts being brewed as above specified, were set in the tun, one portion at a temperature of 70°, with a gravity of 1.0939, and 5 per cent. of yeast, which attenuated 66° in 3 days; other two portions of the same gravity were set at 120°, with about 10 per cent. of yeast, which underwent no fermentative change or attenuation in 6 hours, all the yeast having fallen to the bottom of the tuns. When these two samples of worts were allowed, however, to cool to from 74° to 72°, fermentation commenced, and produced in two days an attenuation of about 79°. It would appear, from these last two experiments, that yeast to the amount of 5 per cent. is so powerfully affected by strong worts heated to 120°, as to have its fermentative energy destroyed; but that when yeast is added to the amount of 10 per cent., the 5 parts of excess are not permanently decomposed, but have their activity merely suspended till the saccharine liquid falls to a temperature compatible with fermentation. Yeast, according to my observations, when viewed in a good achromatic microscope, consists altogether of translucent, spherical and spheroidal particles, each of about the 6000th part of an inch in diameter. When the beer in which they float is washed away with a little water, they are seen to be colourless; their yellowish tint, when they are examined directly from the fermenting square or round of a porter brewery, being due to the infusion of the brown malt. The yeast of a square newly set seems to consist of particles smaller than those of older yeast, but the difference of size is not considerable. The researches of Shulze, Cagniard de la Tour, and Schwann, appear to show that the vinous fermentation, and the putrefaction of animal matters---processes which have been hitherto considered as belonging entirely to the domain of chemical affinity---are essentially the results of an organic development of living beings. This position seems to be established by the following experiments :---1. A matrass or flask containing a few bits of flesh being filled up to one-third of its capacity with water, was closed with a cork, into which two slender glass tubes were cemented air-tight. Both of these tubes were passed externally through a metallic bath, kept constantly melted, at a temperature approaching to that of boiling mercury. The end of one of the tubes, on emerging from the bath, was placed in communication with a gasometer. The contents of the matrass were now made to boil briskly, so that the air contained in it and the glass tubes was expelled. The matrass being then allowed to cool, a current of atmospherical air was made constantly to pass through it from the gasometer, while the metallic bath was kept constantly hot enough to decompose the living particles in the air. In these experiments, which were many times repeated, no infusoria or fungi appeared, no putrefaction took place, the flesh underwent no change, and the liquor remained as clear as it was immediately after being boiled. As it was found very troublesome to maintain the metallic bath at the melting pitch, the following modification of the apparatus was adopted in the subsequent researches. A flask of three ounces capacity, being one-fourth filled with water and flesh, was closed with a tight cork, secured in its place by wire. Two glass tubes were passed through the cork; the one of them was bent down, and dipped at its end into a small capsule containing quicksilver, covered with a layer of oil; the other was bent on leaving the cork, first into a horizontal direction, and downwards for an inch and a half, afterwards into a pair of spiral turns, then upwards, lastly horizontal, whence it was drawn out to a point. The pores of the cork having been filled with caoutchouc varnish, the contents of the flask were boiled till steam issued copiously through both of the glass tubes, and the quicksilver and oil became as hot as boiling water. In order that no living particles could be generated in the water condensed beneath the oil, a few fragments of corrosive sublimate were laid upon the quicksilver. During the boiling, the flame of a spirit lamp was drawn up over the spiral part of the second glass tube, by means of a glass chimney placed over it, so as to soften the glass, while the further part of the tube was heated by another spirit lamp, to prevent its getting cracked by the condensation of the steam. After the ebullition had been kept up a quarter of an hour, the flask was allowed to cool and get filled with air through the hot spiral of the second tube. When the contents were quite cold, the end of this tube was hermetically sealed, the part of it between the point and the spiral was heated strongly with the flames, and the lamps were then withdrawn. The matrass contained now nothing but boiled flesh and gently ignited air. The air was renewed occasionally through the second tube, its spiral part being first strongly heated, its point then broken off, and connected with a gasometer, which caused the air to pass onwards slowly, and escape at the end of the first tube immersed in the quicksilver. The end of the second tube was again hermetically closed, while the part interjacent between it and the spiral was exposed to the spirit flame. By means of these precautions, decoctions of flesh were preserved, during a period of six weeks, in a temperature of from 14° to 20° R. (63½° to 77° F.), without any appearance of putrefaction, infusoria, or mouldiness: on opening the vessel, however, the contents fermented in a few days, as if they had been boiled in the ordinary manner. In conducting such researches, the greatest pains must be taken to render the cork and junctions of the glass tubes perfectly air-tight. The following more convenient modification of the experiment, but one equally successful and demonstrative, was arranged by F. Schulze. The glass tubes connected with the flask, were furnished each with a bulb at a little distance from the cork; into one of which globes caustic alkaline lye being put, and into the other strong sulphuric acid, air was slowly sucked through the extremity of the one tube, while it entered at the other, so as to renew the atmosphere over the decoction of flesh in the flask. In another set of experiments, four flasks being filled with a solution of cane-sugar, containing some beer yeast, were corked, and plunged in boiling water till they acquired its temperature. They were then taken out, inverted in a mercurial bath, uncorked, and allowed to cool in that position. From one-third to one-fourth of their volume of atmospherical air was now introduced into each of the flasks; into two of them, through slender glass tubes kept red hot at a certain point, into the other two through glass tubes not heated. By analysis it was found that the air thus heated contained only 19.4 per cent. of oxygen, instead of 20.8; but, to compensate for this deficiency, a little more air was admitted into the two flasks connected with the heated tubes, than into the two others. The flasks were now corked and placed in an inverted position, in a temperature of from 10° to 14° R. (54½° to 63½° F.) After a period of from four to six weeks, it was found that fermentation had taken place in both of the flasks which contained the non-ignited air---for, in loosening the corks, some of the contents were projected with force---but, in the other two flasks, there was no appearance of fermentation, either then, or in double the time. As the extract of nux vomica is known to be a poison to *infusoria* (animalcules), but not to vegetating mould, while arsenic is a poison to both, by these tests it was proved that the living particles instrumental to fermentation belonged to the order of plants of the Confervoid family. Beer yeast, according to Schwann, consists entirely of microscopic fungi, in the shape of small oval grains of a yellowish white colour, arranged in rows oblique to each other. Fresh grape must contains none of them; but, after being exposed to the air at 20° R., for 36 hours, similar grains become visible in the microscope, and may be observed to grow larger in the course of an hour, or even in half that time. A few hours after these plants are first perceived, gas begins to be disengaged. They multiply greatly in the course of fermentation, and at its conclusion subside to the bottom of the beer in the shape of a yellow white powder.

Mr. Martineau objected to the low temperatures for making extracts mentioned by Dr. Ure.---Mr. Black, on being referred to by Dr. Ure, stated that the temperatures used by distillers and brewers were very different, in consequence of the difference of the materials used in brewing distillers' wash and brewers' wort. The distillers use sometimes only one-tenth part of malt, and the remainder bruised barley, or other corn; and were they to use such high temperatures, in the first mashing, as those used by brewers who use only malt, the mass would get coagulated like thin batter,---or the tun set, as it is technically termed. The distillers, however, after making their first infusion at much lower temperatures than brewers, bring them up, before running off the worts, by the addition of water, at as high a temperature as any used by the brewer. Mr. Black seemed also to object to so high a temperature as Mr. Martineau mentioned for the first infusion, 180° F., but preferred 10° or 12° lower, the heat being afterwards brought up in the same way as in the distillery.

Section C.---Geology and Geography.---Thursday.

Mr. Bowman read a paper on some skeletons of fossil vegetables, found by Mr. Binney, in the shape of a white impalpable powder, under a peat bog near Gainsborough, occupying a stratum four to six inches in thickness, and covering an area of several acres. It remained unchanged by the sulphuric, hydrochloric, and nitric acids, and by heat, and was concluded to be pure silica, in a state of extremely minute subdivision. On submitting it to the highest power of the compound microscope, it was found to consist of a mass of transparent squares and parallelograms of different relative proportions, whose edges were perfectly sharp and smooth, and the areas often traced with very delicate parallel lines. On comparing these with the forms of some existing Confervæ, Mr. Bowman found the resemblance so strong, that he entertained no doubt they were the fragments of parasitical plants of that order, either identical with or nearly allied to, the tribe Diatomaceæ, which grow abundantly on other Algæ, both marine and fresh-water, but are so minute, that individually they are invisible to the naked eye. To enable the Section to judge for themselves, Mr. Bowman exhibited highly-magnified drawings of some of these, from the works of Dr. Greville, and also of the powder, which showed the resemblance to be complete. They are, therefore, the counterparts of the fossil Infusoria of Ehrenberg, and occupy the same place in the Vegetable kingdom as those do in the Animal.

The President observed, that, as far as he was aware, the discovery was quite new to science. He instanced, that some minute floating Confervæ had been found on the Lake of Neuchatel; and Mr. Bowman said he had observed something similar in the lakes near Ellesmere, which annually took place, and rendered it probable that a like deposition of their remains was now going on.

Sir Charles Lemon reported, that an interview had taken place between the Government and the Committee appointed at the Newcastle meeting for taking steps towards the preservation of mining records; and Mr. De la Beche mentioned, that a person had already been appoint- for the purpose, and would enter on the duties of his office next year.

Mr. Murchison then exhibited a Geological Map of Europe, coloured by Von Dechen, and the first part of a work on Petrifactions, collected by M. von Humboldt, in South America. This latter work has led to some important conclusions---no oolitic or jurassic strata seem to exist in South America, or perhaps even in North America; but there is a large development of the tertiary series, and a still larger of certaceous in the southern continent. Specimens of Silurian fossils have been brought to the present meeting of the Association, collected in North America, by Prof. Shepard, of Newhaven.

In reference to the map of Europe, Mr. Greenough gave it as a highly probable opinion, that under the morasses of Northern Germany a valuable coal-field may exist.

Mr. Murchison then called the attention of the meeting to a section of part of Germany which he had lately visited. Mr. Murchison stated, that having, with Prof. Sedgwick, examined the older rocks of Western Germany and Belgium, it is their intention to lay before the Geological Society of London a memoir, illustrated by fossils, on the classification of those ancient deposits, a succession of the Carboniferous, Devonian, and Silurian systems. His present communication bore only on one point of this analysis, offering to prove the geological position of the anthracite or culm-bearing strata of Devonshire and Cornwall. Transverse sections, in descending order, from the productive coal-field of Westphalia on the N.N.E., to the uppermost division of protozoic rocks on the S.S.W., were explained; and one from Dortmund, by Schelke, to the neighbourhood of Limburg and Iserlohn, was specially adduced, in which the various masses of strata are clearly exposed, viz.

1. Coal shales, coal, &c.—a productive coal-field. 2. Millstone grit series, with many impressions of small plants, and occasional thin seams of coal. 3. Thinly laminated carbonaceous sandstones and shales, containing many plants, together with bands of flat bedded, black, bituminous limestone and shale, charged with Posidonia and Goniatites, and alternating with courses of "Kiesel schiefer," or, flinty slate. 4. Carboniferous limestone, of great thickness, like the British, and loaded with many well-known fossils. 5. Devonshire rocks, black schists, grey and red sandstones, with occasional calcareous courses, and numerous fossils, the old graywacke of the Germans. The order and sequence of these strata are indicated and maintained along the lower edge of the whole range of the Westphalian coal-field, the beds necessarily rising to the surface at angles of 30° to 40°, in perfect conformity, and showing throughout the clearest and most complete transition into each other. It was particularly to the group No. 3, that Mr. Murchison directed attention, being quite identical with the culm-bearing strata of North Devon and Cornwall, first described by him and Prof. Sedgwick as a portion of a true coal-field, and as not belonging to the graywacke, or older transition rocks—(see *Athen.* No. 461.) The Westphalian sections establish the geological position of the Biddeford culm strata more clearly than any stratigraphical evidence in Great Britain, by presenting five masses of unequivocal mountain limestone, rising from beneath the black limestone and culmiferous schists, and thus the precise age of the latter is demonstrated. In regard to the rocks of the Devonian system, or old graywacke, which support in mountain masses the carboniferous system above alluded to, Mr. Murchison offered a brief and general sketch, promising, that in the ensuing session of the Geological Society Mr. Sedgwick and he will show that these rocks fairly represent the British old red sandstone, or Devonian system. This latter term foreign geologists do not seem disposed to adopt, although it might save much confusion, it being now ascertained that black and slaty rocks occupy, in very extended districts, the same geological position as the red rocks of Herefordshire. Proofs of the existence of the same order and succession will be hereafter pointed out in the countries of the Hartz and the Fichtelgebirge, as well as upon both sides of the Rhine, while a splendid development of the still older Silurian rocks, both upper and lower, will be pointed out, chiefly on the left bank of the Rhine, also in Belgium, at Liege, and Namur.

Mr. Greenough was inclined now to coincide with Mr. Murchison in opinion as to the age of the culm-bearing strata of Devonshire.—Mr. De la Beche said he was open to conviction on perfect evidence, and that the proofs brought forward from Germany had been the best as yet afforded by Mr. Murchison.—Mr. Williams could not give in his adhesion; and Dr. Buckland was glad that one opponent still remained to the new theory.—Mr. Lyell referred to Mr. Lonsdale, who had been the main instrument in determining the age of the Devonian rocks. By an inspection of the fossils, he had predicted that those rocks, although different in mineral composition, would agree in age with the old red sandstone, being between the Carboniferous and Silurian systems.

Dr. Buckland announced, that the fossil Flora 'of Great Britain was about to be continued by Messrs. Hutton and Henslow, who solicited the loan of specimens, which might be sent to the Geological Society, and would be carefully returned, after drawings had been made from them.

Dr. Lloyd made some observations on the Geology of Warwickshire, and announced the discovery of Saurian remains in that country. He first alluded to the coal-field of North Warwickshire, between Tamworth and Coventry, in which the axis of direction has been ascertained to be N.N.W. to S.S.E. Near Nuneaton, is a quartzy rock, similar to that of Charnwood Forest, being, in all probability, an altered Caradoc sandstone; it contains manganese, and is without any organic remains; some volcanic rocks occur. Greenstone is found at Griff Hollow and at Marston Japet, showing that the district has, at one time, been disturbed; indeed, Prof. Sedgwick considers that this coal-field has been elevated during the deposition of the lower member of the new red sandstone. Between Birmingham and Warwick may be seen some outliers of lias, as at Knowle and Chesterton. At Warwick, a different sandstone from the others may be observed; and at Stockingford, coal, with a limestone underlying---black, smoky, and containing plants---also, occasionally, galena. In this district, there is no magnesian limestone. In the *bunter sandstein* of Allesley, near Coventry, the remains of a coniferous fossil tree have been discovered, and in the same formation a jaw bone, but it is uncertain whether belonging to a fish or a saurian. At Garrison Hill there occurs a highly calcareous rock, but it is uncertain if it can be regarded as muschelkalk: and the absence of this rock renders the division of the Warwickshire sandstone imperfect. There is a difficulty in what class to place the sandstone at Warwick, which resembles bunter sandstein, but it contains the salt springs of Leamington, and which springs are generally confined to the keuper, or upper formation. Perhaps there may be a fault in this locality, by which the sandstone has been elevated, but there seems to be no disturbance of the adjacent strata. The organic remains found in this sandstone have been regarded as belonging to the Dolichognathus, Platygnathus, and Megalosaurus---with them coprolites are found. At Shrewley Common, the sandstone is evidently keuper, containing Posidonia minuta; it bears impressions of animals; also ripple marks and worm marks. In the rag bed of the Warwick sandstone, organic remains have been found; it contains some carbonate of lime. At Warwick a little rock salt has also been found.

Mr. Strickland regarded the sandstone at Warwick as bunter sandstein, that had been elevated by a fault. At Droitwich a similar sandstone is overlaid by the salt marle.---Dr. Buckland said, that a like rock is found on the top of the variegated marle.

Dr. Ward exhibited specimens and drawings illustrative of impressions of the feet of animals on the Greensill sandstone, near Shrewsbury. Greensill Hill consists of a steep escarpment of new red sandstone, and contains four strata that have been described by Mr. Murchison, and in the second of which the impressions were found. This stratum, when exposed to the atmosphere, always splits so as to exhibit ripple marks, and on these marks the impressions of feet have been observed, as well as marks of drops of rain. These last are often in an oblique direction, as if having fallen in a gale of wind, the direction of which is thus pointed out. The foot marks differ from those of the Cheirotherium, in having only three toes, armed with long nails, directed forwards, and not spread out. Nothing resembling the ball of the foot has been observed, except in a few, which have some resemblance to the impression of the foot of a dog.

Dr. Buckland exhibited impressions in sandstone from Dumfriesshire.

Mr. Knipe read a communication on a Trap Dyke in Cumberland. It commences on the east side of the river Petterell, about six miles south of Carlisle, and about two from the limestone quarry at Broadfield; its composition is like onion basalt, decomposing in concentric layers. It passes by Great Barrock Hill and Armathwaite, crossing the River Eden; then by Combe's Peak and Stony Croft, Cringle Dyke, and Renwick, about two miles from which last place a good vertical section of it may be seen, on the west side of the Raven Water, which it crosses. It is met with at Hastside Fell, cutting through the Pennine chain, its eastern termination being about the source of the South Tyne River, near which it appears to have altered the adjoining strata. Its length is twenty-two miles, and its width from twenty to thirty yards. Its course coincides with that of the great Cleveland Dyke, and it is not improbable that they may be connected; if so, a basaltic dyke, 120 miles long, crosses our island from the Solway Firth to the German Ocean.

A paper, 'On the Structure of Fossil Teeth,' by Mr. Nasmyth, was then read, illustrated by several drawings. It had been stated by some anatomists, that the proper dental substance consists of an uniform structureless substance, and of fibres passing through it; but the author was led to believe that this structureless substance is organized, and differently and characteristically in different animals, so as to be a means of classification. He employed a magnifying power of the tenth of an inch focal distance, with an achromatic condenser, and first found, in the tooth of a fossil rhinoceros, the appearance of cells or compartments, and afterwards found it to exist in recent teeth. He also examined the fibres of different teeth, and found that generally they presented an interrupted or baccated appearance,as if made up of different compartments, each class of animals presenting a different arrangement.

In a paper read before the Medical Section, Mr. Nasmyth treated more fully of the organization of the dental inter-fibrous substance, and entered also into some details on the structure of the pulp.

Mr. Darwin announced, that a work on fossil teeth, by Prof. Owen, would shortly be published.

A communication on Peat Bogs, by Dr. G. H. Adams, was then brought before the meeting. The author had examined microscopically many specimens of peat, and had found them to consist of bundles of little capsules, somewhat similar to bunches of raisins, attached to the radicals of the plants growing on the surface of the bogs. These, he thinks, have never been observed before, owing to old black portions of bog having been examined. He considers that fallen trees have no connexion with the formation of peat, except as furnishing carbonic acid gas from their decay. He attributes great importance to the well-known power of plants in separating carbonic acid from the atmosphere, and conceives that the preservative power of peat is owing to tannin, which substance may have escaped detection, from its being united to iron, so abundant in heaths, accounting thus for the dark colour of the lower parts of peat formations. The author considers, that the absence of peat in America is owing to the non-existence there of the family of Ericæ. He remarks, also, that peat does not serve as a manure, from its little tendency to decomposition; and he proposes to assist the decomposition by means of sulphuric acid---thus rendering available for agriculture large tracts of bog land now lying useless, especially in Ireland. He compares the analysis of Apotheme, the chief constituent of vegetable mould, with that of gallic acid, and thinks that the action of sulphuric acid on the latter, as contained in peat, would probably produce the former, which is the chief support of vegetation. If putrifying vegetable matter be mixed with peat, its unpleasant odour at once ceases. The author urges the importance of destroying this preservative power of peat, so that it may be converted into a manure---first, by destroying the plants, next by burning or paring the surface, then adding dilute sulphuric acid to it, collected into heaps.

Mr. J. B. Yates read a paper 'On the changes and improvements in the Embouchure of the Mersey.'---He referred to the new channel in the harbour of Liverpool, which had been brought before the notice of the Association by Capt. Denham. The intricacy of access to this harbour arises from the accumulation outside of numerous beds of sand, which are frequently and suddenly changing their position and elevation. It can scarcely be doubted, that at some remote period the estuary of the Mersey did not exist at all, or, at most, in a very limited form; a forest and morass may have occupied the land between Formby Point and Helbre. Numerous trunks and roots of large forest trees are, to this day, found along the Cheshire and Lancashire shores, while extensive tracts of peat are observed in many places starting up among the sands. A violent disruption must have taken place at the mouth of the estuary, by which enormous masses of sand and marle have been thrown out, perhaps proved by the homogeneous structure of the banks on either side. In 1828, a number of human skeletons were disinterred opposite the Leasow Lighthouse, affording strong evidence that a burying-ground had formerly existed there, and a similar cemetery is discernible at Formby. This lighthouse stands in place of another, which was nearer to the sea by more than half a mile---a site which, at the time of its erection, seemed to have been firm, dry land, but was rendered useless by the encroachments of the water, which continued to increase. It was not until the sea had broken down the ridge of sand which had formed its boundary, that a strong embankment was made, extending a mile and a quarter in front of the present lighthouse. The sand banks in this estuary are tossed to and fro by the force of the winds and tides, and are constantly changing their shapes and elevations, and, having no escape, they remain pent up in the bay. In 1687, an excellent channel existed opposite to Formby Point, its depth from three to ten fathoms; but, not being marked by buoys, the Rock Channel was at that time the entrance in common use, though dry at low water. It has since become deeper, and thus a change has taken place upon the Hyle Sand Bank. A ridge, running along the middle of this bank, has been cut through by a channel having forced itself in a northerly direction, from Helbre island towards the Light Ship. The channel described by Capt. Denham at the Dublin Meeting is now useless, although used for some time with advantage; but it runs perpendicular to the course of the tide, which accounts for its present state. Fears have also been entertained, that the other channel, called the Horse Channel, was filling up. Lately, a diagonal channel has been formed, by aiding the ebb current of the tide in its natural diagonal course, between Lancashire and Cheshire. This was done by dredging, by means of a double-toothed harrow, twelve feet across, dragged backwards and forwards by a steamer of 100 horse-power over the intruding banks, the inner part of which was stated to rise forty-three feet higher than the outer or seaward part. An enormous wooden scraper is also used. The matter taken up appears to contain a small portion of peat, and weighs somewhat lighter than the sand found within the estuary. This new channel has been proved to answer the purposes of navigation beyond original expectation, and the approach to Liverpool is even better than before.

Mr. De la Beche mentioned, that submerged peat is found along many of the shores of Europe, being evidently the remains of forests that had sunk. These have been covered with sand, and now there are encroachments made upon the coasts near them, thus showing two sorts of changes of level. He was averse to any great encroachments being made on the shores of estuaries, as the natural process of scouring by means of the reflux of the tide was diminished.

SECTION D.---ZOOLOGY AND BOTANY.---Thursday.

Dr. Pritchard read a paper on 'The Extinction of the Human Races.' He expressed his regret that so little attention was given to Ethnography, or the natural history of the human race, while the opportunities for observation are every day passing away; and concluded by an appeal in favour of the Aborigines' Protection Society. The paper gave rise to a long and desultory conversation, in which Dr. Hodgkin, Mr. Wilde, Mr. Watson, Mr. Hall, Dr. Daubeny, Dr. Wilson (of America), Mr. Thompson, and others, took part.

A Report on the Disbribution of the Pulmoniferous Mollusca in Britain, and the Causes influencing it; drawn up at the request of the Association, by Mr. E. Forbes.---The object of this inquiry was to ascertain the geographical and geological distribution of pulmoniferous mollusca in the British isles. The subject was considered under three heads: first, a view of the various influences which affect their distribution; second, a detailed view of the distribution of the indigenous species in the various provinces of Britain; and third, the relations of that division of the native Fauna to the Fauna of Europe, and the distribution generally of the more remarkable species. Under the first head, after enumerating the various species of pulmoniferous mollusca inhabiting Britain, Mr. Forbes proceeded to review the causes influencing their distribution, dividing such causes into primary and secondary. Under the head of primary causes, he considered the two influences of climate and soil. The influence of climate in Britain is indicated by the reduced number of species found in the more northern or colder districts, as compared with the number inhabiting the provinces of the south and centre. It is also indicated by the disappearance of species which inhabit soils indifferently, as we advance northwards, and by the presence of species in certain situations in southern and warm districts, which usually avoid, or are sparingly found in such localities. It is further shown by the tendency of individuals to multiply in temperate situations, and by the superior beauty of colouring displayed by species inhabiting warm districts. The author then pointed out, that there existed in many places a stronger influence than climate, and showed that this influence was in its nature geological. He showed that various kinds of rocks influence the distribution of mollusca; that calcareous rocks are especially favourable to their distribution; and that all rocks containing much lime tend to increase both the number of species and of individuals living on them. Certain species are confined altogether to certain rocks, others to a class of rocks; and instances of the occurrence of such phenomena in Britain were enumerated. Some rocks influence the distribution *negatively*, diminishing the number both of species and individuals. The order of influence of rocks on species in Britain, is as follows, commencing with the most influential :—

1. Cretaceous and oolitic.
2. Carboniferous rocks and trap.

3. Tertiary.
4. Saliferous.
5. Slates.
6. Granite and Gneiss.

Mr. Forbes noticed, that in certain cases climate neutralized the influence of the rock, and *vice versâ;* and instanced Guernsey, as a locality where the neutralization of geological influence by climate is *positive*, and Shetland, where it is *negative*. Under the head of secondary influences, Mr. Forbes considered the effect of the neighbourhood of the sea---the neighbourhood and elevation of mountains---the presence of woods, and the influence of the various trees found in them---the influence of water, especially of artificial water, as canals, and the vitiation of the Fauna by the agency of man, as in the case of the transportation of species by ballast, &c. Instances were given of the effect of these various influences in Britain, and the comparative effect of each on the existing Fauna considered. It was stated, that, in our country, the influence of elevation is always negative, but that in many other countries it is positive. It was shown also, that fossils, especially those of the newer pliocene strata, materially influence the Fauna in certain localities. A detailed view of the distribution of the species was then entered into. They were arranged under ten districts, viz. 1. the Channel Isles; 2. S. E. of England; 3. S. W. of England; 4. N. E. of England; 5 N. W. of England; 6. S. of Ireland; 7. W. of Ireland; 8. S. of Scotland; 9. W. of Scotland; 10. Shetland Isles. Tables were shown, exhibiting the relative importance of the various influences in each, and the causes of the presence of the more local species were considered. *Helix revoluta* and *Helix naticoides* were mentioned as additions to the British Fauna from Guernsey. The researches of Mr. Alder, of Newcastle, and Mr. Bean, of Scarborough, were particularly alluded to, and much novel information contributed by those gentlemen mentioned. Mr. Forbes then considered the distribution of the principal British species in foreign countries; and in a table exhibited a comparison between the principal published lists of Europe. The southern countries present much fuller lists than the northern. In the number of native species of helix, England exceeds Scandinavia by seventeen species, and Brabant by fifteen, but yields to the other European lists of equal importance, especially those of the southern countries of Europe. France exceeds Britain by no less than forty-one species. The *Helix fusca*, the *Clausilia Rolphii*, the *Pupa anglica*, and the *Lymnæa involuta*, of Thomson, were mentioned, as species, only found in Britain. Many remarkable instances of extensive distribution were mentioned. The common snail, *Helix aspersa*, is equally common throughout southern Europe, and is found also in parts of Asia, Africa, and North and South America; and the edible snail is nearly as widely distributed. The *Succinea amphibia* is very widely spread over the world, being found throughout Europe, from Archangel downwards, in North America, and in North and South Africa, as far as the Cape of

Good Hope; and the *Succinea oblonga* has also a very wide range. The consideration of the distribution of native species in foreign countries, was pressed as an important part of the examination, since, without such consideration, many fallacies may arise in drawing our conclusions.

Mr. Lyell observed, there were several points in relation to the distribution of recent animals that geologists required to know. In the first place, the influence of various kinds of rocks on the distribution of species. Strata in various stages of their growth contained various species. What were the laws which regulated this distribution with existing species? The mere chemical influence of strata is important. Freshwater shells exist without marine, and *vice versâ;* and it was desirable to know what was the influence of rocks in their neighbourhood upon them. It was desirable to know the chemical composition of rocks, as in many instances this must have great influence. Mollusca, for instance, formed their shells from lime, which they must have taken up as food. Again, a knowledge of the distribution of subaqueous species became important; and the sediments in the beds of rivers, and places where they are found, should be carefully observed and recorded; also the depth of the waters in which they are found, and the fuci or other plants which may grow in their neighbourhood. Shells are the most frequent organic remains, and therefore the most important. Mammalia, fishes, and reptiles are frequently absent in strata, but shells never. One of the great difficulties in studying these shells, was a want of knowledge of those which existed. As we passed through each stratum, the shells of each resembled more and more those of the strata above it, the nearer they were to it. Now the question presented itself in some of the upper strata, as to whether conchologists might not have overlooked existing species, and thus animals be thought extinct which are not so. Mr. Bean, of Scarborough, had lately found a shell that was supposed to be extinct. Another point of importance is the relation of shells to each other in a given district, such as the relation of the shells in rocks to those found in the sea near them. He had lately proposed the question to Messrs. Gray and Sowerby, as to whether there was any means of determining the relation between the number of the species of shells in the Mediterranean and the seas of the north of France. They told him there was no satisfactory means of doing so. They differed in their estimate, and the amount of information was of little value.

Mr. J. E. Bowman exhibited specimens of a species of Dodder (*Cuscuta epilinum*), first found in Britain, two years ago, by himself; and again in a new locality, within the present month. He believes it is to be found exclusively upon flax, and has been overlooked for *C. Europæa,* from which, however, it is quite distinct in its pedunculated heads, globular tube of the corolla, and the insertion of the stamens above the tips of the scales, which are geminate or bifid, with the lobes divaricate or fimbriated. As he observed these scales to differ a good deal from each other, even in the same corolla, he cautions botanists against trusting too much to them as a specific character, with further observations. Still less does this agree with the continental *C. epilinum* of Weihe, which is described as "simplex, glomerulis ebracteatis, sub 5-floris;" because the new plant is sometimes branched, has its heads always subtended by a broad bractea, and each head, when luxuriant, consisting of eight, ten, or twelve flowers. Still, as the specific name is so strikingly characteristic of its habit of growing always on *flax*, and is indeed as old as Dodonæus and Gerarde, the author contends that it ought to be retained; and that Weihe's plant (if such an one there be, though he suspects some mistake,) should be named anew, or its character be revised. Mr. Bowman then described the peculiarities in structure of this singular parasite. When it has fixed itself upon the flax, the root and lower part of the stem shrivel up and die away, and a group of little warts or tubercles is produced from the inner surface of the spire between each head, which strike into the flax and extract its juices. This economy places each head nearly in the situation of an independent plant; so that, if the stem were separated at intervals, each detached portion would continue to flower and to ripen its seed. This view occurred to him, on observing that the stem gradually thickened upwards as it approached each head, and was again reduced to half its diameter immediately above it; each head being thus dependent on its own subordinate system of exhausting suckers. Another beautiful compensation for the loss of the root, and supporting the view just advanced, is found in the succulent nature of the flowers, which are as fleshy as the leaves of the mesembryanthemum tribe, and contain reservoirs of nutriment to insure the ripening of the seed, and supply the deficiency consequent on the desiccation of the flax. The author adverted to the total absence of green colour in the dodder and other parasites, which is generally considered to be owing to their not *directly* elaborating their juices from the soil. But the misseltoe is green, though truly parasitical. Others suppose the want of colour to arise from their growing in the shade, or being destitute of leaves; but the dodder, though leafless, grows in the full sunshine; and lathræa has real leaves, though they are buried in the soil, amply furnished with stomata, which line the inner surfaces of cylindrical cells, and are most wonderfully adapted to their anomalous situation. In fact, they are true leaves turned inside out. The real explanation of the absence of green in plants arises, in all cases, from the want of stomata or pores in the cuticle or outer skin; for these pores are the lungs, and through them alone the atmosphere can be admitted, and chemically decomposed, by the action of light; some of its ingredients ministering to the support of the plant, and others entering into new combinations to produce that beautiful variety of verdure, which is the usual summer livery of the vegetable world.

A Paper was then read 'On the Cultivation of the Cotton of Commerce,' by Major-Gen. Briggs. The objects proposed in this paper are---First, to excite inquiry on the various species of cotton plant that produce the cotton of commerce. Secondly, to ascertain the nature of soils adapted to each. Thirdly, to prove the practicability of cultivating the plant in India, for the supply of the British market to any extent. Of the species that produce the various cottons of commerce, we have at present very little accurate knowledge, and this has arisen from the alterations undergone by the plant in the process of cultivation. But there can be no doubt that the plants which produce cotton in America, Asia, and Africa, are of decidedly different species. The plant that produces the Brazil cotton, probably the *Gossypium hirsutum*, grows to the height of from ten to twenty feet, is perennial, and produces cotton with a long and strong staple, and moderately fine and silky. The plant common to the West Indies, said to have been imported from Guiana, is triennial, bearing abundantly a fine silky long staple, and is the *Gossypium barbadense* of botanists. This also is the plant which produces the Sea-island cotton. When this plant was carried from the coast into the interior of Georgia and Carolina, in the United States of America, the seed changed from a black to a green colour, and the staple became shorter, coarser, and more woolly. This plant was afterwards introduced into Egypt, and is the same that produces the Bourbon cotton, cultivated by the French on that island. Mr. Spalding, in a letter alluded to by Mr. G. R. Porter, in his work on tropical productions, records several varieties, attention to which is of the greatest importance to the cultivation, since they vary in the character of their staple, in the shape and size of their pods, in the hue of the cotton, and in the duration of the plants. The common indigenous plant of India is the *Gossypium herbaceum* of botanists, and differs in appearance from the cottons of the Western world; besides which there is the *Gossypium religiosum*, producing the brown cotton extensively grown in China. It is of the former plant I would desire to speak more especially. It is usually cultivated as an annual, but has been successfully treated and grown as a perennial by the process of pruning down when the cotton is gathered. The produce of this plant is not inferior in fineness, and is superior in point of richness of colours, to the best cottons of America. The staple is however short, and by the great neglect hitherto evinced in picking the produce at the proper time, and carelessness in allowing particles of dried leaves, or the calyx of the flower to adhere to the wool, it fetches a lower price, and is considered an inferior article, in the English market, to the New Orleans and Georgian of America, though really superior in quality and durability. There is another kind of cotton produced from a species in Africa which Dr. Royle considers allied to the *Gossypium herbaceum* of India. We now come to speak of the soils in which these plants are cultivated. Several specimens of American soils on which cotton is grown, have been analyzed by Mr. E. Solly, and he finds them generally to consist---first, of a preponderating quantity of sand (silex). Secondly, of alumina or clay. Thirdly, of the oxides of iron and manganese, which give the warping colours to the soil. Fourthly, of very small proportions of carbonate and sulphate of lime. And lastly, of organic matter in two states; a fibro-vegetable and a soluble matter forming from four to eight per cent. Soils of this kind where hardly anything else will grow, are adapted for the cotton plants of America; a fact mentioned by Mr. Porter, and confirmed by Mr. Gray, who was for some years a cultivator of the plant in America. The land on which the indigenous plant of India termed *Gossypium herbaceum* grows, is very different. It is composed chiefly not of sand (silex) but of the results of the decomposition of trap rocks, the *debris* of the mountains that constitute the extensive trap formation of central India. This soil lies upon or borders on the limestone; it contains a large quantity of vegetable matter, abounds in oxide of iron, is retentive of moisture, and forms a rich, tenacious loam approaching to clay. Such is the soil of the indigenous cotton plant of India, and therefore differs from that of America, so that we ought not to be surprised to learn that all attempts at cultivating the American plant in this soil have failed. But there are in India abundant other soils on which the indigenous plant will not thrive. These prevail in Bengal, on the Coromandel Coast, and in fact throughout India. They consist mainly of the detritus resulting from the disintegration of rocks of the primary and secondary formations, such as granite, gneiss, sandstones, with here and there lime, producing a light soil, fertile or otherwise according to the quantity of organic matter it may contain. The indigenous plant will not grow here, but the American plants thrive on it. This has been proved by experimental farms near Bombay, and the Western Coast, in Upper Hindustan, on the Malayan Peninsula, and on the shores of Coromandel, in all of which tracts the American plants are growing at present in much perfection, though not in quantities sufficient to make any impression on the cotton market of this country. India could supply all the cotton Great Britain can ever require, even from her indigenous plants, but for local obstacles. The soil, favourable to the growth of this article, however, is situated in a central region removed from the coast, and the trade consequently labours under the difficulty attendant on a lengthened journey by land. This will not be the case when the cotton is grown on the lighter soils of the coast. Here every facility exists for its exportation, for there is no doubt that an article equally good might be obtained at a much cheaper rate than that now procured from America.

Mr. Felkin stated, that there was no objection to Egyptian cotton on account of its quality, but it could not be bleached. There was also much sand in it; this was why it was not more used; and no cotton, however cheap, would be purchased in the market with these drawbacks.---In answer to an inquiry, Gen. Briggs stated, that the nankeens of commerce were made from a naturally brown cotton, probably the *Gossypium religiosum.* This was a very different plant from the indigenous cotton of India.—Mr. Danson had seen cotton from Peru equal to Sea island, in point of silkiness, length of staple, &c. The specimens of cotton from Burmah, now exhibited, he thought were of a very superior quality. Other products, he thought, might be imported from the East, such as wool.—Gen. Briggs did not know where the wool of the East Indies was brought from. Shawls were embroidered at Delhi, but not manufactured. Many of the products of the East Indies could be imported; but it was a curious fact, that at the present moment, although we had possessed India so long, we absolutely knew nothing about its productions and capabilities. We had sent annually from England thousands of gallons of linseed oil to India, whilst millions of pounds of the seeds of linum were rotting throughout the whole country. There were not less than fifty species of plants, from which we might obtain caoutchouc; and yet we had imported but little from thence.

Section E.—Medical Science.—Wednesday.

Mr. Evans presented to the Section an extraordinary case of Spina bifida. The patient was a boy of twelve years of age, enjoying excellent general health in other respects; he was strong and active, but his head seemed enlarged from chronic hydrocephalus. The tumour occupied the lumbar regions, was semi-transparent, and the size of a child's head.

'Observations on Poisoning by the Vapours of burning Charcoal,' by Dr. Golding Bird.—Dr. Bird stated, that he was induced to examine into the subject experimentally, from the discordant opinions hitherto published on the various questions connected with it in a toxicological point of view. An opinion has been held, that vapours of carbonic acid were more injurious when produced by the combustion of coal and charcoal, than from any other source, on account of the admixture of light carburetted hydrogen gas. This opinion he dissented from, as it was well known that in coal-mines the fire-damp, as this gas was called, was inhaled, with perfect impunity. To ascertain the *modus agendi*, of the gas when inhaled, he made numerous experiments, by immersing animals in different mixtures of it and atmospheric air, as well as in the pure gas. In the latter case, the animals died asphyxiated, as when immersed in water or mercury, the spasm of the glottis preventing any portion of it from being inhaled. If not more than 25 per cent. be present, then respiration will go on, and its true poisonous effects take place. As to the amount of this gas necessary to produce fatal effects, Dr. Bird found that as a general rule, any quantity above 3½ per cent. was capable of producing death. Two opinions prevailed on the nature of these properties: the first was, that the gas acted negatively, as pure nitrogen or hydrogen is known to do, by preventing the due supply of oxygen. To test this opinion, he formed a mixture containing twenty-one parts of oxygen, and seventy-nine of carbonic acid, and death followed instantly from immersion in it; and the same result followed when the proportion were reversed, although a taper burned brilliantly in the latter combination; showing, that the burning of a light in any suspected situation is not always a safe test of the absence of danger. The second opinion is, that this gas, when respired, exerts a specific poisonous action on the nervous system. This latter, Dr. Bird adopts, from various considerations drawn from his direct experiments, and from the symptoms observed in numerous cases. These are principally those denominated cerebral, such as head-ache, vertigo, suffused eyes, mental horror to an intense degree. Even with these symptoms, respiration may go on freely. Death is frequently preceded by vomiting, which is a marked symptom of cerebral disease. In cases where recovery has taken place, the sequelæ are decidedly of nervous character: they have been, partial paralysis, dumbness, and idiotcy; and this poisonous effect he thought took place independently of absorption, from its immediate effects on the nervous system, to which it was applied. Death has also been induced by its external application to the body, without its being, at the same time, respired. Dr. Bird related some experiments of Dr. A. T. Thomson, in which the pain of inflamed surfaces was instantly removed on their being plunged into carbonic acid. He dwelt on the pathological effects of the gas as exhibited after death, and concluded by pressing the importance of minute post mortem examinations in every case of death from this cause coming under the notice of medical men.

A member stated from his own experience, that in the burning of charcoal a quantity of carbonic oxide is generated in many instances, and this must be taken into account in any accurate examinations of the question.---Prof. Macartney observed, that when the egg which has been for some time in process of incubation is placed in carbonic acid, and the temperature preserved, the developement of the chick ceases; and this he deemed a strong proof of the action of the gas being on the nervous system, as in this case there is no respiration, and the process supplementary to it is not at all interfered with.

Prof. Macartney then read a paper 'On the Rules for finding with exactness the Position of the principal Arteries and Nerves, from their relations to the external forms of the body.'—He first alluded to the fact demonstrated by painters and sculptors, that the proportions which belong to the external figure of the human body are, in general, regulated by the primary relations of duplicates and thirds, and their multiples; and that he had discovered that a similar law of proportion prevailed with respect to the internal parts of the body—more particularly with regard to the trunks of the arteries and nerves, in relation to the limits of external form. They sometimes take a middle line along the limb, as may be observed in the sciatic nerve, but more frequently they occupy lines dividing the external form into thirds, or proceed from the median line of the side of an extremity to the middle of the opposite side; or they may pass from the middle to the division into thirds, or from a point placed on a line dividing the external form into three equal parts, and then approaching the middle, so as to form, with the fellow, two parts of a triangle. He illustrated this rule by applying it to the entire course of the artery of the upper extremity, and its principal divisions, from the subclavian to the palmar arches, and from the course of the occipital arteries. He remarked, that the common mode of dissecting arteries and dried preparations was calculated to lead into serious errors, in consequence of which he had been in the habit of teaching relative anatomy, by successive removal of the layers placed above them, so as not to disturb their lateral connexions. The position of the three facial nerves, where they emerge from their foramina, illustrate the same rules, being placed on vertical lines, dividing a well-formed face into three equal parts. Prof. Macartney laid down exact rules for finding the exact points of their emergence. He was not aware that any attempts to lay down proportional measurements had been made in England as a guide in operations, though a few rules have been laid down on this subject by Lesfranc and Manec, in France. After forty-one years' experience of those rules, he could relate numerous cases of their great value in operations, and of the unfortunate results of ignorance of such guides, in cases where operations were performed. In conclusion, he showed that the same primary relations of two and three regulate the progressive movements of animals provided with extremities, and determine also their powers of perception and comparison; and that they constitute the foundation of the rhythm of music and of language. These positions he illustrated by reference to the perceptive powers of man as exercised by the different senses, particularly those of sight and hearing.

'On the Cause of the Increase of Small-pox, and of the Origin of Variola-vaccinia,' by Dr. Inglis.—Dr. Inglis stated, that variola was every year upon the increase, the cause of which was, not that vaccination was inefficient, or that the virus had degenerated, but that, from a long immunity from small-pox, the public had ceased to think vaccination necessary; and he suggested that government should be petitioned by the Medical Section of the British Association to enforce (as is done aboard), not only the vaccination of every child born in the kingdom, but the re-vaccination of every man in the British Service. He next adduced proofs from the cow-pox Institution of Dublin, from foreign reports, and from the innumerable cases of successful re-vaccination, that the vaccine virus had not degenerated, but that the human system did undergo a change during some unknown number of years. In Ripon, during the year 1837, variola prevailed extensively as an epidemic, and Dr. Inglis observed at that time innumerable cases of varicella; those affected with chicken-pox, were principally children upon whom vaccination had not recently been performed, and those who had chicken-pox, without vaccination, seldom contracted small-pox. The two diseases appeared to Dr. Inglis to arise from one cause. Many cases, to prove convertibility of the one disease in the other, were adduced. Dr. Inglis having full faith in the efficacy of vaccination and of re-vaccination, after first inserting the vaccine lymph, inserted into his arm in several places, the virus from variolous patients in different stages of the disease, and in one instance, from a patient who was dying from the disease, but in none of them did he succeed in inducing an eruption: the inflammation and pruritus was considerable for a day or two, but then gradually subsided. That the vaccine virus, therefore, decreases in its preventive influence is a supposition at least difficult of proof, for, from the beginning, this prophylactic power was imperfect in different degrees, and even an attack of small-pox itself, is no certain security against a second or even a third attack. The next point in the paper was to show that the two visitations of small-pox and vaccination could and did go on in the system at one and the same time, distinct cases of which were brought forward. Now, since two dissimilar contagious irritations cannot run their course together without the one impeding the other for a time, Dr. Inglis was led to suppose that variola and variola-vaccinia had the same common origin, or rather that vaccinia sprung from variola. The paper concluded by the following brief summary:—1st, That small-pox is decidedly on the increase, and that during each successive epidemic there is an increase of variolous patients from amongst those who were vaccinated in infancy. 2nd, That the vaccine virus is as effectual now as ever it was, but that re-vaccination is necessary after a period of years, is yet unknown. 3rd, That the same cause which produces small-pox duriug a variolous epidemic in the unvaccinated, may and does give rise to chicken-pox in the vaccinated. And 4th, That there is every reason to believe that cow-pox had its origin in variola.

'On the new Vaccine Virus of 1838,' by Mr. J. B. Estlin.—The paper stated that the author had procured some fresh vaccine lymph from the cow in August, 1838, and that in consequence of much dissatisfaction among medical men with the matter previously supplied by the National Vaccine Establishment, numerous applications were made to him for the new lymph, and that it soon became extensively employed. The object of the present communication was to show, that the powers of the new virus diminished in intensity as successive vaccinations increased its distance from the cow. The author had watched it through forty-eight subjects in succession, and for nearly twelvemonths. During the first three or four months, rather severe local and constitutional effects followed. During the latter months, however, of the year of trial, the activity of the matter had greatly diminished; while the vesicle at the present moment produced by it retains all the characteristics of perfect cow-pox, as described by Jenner. The author also referred to some experiments lately made by Mr. Ceely, of Aylesbury, in which cows were inoculated with the matter of *small-pox,* the result of which was, the appearance of the regular *vaccine* vesicle upon the inoculated part of the animal. From this vesicle, lymph taken and introduced into the human subject, produced the genuine cow-pox.

Dr. Baron informed the Section that he was about to publish a Report on the subject of variola, and that therefore he would not enter fully into the question, but he wished to state the principal arguments for the identity of variola, and what Jenner denominated variola-vaccinia, or cow-pox: the general conclusions he arrived at were as follows:—1st, That cattle in many ages and different countries have been affected with small-pox. 2nd, That those invasions have been simultaneous with the occurrence of the disease in man. 3rd, That it appeared in England, in the year 1745, again in 1770, and continued until 1780. 4th, That the casual transmissions of this disease, preventing the accession of small-pox in man, induced Jenner to propagate the affection from one human being to another. 5th, That when severe among animals, severe also in the human subject. 6th, That as it has been propagated from the cow to man, it has also been transmitted from the human subject to the cow, by inoculation. 7th, That the disease becomes milder when transmitted to the cow, still preserving *its protecting* influence.

Sir James Murray again adverted to a subject brought forward by him at the meeting at Liverpool (see *Athen.* No. 517), the urinary secretions in the circulating fluids.

Thursday.

'On Alkaline Indigestion,' by R. D. Thomson, M. D.—The author stated that he had brought this subject before the British Association at Bristol, but that since that period he had not only from ample experience confirmed the results of his former inquiries, but had elicited several other conclusions of importance. In the healthy state, there is no doubt that during a portion at least of the process of digestion the contents of the stomach are in an acid state. Some had concluded that this acidity proceeded from the presence of muriatic acid, upon what grounds Dr. Thomson would discuss in the Chemical Section (see *ante*, p. 675); others that it proceeded from acetic or lactic acid. 1. Whatever this acid may be, there is no doubt that when it accumulates to a certain extent, the stomach can no longer sustain it, and disease ensues in the form of heartburn, acid eructations, &c. 2. Where the contents of the stomach assume any condition offensive to that organ, either from too much acid or from too small a proportion, the stomach, in many cases ejects a clear fluid, which Dr. Thomson has found to be accompanied by different symptoms, according to the chemical re-action of the fluid: thus in heartburn an acid fluid is ejected, but without any cessation of pain in the stomach; while, on the contrary, if a neutral fluid be ejected, according to the experience of the author, the pain is alleviated on the instant that the fluid is got rid of. This is a more rare case of indigestion, but the author has met with it several times. It may be termed *Neutral Indigestion.* 3. The third form of indigestion which Dr. Thomson has met with, is the alkaline state of the contents of the stomach.

He terms it *Alkaline Indigestion.* The peculiar features of this disease are a violent pain in the region of the stomach, accompanied sometimes with a feeling of fainting, head-ache, and more rarely an inclination to vomit. Suddenly a sensation of spasm comes on, as if some contraction were taking place, and the patient speedily finds his mouth full of water, which he is obliged to empty. This operation he has no sooner performed, than he requires to repeat it, and at last a continuous stream flows from his mouth, which endures for some time, when it ceases, and along with it the pain of the stomach. This, together with the chemical re-action of the fluid ejected, appears to distinguish in a very complete manner, alkaline and neutral indigestion from the acid state, all of which have been confounded by former writers. The distinction is the more important, because these different forms require, in some measure, opposite modes of treatment. With regard to the cause of the alkaline re-action, Dr. Thomson stated that after evaporating the fluid emitted from the stomach, and igniting the residue, he had obtained, by crystallization, fine crystals of carbonate of soda. The presence of these, however, he ascribed often to the decomposition of common salt by the process, or to the previous existence of lactate of soda in the fluid. He was more inclined to attribute it to the former source, because the quantity of crystals was so very considerable. Dr. Thomson stated that the ejection of these fluids from the stomach was much more common than was usually imagined, as out of forty or fifty patients admitted daily at the Blenheim Street Dispensary, in London, he generally found one or two affected with such symptoms. For some years past he had made it a rule always to examine these fluids, and the results of his experiments were embodied in his present communication. He observed that these complaints were frequently symptomatic of diseases placed in other organs, as the uterus, liver, &c. But the secondary disease was often the more disagreeable, and therefore required to be as carefully treated as the original one.

Mr. Hodgson read a paper, ' On the Red Appearance on the Internal Coat of Arteries,' which, he stated, did not depend on inflammation in every instance, and from which it should be carefully distinguished ; it might occur extensively, or in small patches, or in different parts of the same subject, presenting different shades of colour. It was found in subjects of all ages, in healthy as well as morbid coats, in the lining membrane of the heart, and of the veins, but less frequently in the latter. It may be found when blood is present in those cavities after death, or where they are completely empty. Mr. Hodgson related the experiments of Laennec and Andral, which proved that this red appearance might be communicated after death by immersing the vessels in blood. As to the efficient cause, he stated, that it might proceed from imbibition, in the same manner as we find the neighbouring membranes stained with bile from the gall-bladder and its ducts ; the first changes towards decomposition and putrefaction might allow of it more readily.

Some writers look on it in every instance as the result of inflammation; slight modifications of vitality may permit its occurrence during life, as we find it, where chronic inflammation has existed, giving rise to deposits of an atheromatous matter. When dependent on inflammation it will be found affecting the inner coat only, but when on other causes it will often pervade the elastic or middle coat as well as the serous. Finally, he stated that it might be found depending on the co-existence of those causes which were capable of producing it singly.

Mr. Hodgson repeated the statements which he made after the reading of Dr. Macartney's paper, on Tuesday; that, although nature does sometimes use other means for suppressing hæmorrhage, the most frequent mode was a vital constriction and contraction of the coats of the artery, and that this constriction and narrowing of the arterial tube may be produced by exposure and by pressure. That this is the mode adopted to prevent the hæmorrhage in cases of Gangrene, when separation is effected. In support of these views, he presented to the Section some preparations and drawings, particularly illustrating the various conditions in which arteries are found, after successful operations for aneurism: true anuerism, he pointed out as depending on a weakening and degeneration of the middle coat of the artery.

Dr. Macartney thought that it was of importance to discriminate between the red appearances described by Mr. Hodgson and inflammation; they had a painted appearance, were devoid of tumefaction, and were most perfectly distinguished by being insusceptible of injection. There was, he stated, much analogy in the red patches observed on the pharynx and œsophagus in cases of hydrophobia; he remarked that these appearances might not depend on the putrefactive process, but be caused more by changes in the blood itself than in the solids. Dr. Macartney dwelt on the important part played by the effusion of coagulable lymph in the closure of arteries, independent of and even previous to inflammation.

Mr. C. T. Coathupe detailed the results of a series of experiments on the Respiration of Deteriorated Atmospheres, which he instituted to determine whether the injurious effects which have followed the respiration of charcoal vapours had depended on carbonic acid, as was generally thought, or on the specific agency of some other volatile product. The volatile products of the combination of charcoal he stated to be as follows:—

Carbonate of Ammonia,
Hydrochlorate of Ammonia,
Sulphate of Ammonia,
Volatile Empyreumatic Oil,
Carbonic Acid Gas,
Carbonic Oxide,
Oxygen,
Nitrogen,
Aqueous Vapour.

From a number of experiments on the elimination of carbonic acid during respiration, he arrived at the following results :—that 266.66 cubic feet of atmospheric air pass through the lungs of an adult in twenty-four hours, of which 10.666 are converted into carbonic acid, yielding 5.45 ounces of carbon, or 124.628 pounds annually, which will give a total of 147.070 tons of carbon as the annual product of the inhabitants of Great Britain and Ireland! The average amount of carbonic acid found in atmospheric air in which animals had expired, was found to be, for warm-blooded animals, 12.75 per cent., for the cold-blooded animals, 13.116 per cent. When the animals were removed, on becoming comatose, the average amount of carbonic acid was found to be 10.42 per cent. On confining a taper until its extinction, the quantity of carbonic acid found was 3.046 per cent. From hence it would appear, that an atmosphere that has ceased to support combustion can support animal life for some time, which Mr. Coathupe proved by direct experiment.

Dr. Costello presented a report of ten cases of Calculus treated by Lithotrity. The patients were of ages between fifty-three and seventy-six, the stones varying in size from that of a pigeon's egg to that of a hen's egg. The lithotrite was successively applied at sittings of from thirty to fifty seconds. Dr. Costello strongly insisted on the necessity of this point, especially at the commencement of the treatment, as the constitution is thus saved from the shock and re-action which follow protracted operation. One of the cases was remarkable: the collected fragments of the removed calculus were shown to the Section; they filled a bottle capable of containing at least four fluid ounces. The patient had suffered upwards of ten years; during the treatment he superintended the farming of his estate as usual, without any inconvenience; the entire of the ten cases were cured, bearing high testimony to the value of this improvement in operative surgery. In connexion with these operations, Dr. Costello related an incident which, to use his own words, "exemplified the progress of surgery and steam travelling,"—he operated on three patients residing in three different counties, and travelled over a space of upwards of 200 miles in eighteen hours.

Mr. Nasmyth read a paper 'On the Microscopic Structure of the Teeth,' in which he treated also of the covering of the enamel and of the organization of the pulp. He first stated that his researches had led him to a conviction contrary to that of Retzius, Purkinje, and Fränkel, for he had found that the enamel *in all cases,* possesses a distinct envelope or coating. On the incisor of the calf, and on several other simple teeth, he had also traced in it the corpuscles of Purkinje, analogous to those found in bone.* With respect to the microscopic

* A full description of this structure will be found in a paper by Mr. Nasmyth, in the forthcoming volume of the Transactions of the Medico-Chirurgical Society, accompanied by drawings.

structure of the teeth, Mr. Nasmyth treated principally of the interfibrous substance, which he said was not "structureless," as has been erroneously stated, but decidedly cellular. The fibres themselves he described as presenting an interrupted or baccated appearance, as if made up of compartments, which differ in size and relative position in various series of animals. He detailed their peculiarities in the human subject, in some species of the monkey tribe, and in the oran-outan. After the earthy matter of teeth has been removed by acid, the animal residue, he stated, consists of solid fibres, and if the decomposition be allowed to continue, these fibres present a peculiar baccated appearance. The general appearance of the fibres treated by acid is similar to that of the fibres of cellular tissue generally, and the diameter of each corresponds exactly to the calibre of the dental tube, as described by Retzius, and which, according to that writer is pervious, although, at the same time, he says, that it is always more or less filled with contents of an earthy nature. With regard to the internal structure of the pulp, Mr. Nasmyth stated that the number of minute cells presenting themselves in its interior, in a vosicular form, is very remarkable. They vary in size from the ten-thousandth to one-eighth of an inch in diameter, and are evidently disposed in layers. The parenchyma of macerated pulp is found to be traversed by vessels, and to be interspersed with granules. The arrangement of these cells or vessels, Mr. Nasmyth thinks, may account for the shrinking or nearly total disappearance of the pulp which he has frequently observed: their use in the economy of the part he has not yet ascertained. They are evidently filled either with air or fluid. He finds that they exist on the formative surface of the pulp. Mr. Nasmyth next proceeded to the nature of the process by which the ivory is developed. The formative surface of the pulp, which is in apposition to the ivory, and by which the latter is produced, he described as presenting a general cellular arrangement, which he denominated reticular, resembling a series of skeletons of a desiccated leaf. This reticularity is found to have peculiar diversities in different classes of animals. Mr. Nasmyth has found that a similar appearance is presented by the capsule and by the capsular investment of the enamel. The leaves or compartments of the reticulation are surrounded by a well-defined scolloped border, from which occasionally processes are observed to arise at regular intervals. With respect to the formation of the ivory, Mr. Nasmyth stated that he was not prepared with a satisfactory theory, and would only submit a few observations based on his own researches. On the surface of the pulp, he said, are found innumerable detached cells with central points, which latter are at regular intervals corresponding in extent to those existing between the fibres of the tooth. The cellules of the fragments of the ivory which are found scattered on the pulp, resemble exactly in size and appearance the cellules of the latter when in a state of transition. Mr. Nasmyth is of opinion that from the spirally fibrous frame-work of the reticulations are evolved the spiral fibres of the tooth. The diameters of the two sets of fibres exactly agree. The projections on the formative surface of the pulp correspond to the centres of the cells, may be traced to belong to their structure, and are evidently fibres passing upwards from the pulp. Mr. Nasmyth has also ascertained that the fibres of perfect ivory resolve themselves by decomposition into similar granules. He has not discovered the manner in which the osseous matter is deposited in the cells of the interfibrous substance, but he has observed that these cells are subdivided into minute cellules, for they present the appearance of being filled with smaller cells in certain progressive stages of development. But in whatever aspect, said he, we view the formative organs of the tooth and the dental tissues, themselves, and whether we examine the latter during the process of their development or after their formation has been completed, we are everywhere met by appearances which denote a cellular or reticular arrangement. Mr. Nasmyth concluded his paper by a notice of Schwann's work on the cellular character of primary tissues, dwelling on his views of the cellular organization of the pulp, from which his own were essentially different.

Saturday.

Dr. Ludwig Guterbock exhibited a number of instruments made from ivory, softened by the removal of the earthy matter by the action of dilute acid. In a brief memoir on their origin, he showed, that the first idea of the preparation was not due either to the German or Parisian individuals who had claimed the honour, as it was contained in an English work, published some time ago, under the title of 'Useful Arts and Inventions.'

Mr. Nasmyth read a paper 'On the Structure of the Epithelium,' which he described as being composed of cells. He first alluded to the views of Leewenhoek on the subject, contained in letters to the Royal Society, written in 1674, and 1684-5, and according to which, this tissue is composed of scales. The researches of subsequent inquirers tend to prove that scales or cells of various forms exist on the surface of all mucous and serous membranes, on the inner membrane of the vascular system, &c. Mr. Nasmyth described the epithelium as a layer of substance destitute of vessels, covering the vascular surface of mucous membranes. The scales, as they were first termed by Leewenhoek, of which it is composed are flat bodies, with a thick portion or nucleus in their centre, and with very thin and transparent margins, which are sometimes curved; their surface often presents numerous transparent points, with very fine lines. The nucleus of the scale generally contains a small body, which has been called the nucleus-corpuscle. If the secretion be removed from an irritated mucous membrane, these bodies are found to assume the appearance of cells, but generally at the surface they resemble scales, from having increased in size, and undergone compression. In the fœtus, the well-defined scales of the epidermis are not unfrequently seen externally; the *rete malpighii* consists of newly-formed cells; and between the two may be observed other cells, in a state of progressive development. In the epithelium generally, a nucleus is first formed, and then a cell is formed around it. These cells are connected by a gelatinous substance, interspersed with minute granular bodies, which displays considerable elasticity, and which sometimes presents a fibrous appearance. The granules can be caused to disappear by compression. In certain parts of the epithelium of the calf, distinct fibres are observed to pass over the surface of the scales, and to connect them together, thus forming a very delicate net-work. On the surface of the body and of the mucous membranes of a man and animals generally, the superficial scales are thrown off by pressure from the cells beneath; but in some cases, as with frogs and efts, the epithelium scales are removed in a continuous layer; and Mr. Nasmyth is disposed to believe that it is the covering which, according to naturalists, is swallowed by the animal after having been shed. The cuticle and epithelium then are evidently organized bodies. It would appear that they are formed from a fluid secretion, and that their various stages of development are as follows: 1st, the formation of nuclei and their corpuscles;—2nd, that of cells;—3rd, the growth of the latter effected by vital imbibition;—4th, their compression and gradual conversion into minute lamellæ, or scales. The cells seem to have within themselves a power of growth, and it remains for pathologists to determine what share the derangement of this function has in the production of cutaneous diseases. Under certain modifications, the epithelium certainly presents vital phenomena, among which may be mentioned the ciliary motions. Mr. Nasmyth concluded his paper by an especial description of the portion of the epithelium lining the cavity of the mouth. In the fœtal subject, previous to the extrusion of the teeth, it forms on the alveolar arch a dense projecting layer, distinguishable from the surrounding membrane by its whiteness, and by superficial and waving ridges and sulci. The younger the subject, the greater is its thickness. It is made up of a mass of scales, lying one above the other, and thus presents no resemblance to cartilage though it has been generally classed as such. In the interior of its structure, where it corresponds to the molar teeth, small vesicles may be frequently observed, varying in size from one-fourth to one-eighth of a line in diameter. On microscopic examination, the particles of these are found to consist of attenuated scales, and their cavity to contain a fluid abounding in minute granules and cells. They are probably the "glands" described by Serres as intended for the secretion of the tartar. Larger vesicles are also found implanted in the vascular mucous membrane, composed of a very delicate tissue, and containing a transparent fluid, which coagulates on the application of heat or acid. In this fluid float numerous globules and scales, similar to those of the epithelium generally. The internal, or attached surface of the alveolar epithelium presents numerous fringed processes, which sink into the substance of the subjacent mucous membrane. These are found to be composed of elongated scales. By immersion in water or diluted spirits of wine, these fringes are much enlarged, and their size, indeed, exceeds that of the dense epithelium itself.

Mr. Hodgson made some remarks on organization without any perceptible vascular connexions, and referred to the ovum at an early period, and the crystalline lens, as examples.---Dr. Macartney brought forward the circumstances under which loose cartilages existed in the knee joint as instances of the same phenomena, which he said increased and decreased, and changed their structure, existing at first as coagulable lymph, and afterwards as cartilage and bone, without any vascular connexions.---Prof. Partridge adduced as instances the loose bodies in the sheaths of tendons, which he knew to enlarge, though they were previously completely detached.

Nouveaux Memoires de la Société Imperiale des Naturalistes de Moscow, Tom. iv. (with 13 *plates, and forming the* 10*th vol. of the Collection).* Moscow, 1835, 4to.

In noticing for the first time the Memoirs of a Society which is likely to be little known to many of our readers, we may mention that the Imperial Society of Naturalists at Moscow has existed for many years, and has published numerous volumes of valuable transactions. Its primary object is to investigate the natural history of Russia, and for this purpose a museum is formed, and almost every year individuals are sent, at the expense of the Society, to examine the most remote and least known portions of the empire. The whole expenses of the Society are defrayed by the Emperor, who presents it with an annual donation of 10,000 R. ass. In addition to this each member contributes yearly 30 R. which forms a sum in reserve. Each member on admission must present to the Society a memoir, or a work known to scientific men. The meetings are held monthly. The memoirs are allowed to be written in Latin, German, French, English, Italian, or Russian.

The volume of Transactions referred to above is almost exclusively devoted to Entomology. The first paper, which occupies 113 pages of the volume, is entitled, "Additamenta Entomologica ad Faunam Russicam," and contains the descriptions of no fewer than 283 *new* species of Coleoptera. These were collected in remote provinces of the empire by Szovitz, an individual employed principally to examine the botany; but who devoted his leisure hours to what has been called its sister science. This person having been carried off by fever while prosecuting his researches, M. Faldermann was employed to render his entomological discoveries available to the public. While engaged in this undertaking, another collector, named Ménétriés, returned from the

Asiatic provinces with numerous acquisitions, and it was deemed advisable that the discoveries of both should appear together. The result is the highly important addition to the number of known species mentioned above. Most of them have been referred to already existing genera, but in four instances, M. Faldermann found it necessary to establish new genera. These he has named *Platynomerus*, *Microderes*, *Tanyproctus*, and *Pachymerus*. The former of these is nearly allied to Pristonychus, the second to Platymetopodis of De Jean; the third contains two lamellicorn insects, and its station is indicated between Melolontha and Scarabaeus; the fourth likewise belongs to the lamellicorn section, and has considerable affinity to Amphicoma. Several of the species are of considerable size and brilliant colours. Such especially is the Carabus Humboldtii, which is equal in size to any of our native species, and has the elytra finely glossed with coppery-red. Thirteen new Cetonias are described and figured, and many of them partake of the lustre and rich colouring which distinguish that beautiful tribe. The brachelytrous species amount to 16. Among the malcodermata, a new species of Lampyris (*L. orientalis* pl. 6. fig 6, 7), is introduced, so closely resembling our native glow-worm that it might readily be taken for a variety. The eastern insect, however, is distinguishable by being broader, by having the elytra darker and more dilated behind, while there are three distinct ridges along the surface of each. Cicindela has received an accession of five species; Cychrus 1, Carabus 12, Harpalus 11, Cantharis 11, Silpha 6, Onthopagus 12. This paper does not advance beyond the section Heteromera, but the remaining tribes have to appear in a subsequent faciculus. The plates, it may be added, are in general well executed, but in no instance are dissections given. Magnified representations of the oral organs when new genera are proposed, as in this case, should be regarded as quite indispensable.------II.---*Description de quelques Coleopteres recueillis dans un voyage au Caucase et daus les provinces transcaucasiennes Russes en*, 1834 et 1835. Par T. Victor. This paper is chiefly occupied with descriptions of those minute and singularly formed insects composing the family *Pselaphidœ*. Many new localities are cited for species previously known, and a considerable number described and figured, which are considered new. We are likewise made acquainted with a few minute Coleoptera belonging to other families, which do not appear to have been previously noticed by entomologists------III.---*Lettre sur le genre Xeranthemum*. Par F. E. L. Fischer, et C. A. Meyer. The object of this paper is to elucidate the structure and history of various species of this interesting tribe of plants. Some new kinds are noticed, and useful observations advanced on the synonomy of those formerly described. It is accompanied with lithographic plates, illustrating the structure of the flowers and pappus.

Bulletin de la Société des Imperial Naturalistes de Moscow. Tom. ix. Accompagnè de ix. Planches. Moscow, 1836. 8vo.

Art. 1. The first 115 pages of this volume, of which we need mention only the principal articles, are occupied with a paper by Dr. Besser, entitled "Supplementum ad Synopsin Absynthiorum, tentamen de Abrotanis, dissertationem de Seriphidiis atque de Dranunculis," designed to convey additional information on these subjects, which had previously been treated more at length by the same author.——2. Ueber die erste ursache der unebenheit der festen erdoberflæche.——3. Helices proprie dictæ hucusque in limitibus Imperii Russici observatæ, a Joanne Krynicki. This individual appears to have examined the terrestrial mollusca of Russia with great care, and this communication forms a sequel to others already published by him on the same subject. No fewer than forty-one species are described in this paper very minutely, with their synonyms given at length, and several new species are introduced. In the genus *Helicogena* (Fer.) it is interesting to remark the occurrence of a species well known in more southern regious viz, *H. pomatia,* which has been found in the wooded and shady districts of Volhynia and Poltava, but it must be accounted very rare. Similar observations apply to *H. nemoralis,* which is likewise classed among the rarer kinds. *H. hortensis* and *H. arbustorum,* well known species in this country, have special localities assigned to them, a proof that they are by no means generally distributed; the former has been formed in Volhynia, the latter in Podolia.——4. Uber Irit und Osmit, zuei neue mineralien; von R. Hermann. Discovery of two new minerals, named Iridium and Osmium, among the sandy residuum left after the extraction of platina. ——5. Libellululinarum species novæ, quas inter Wolgam fluvium et montes Uralenses observavit, Dr. Edward Eversmann. This notice comprises descriptions of four new species of Libellula, two of Æshna and two of Agrion.——6. Lettre *de M. le* Conseiller d'Etat et chevalier de Gebler, contenant un rapport d'un voyage dans les hautes montagnes Catouniennes jusqu á la frontiere de la Chine, et description des trois nouvelles espécés de coleopteres. The insects described (and figured) are *Heliophilus hypolithus, Clytus Altiacus* and *Chrysomela Kowalewskii,* the latter an elegant species of a rich golden green, with blue ridges on the elytra.——7. Orthoptera duo e montibus catunicis, descripta et icone illustrata, auctore G. Fischer de Waldeim. These insects, which do not seem very dissimilar to other species of *Grillidæ* already described, are named *Œdipa Gebleri* and *Œ. rhodoptera.*——8. Bereicherung zur kafer-kunde des Russischen reiches, Von F. Faldermann. A paper containing descriptions (illustrated by figures) of a considerable number of a new coleopterous insects.——9. Quelques mots sur le Caucase par Jean Kaleniczenkow. The writer was induced to visit the district of the Caucasus by observing that every naturalist who had visited it from the time of Pallas, had succeeded in discovering new objects of interest. He set out in 1832, and the above paper gives a slight sketch of his proceedings, it being his intention to give a more ample account at some future time. He refers chiefly to the plants observed in his route. In the district of Isioum he describes the mountains as calcareous, containing fossil shells and belemnites, and they produce many plants entirely foreign to the flora of Kharkov. Beyond them appear the plants belonging to the *Steppes* properly so called, viz. *Dictamnus Fraxinella, Statice Gmelini, Glycyrrhiza glandulifera* (Kit.) *Artemisia procera*, &c. At Moskovskaia, in the government of the Caucasus, he observed on the sides of hills inclining to the south, and even on their summits, *Xeranthemum Annettæ, Polygala major, Pimpinella Tragium, Roso pimpinellifolia, Vitis vinifera*, &c. Near Jessuntouk, the ridges of the limestone mountains are covered with *Rhus cotinus, Aconitum Anthera*, &c. The banks of the impetuous river Podkoumok are fringed with *Hippothoe rhamnoides, Tamarix gallica* and *Palisii, Salices*, &c. In a valley surrounded on all sides by mountains, from which the Narzanza takes its rise, and where there are thermal baths resorted to by invalids, the most conspicuous and interesting plants are the following: *Betonica grandiflora, Polygala Sibirica* (Linn.) *Rhinanthus orientalis*, (Linn.), *Primula amoena, Dianthus fragrans, Azalia pontica*, (Linn.), *Trollius Caucasicus, &c.*------ Beschreibung einiger neuen in Liefland augefunden insecten, Von B. A. Gimmerthal. Contains descriptions of several new dipterous and neuropterous insects.

Muller's Archiv für Anatomie, Physiologie, &c. Parts iii. and iv. 1836.

Ueber de Metamorphosen des Eies der Fische u. s. w. Von M. Rusconi. *On the changes which the Ova of Fishes undergo previous to the exclusion of the Embryo.*---In order to continue his observations on this subject, the author repaired to the lake of Como early in July, being assured by the fishermen that both Tench and Bleak deposit their spawn at that period. On the 10th of that month he procured some eggs from a female tench (Cyprinus tinca, Lin.), and placed them in a glazed earthenware vessel filled with water from the lake. They immediately sunk to the bottom, and two or three drops of milt were expressed from a male fish upon them. The eggs were perfectly transparent, and of a greenish yellow colour, like that of olive oil. The milt was of the colour of milk, but much less fluid. In four hours after the fecundation, some of the eggs seemed to have lost their transparency on one side, and others by degrees assumed the same appearance, so that in twenty-four hours they had all become opaque, and their vitality was considered to be extinct. This the author supposed to have arisen from too large a quantity having been laid one upon another in the vessel, and he accordingly took a flat shallow dish, the bottom of which was covered with paper, and filled it with lake water. Some more fecundated ova were then placed in it, so that they did not come in contact with one another. In five hours he again remarked that some had become opaque on one side, and in twenty-four hours the same thing had occurred to nearly all. Some few, however, remained transparent, and these he raised gently from the dish, by means of the paper that was under them, and transferred them to glasses of water for farther observation, placing eight or ten in each; in six or seven hours after this operation, he saw by means of a microscope that the embryo had begun to move, and in twenty-four hours (fifty from the moment of fecundation) the young fishes burst through their envelope. The experiment was again repeated in order to ascertain whether the ova of fishes undergo similar changes to those of the Batrachians (vide Analysis of Muller's Archiv at p. 292,) and half an hour after the eggs had been placed in the dish, he lifted out those which remained transparent, and transferred them to glasses as before. It was now his object to destroy the vitality of some of them at each stage of their development, in order to examine the progress that had been made, at leisure, and for this purpose he dropped into the water four or five drops of a mixture of one part of nitric acid and eight parts of water, which had the desired effect. This was applied at intervals of fifteen minutes during ten hours, and the following are the results obtained: Soon after the application of the milt, the ovum of the tench loses its spherical form, and swells out into the form of a pear. At the point where this swelling begins it is surrounded with a cluster of microscopic globules, which before were spread all over its surface. In half an hour the pear-shaped excrescence is divided into four globules; these in a quarter of an hour more are subdivided into eight, and in a similar period into thirty-two, still remaining clustered together on the top of the egg. In another half hour more globules appear, decreasing in size as they increase in numbers, till at length, from their minuteness, the part of the egg to which they are attached becomes almost as smooth as when they were undeveloped. The embryo fish now becomes discernible in the form of a whitish semitransparent speck, which is the rudiment of the vertebral column. The organization of the skin then gradually proceeds, and the embryo increases in length, coiled round the yolk, till the head becomes perceptible. In forty hours from the fecundation, the embryo tench first gave signs of motion, and at most, twelve hours later, it had freed itself from the skin of the egg. The fish is then two lines in length, and the blood has already acquired its natural colour. For some hours after leaving the egg, the young fry appeared stupified; they lie on their sides and are unable to swim, until the swimming bladder is developed, when they immediately assume their proper position and their natural activity. The intestines are not fully developed until seven days after leaving the egg, when they begin to feed voraciously, and exclusively upon animal substances. The fry of the bleak, on the contrary, will only eat vegetable matter, at least during this early period of their existence. The temperature of the room in which these experiments were carried on, ranged from 72° to 77° Fahrenheit. The ova of the bleak are larger than those of the tench, and are for that reason preferable for the purposes of observation, besides being more easily procured. When they had reached the point at which the globules disappear, their vitality was no longer destroyed by the acid before-mentioned; but they were then placed upon a piece of black cloth, or more frequently on a plate of polished silver in a glass of water, and the changes they underwent examined by means of a single lens. The author afterwards had an opportunity of watching a large shoal of Cyprinus Gobio in the act of spawning; he took up three or four pebbles upon which about a dozen eggs were deposited, and placed them in an earthenware vessel in his room, and paid no farther attention to them. About eight or ten days after, he observed four young fish swimming about with vigour, which were so transparent as not to be easily seen except in dark-coloured vessels, and he appears to have met with none of the difficulties in rearing fish from the ova, which Herr von Bäer states to have so much impeded his observation.

These numbers also contain a paper on the Spermatic Entozoa of vertebrate animals, by Professor Wagner, and one on those of the invertebrata, by Dr Siebold of Danzig. The latter author also has one on the anatomy of the Asterias; and there is likewise the first part of a paper on the effects produced by acetate of lead on the organism of animals (dogs and rabbits), by Dr C. G. Mitscherlich.

On Collections and Museums. By Mr. J. M'Clelland.

We make no apology for extracting the following from the Proceedings of the Asiatic Society; chiefly consisting of the remarks of Dr. Horsfield, the Curator of the Honorable Company's Museum, contained in a letter in which he solicits from India contributions for the collection under his charge, regarding which he observes—

"The Museum itself is not very extensive, but it is nevertheless of much importance in connexion with Indian zoology, as it contains several extensive local collections.

"It consists mainly of the following Faunas, which are more or less perfect:—

"*Firstly.* A collection of upwards of 200 species of birds from Java, and a proportional number of quadrupeds. This was formed by myself, and brought to England in 1819, when it constituted the nucleus of our zoological collection.

"*Secondly.* We have a pretty complete series of Birds collected in Sumatra by Sir Stamford Raffles, and some of his Mammalia.

"*Thirdly.* We have a similar collection made by the late Dr. Finlayson in Siam and in the Indian Archipelago.

"*Fourthly.* We have a nearly complete series of Mammalia and Birds collected by Colonel Sykes in the Dekun, of the importance and extent of which you can judge by the respective catalogues contained in the Proceedings of the Zoological Society for 1831 and 1832.

"*Fifthly.* We have a few specimens from China, Nepal, and the Upper Provinces of Bengal, but these are imperfect and fragmentary.

"To these has now been added a series, almost complete, of the Mammalia and Birds collected by yourself in Assam, which have been mounted, and form a valuable addition to the specimens exhibited in our Museum.

"All these separate Faunas are neatly arranged in our natural history department, which consists of a large room well lighted, and provided with excellent cabinets for the preservation of the subjects.

"This Museum I may say is established on a modest scale, and without the pretension to extent or elegance of the national collections (such as the British or Hunterian, or even the Zoological Societies) but our specimens are generally good, being prepared by the best London artists, and my endeavour is to have them correctly labelled.

"Our collection consists mainly of Quadrupeds and Birds; but we have also a small collection of Fishes, Reptiles, and Serpents, which have recently been examined by Dr. Cantor, who has prepared a list of them, agreeably to which they are arranged.

"It is my intention as soon as possible to prepare a general list of the Mammalia and Birds which are arranged in our Museum for transmission to you, so that you may form an accurate idea of what we have, and be enabled to judge of what we want.

"I have no doubt the nature and importance of natural history is more considered and appreciated now, than it was in former times; and I cherish the hope that the countenance and support of Government will ere long be extended to it in an effectual way; but this I can at present only allude to as a wish or expectation. Meanwhile I may enumerate some of the subjects which would be particularly desirable. We want, for instance, many of the birds of Bengal. All the rarer species, and some of the more common (of these I hope soon to send you a provisional list); we want generally the Birds of Sylhet, the Garrow Hills, Tenasserim, Arracan, Burmah, &c. &c., and duplicates of the new, and of all the rarer species discovered by you in Assam.

"We want a complete series of the Birds of Nepal, also Mammalia; the smaller species would suit our purpose best, as we can more easily accommodate them. But above all, and especially, we want a large, full, and complete collection of all the *Vespertilionidæ*, or *Bats* of India. This is the most important family, as it has never been sought after; and I beg and entreat you to have a large collection made generally throughout all India; and I need not point out to you the localities where these animals are most likely to be met with."

Here Dr. HORSFIELD enters into particulars regarding the genera and species.

"But besides these it is in the branch of *Entomology* that I would at present strongly solicit contributions to the Company's Museum. I am more anxious on this head, as I have succeeded in bringing an extensive collection of Insects from Java in excellent condition, and with the exception of these, and the collection of Colonel SYKES, we have absolutely nothing from Bengal or from India generally."

On this subject Dr. HORSFIELD delicately alludes to the probability of gentlemen connected with missions still holding collections of Insects unappropriated, under the supposition, perhaps, that such objects would be less appreciated than the large animals; on the contrary, Dr. HORSFIELD states that contributions to this department of the Museum would be as likely as any other means to promote the interests of science, and to secure the approval of those who are interested in the collection at the India House.

With regard to Insects. The public collections which remain, I believe, unappropriated, are those made by Dr. WALLICH, Mr. GRIFFITH, and myself, when employed on the Assam deputation, and Dr. HELFER's collection. That which was made by the Assam deputation is still, I believe, at the Botanic Garden, and like Dr. HELFER's collection has not yet been transferred to the Government. With regard to the former, perhaps the Society has no authority to interfere; but as the Society has been authorized to take one series of Dr. HELFER's collection for its own Museum, and to select another for that of the India House, it might be necessary to address Dr. HELFER on the subject, particularly as his collection of birds for the Honorable Court has been packed up for some time in the Museum, and are only detained till the insects which have not yet been submitted to the Society should accompany them.

The large collections of birds and insects made by Captain PEMBERTON during his mission to Boutan, and the officers who accompanied him on that occasion, have been long almost unobserved in the Museum, owing to the late repairs of the house. The greater part of the birds composing that collection were previously in our possession, but such as were new to it were transferred to our cabinets, and the rest enclosed in cases for transmission to the India House. The insects of the same collection which are numerous, and no doubt rich in undescribed forms, are also in course of being dispatched with the birds; a series having been reserved for our own collection. The pains taken during Captain PEMBERTON's Journey, to mark the localities in which the different objects were collected, cannot be too highly applauded, especially as this very important circumstance has been hitherto altogether neglected on such occasions.

Mr. LYELL in a letter addressed to Mr. M'CLELLAND, dated 7th September 1839, states, that he is very anxious for accurate information respecting the geography of living *testacea* and Indian *tertiary* shells, and if furnished with duplicates from the Museum of the Asiatic Society, proposes in return to supply the Society with fossil and recent shells in exchange.

The Society, it is to be regretted, has few fossil shells from Indian beds, and a very imperfect collection of recent species. Indeed the little attention that has been paid to these important subjects in India, seems to have induced collectors to send their contributions elsewhere. Several friends, and others interested in the advancement of science, are most favourably placed on the Malay coast, at various points from Chittagong to Mergui, and we may look, I trust, with confidence for large collections from this quarter in the peculiar department alluded to. I have myself been already indebted for a miscellaneous collection of shells from Dr. Helfer, and slight contributions have been made to our Museum from time to time by different individuals; but I question if we have as yet a tenth part of the species of the Bay, while we are altogether without the corals, polypes, and radiata, so abundant in all the Eastern seas.

Mr. A. P. Phayre, assistant to the commissioner of Arracan, kindly sent me some time since a few interesting specimens of the rocks in the vicinity of Akyab, which are perforated to the height of six feet above the greatest elevation of spring tides, the same as beneath the level of the water, by a species of *Pholas*. Mr. Phayre justly ascribes this to a change of level in the rocks composing this part of the coast, and regards the perforations as identical to those which have been observed in the sandstone at Cherra Ponji. With regard to the Cherra Ponji rocks, I am indebted to Mr. H. Walker for an observation of very great importance when observing the number of *Echinidæ* in my collection from that quarter; he suggested the probability of the elongated moulds contained in what seemed to be perforations, being nothing more than the spines of a *Cidaris*, a species of *Echinus*. On this subject, as well as the *Echinidæ* generally, which I find to be very abundant in the Cherra beds, I hope soon to have a communication to make, being now employed in an examination of the Indian species, particularly those which I have found fossil.

These departments of the animal kingdom are of the more importance to our collections, as we can hardly advance a single step in geology until our cabinets are complete, or nearly so, in recent species.

Mr. Phayre has liberally undertaken to collect for us at Akyab, but we require equally zealous correspondents at Chittagong, Kyuk Phyu, Sandoway, Moulmein, Mergui, and at all the different stations along the coast, before our Museum can be considered in a progressive state.

With regard to fossil species, our collection is equally defective; indeed so long as we are without a complete collection of recent shells, fossil species would be of little interest in our Museum. As proof of the poverty of our collection, I may remark, that of one striking and numerous family, affording probably some hundred species, most of them found in the Indian seas, yet *two* species only are all we have in our Museum, and these from unknown localities, probably New South Wales.

As animals of this family have been found in a fossil state, in a bed of sand, reposing beneath the common soil of the Sylhet mountains, under circumstances which we are bound to investigate, the fact may induce those who reside along the coasts above alluded to, to contribute their share towards the inquiry, by forwarding specimens of them to our Museum. The dried testa of *Echinida,* called *sea-eggs,* are very abundant, I understand from Captain Brown, on the shores of Rambree Island, and all the islands from thence to the Straits, while the living animals usually named sea-hedge-hogs, from the number of spines with which they are covered, may be had from rocks in the same vicinity. The bleached shell is seldom perfect, so that the living animals when put fresh into spirits form the more valuable specimens ; but from the ease with which the former may be collected and preserved, as well as from their beauty as mere ornaments, they ought to form a portion of every collection, and from the philosophical interest of the subject, they would be a welcome addition to our Museum.

Enough, I trust, has been said to induce residents on the Malay coast, and other situations where similar facilities are afforded, to enable the Society to avail itself of the offer of Mr. Lyell, and at the same time to enlarge, or rather form its own collections of Indian species.

The interest now awakening in Europe regarding the natural history of this country, is calculated to produce a more powerful effect in exciting a spirit of inquiry here, than any arguments that could be urged on the spot. Thus, we have not only a Museum at the India House, now opened for the exhibitions of animals collected in India, but the first philosophers are ready to co-operate with us and aid our inquiries.

Proceedings of the Asiatic Society of Bengal.

For the circumstances that gave rise to the following report, we must beg leave to refer our readers to the Journal of the Asiatic Society, in which the Proceedings of the Meeting of February last are recorded. The peculiarities of the case are simply these,—In May last we were appointed Curator of the Society's Museum on the usual salary of 200 Rupees a month. In July, it having been represented by the Secretary that the expenditure exceeded the receipts of the Society, when to prevent danger to the institution from this cause, we gave up the salary attached to our office, and continued to discharge the duties on this footing till 26th January last, when it appeared that the Government had sanctioned what could be regarded neither more nor less than the restitution of our salary, at the same time placing funds for the purpose at the disposal of the Society. Conceiving that the stipulations insisted on by the Society would only have the effect of rendering the office of Curator a dead letter, as far as the objects of the Government, and the interests of science are concerned, we declined to comply with them. We give the report as we received it.

STET MONUMENTUM!

To Dr. J. M'Clelland.

We beg leave to inclose for your perusal the Report of the Committee of Papers of the Asiatic Society regarding the duties of the office of Curator to the Museum.

The Report is based on the resolutions of the last Meeting, as set forth in paragraph No. 2.

We will be obliged by your communicating to us your decision as to accepting or declining the appointment.

17*th February*, 1840. *Officiating Secretaries Asiatic Society.*

That the office of Curator to the Society's Museum be held in future on the following conditions. 1st. Two hours at least to be devoted daily to the duties of the Museum. 2nd. Monthly Reports to be made to the Committee of Papers. 3rd. The objects of Natural History belonging to the Society's collection not to be removed from the Museum. It was further decided that the Committee of Papers should report to the next Meeting on the nature and extent of the duties the Curator is to undertake, with reference to the office as held in other Museums.

The Museum of the Asiatic Society of Bengal may be considered to embrace two very distinct departments. 1st. That of Oriental Antiquities, Literature, Architecture, and Numismatics. 2nd. That of Natural History.

It would be of great importance to secure, were it possible, the services of a Curator conversant with both these divisions, but such a combination of acquirements is so rare, that the Society must trust the arrangement, elucidation, and preservation of the articles appertaining to the first division to the honorary services of the "Oriental" Secretary, the Librarian, and Pundits.

In the department of Natural History, it should be borne in mind that the Curator's great object should be to arrange and extend the Society's collections, so as to make these available for the information of the Student, conducive to the general illustration and advancement of Science, and worthy of the place the Society holds among learned institutions. Viewed in this light, it is of far more importance to the Society.

that their Curator should assiduously apply himself to the collection, naming, and arrangement of all procurable specimens of the animal and mineral kingdoms, than, that he should specially devote himself to the minute elucidation of any sub-division of these subjects. By the elaborate investigation of a group or family, he may doubtless distinguish himself, and gain high individual reputation, but his utility to the Society would be far greater, by his applying himself to the humbler duties we have specified; moreover, it appears to us that these duties are in themselves more than sufficient to occupy the Curator's time, were it even to be entirely devoted to their discharge. Our collection of minerals is an utter chaos, though rich in anonymous specimens, valuable in themselves as illustrations of abstract mineralogy, but devoid of interest in a Geological or Geographical light, owing to the neglect with which they have been treated by some preceding Curators.

It appears to the Committee of Papers that the first object of the Society, in remodelling its Museum, should be to form a *grand* collection of minerals and fossils, illustrative of the *Geology*, *Geography*, and *Palæontology* of our British Indian possessions.

A few of the existing minerals and some superb fossils in our Museum are available for this object, but it is clearly within the scope of the Society's influence to procure within a few months, collections of specimens from every part of India, and in such numbers as would find the Curator in ample employment. While waiting for these additions to our collections, he should proceed to name and label those already in our possession. There is no need for delay for the preparation of Cabinets.* The specimens should be named, labelled, wrapped in paper with a number affixed, and then packed in boxes until the cabinets are ready.

This duty the Committee think should supersede all others for the first few months of the Curator's employment, meanwhile his subordinates would conduct the arrangement of such specimens of the animal kingdom, as might require immediate attention.

Duplicates of all specimens should be preserved for *verification* and *analysis*. Triplicates should be retained where ever practicable, for presentation to other Museums in exchange.

The monthly reports should be a statement of progress in this duty, *and affording* a catalogue of the minerals *adjusted*. The specimens themselves should be exhibited to each Meeting.

All correspondence connected with the Museum should pass through the Secretary's office, in conformity with the practice of all similar institutions. It seems to the Committee of Papers an anomalous and inexpedient practice, to commit the whole management of exchanges and similar transactions to the Curator. The suggestions of that offi-

* Admirably consistent with the Secretary's note, Journal Asiatic Society 1839, page 244, in which he declares it would be quite futile to do any thing in this department till cabinets be first provided.

cer will be always received with due attention and respect by the Committee, but it is manifest, that without their being referred to it, the Committee cannot be responsible for the expenditure which the Curator's measures and correspondence may entail, for the views on which he may act in the management of the Museum, nor for the light in which this department of the Society's labours may be regarded by scientific men and institutions in other countries.*

It seems necessary too to stipulate that all memoirs or papers drawn up by the Curator for publication, as well as plates, models, &c. on subjects he may have investigated in discharge of his duties, should be in the first instance placed at the disposal of the Committee of Papers, also that all proofs of such papers pass through the inspection of the same body. The Committee are led to this suggestion by the circumstance of a *fly-leaf* having been prefixed without their *sanction* or *knowledge* to the last Volume of the Transactions. Although containing nothing from which the Committee would dissent, the precedent is one which they are desirous of avoiding, as it obviously may lead to many objectionable results.

The Committee deem it highly desirable to secure, if possible, Dr. M'Clelland's valuable services *on the terms they have now set forth.* His acquirements in the various departments of Natural History, his zeal for the promotion of Science, and the liberality and disinterestedness he has evinced in his past connexion with the Museum, entitle him to be preferred to most competitors for this appointment. The Committee have endeavoured in this Report however to discuss without bias towards any individual, the stipulations for tenure of office which they deem most conducive to the interests of the Society and of Science, and most likely to receive the approbation of the Government, through whose liberal grant the occasion of this discussion has arisen.

In the event however of Dr. M'Clelland's declining to accept the situation on the terms now proposed, the Committee recommend that candidates be invited to present themselves, that the testimonials of such candidates be examined and reported on by the Committee of Papers, and finally considered at a General Meeting. That the individual selected be appointed for 12 months, and his permanent appointment be made dependent on the ability and industry, evinced during the probationary period.

* This paragraph is only calculated to mislead those who do not think, or who do not know the Society. In the first place the Society is not, and never has been, in the habit of making exchanges of objects from the Museum; in the second place the Curator can enter into no engagements in the name of the Society or the Committee of Papers, so that neither of these bodies can be held responsible for his acts; in the third place, there is no correspondence connected with the office, and never has been; and, lastly, it would be the height of absurdity to suppose that scientific men and scientific institutions would or could for a moment hold any or all the members of the Committee of Papers responsible for the scientific part of the Curator's duties.—Ed.

Should no candidate of sufficient acquirements present himself within three months, the Committee recommend that the president be requested to communicate with the *proper* scientific authorities in Europe, authorizing the appointment and dispatch to India, of a competent individual, bound to serve the Society for a period of five years, and subject to the rules herein expressed.

The Committee would not be disposed to extend to any other individual but Dr. M'Clelland the privilege of devoting but two hours daily to the Museum, and would require four hours at least actual attendance at the Museum, from whatever other candidate might be selected.

(True Copy,)

W. B. O'SHAUGHNESSY,

Offig. Secy. Asiatic Society.

Minute by Dr. J. Grant.

I regret that I cannot concur in the whole of this Report, agreeing with much of the general principle that pervades it. I dissent from its application to our peculiar circumstances. The Report closes with a well merited expression of the desirableness of securing, if possible, the services of a zealous, able, industrious, and disinterested naturalist upon the spot, and yet proposes to fetter him with rules, which I fear might damp his ardour and circumscribe his usefulness, without any commensurate benefit to the institution, or perhaps alienate him altogether from a situation which he is well qualified to adorn.

The Report proposes the consideration of the subject entirely on abstract principles, without reference to individual fitness here, or convenience of availing ourselves of such at once, but sincerely believing as I do that the readiest practicable plan is to avail ourselves of the intellectual means at hand, rather than incur the delay of waiting for remote and uncertain materials, I am averse to the adoption of rules which I fear may deprive us of Dr. M'Clelland's services.

The three suggestions contained in the opening paragraph of the report appear to me objectionable, for the reasons to be stated as I proceed. 1st. I would not tie down Dr. M'Clelland (supposing him ready to undertake the office of Curator) to two hours daily *in* the Museum; though it is not unlikely that at an average Dr. M'Clelland would devote so much time to the duties of the Museum;---yet I conceive that the precise locality of duties bearing on the Museum, is of less importance than their being essentially well produced and looked after, not merely *in* the Museum, but out of it; since Dr. M'Clelland might labour very usefully for the Museum in his own house, without a scrupulous and inconvenient measuring of time within the walls of the Museum, that if left to himself might occasionally extend to more even than two hours. 2nd. Monthly Reports, for some time to come, would almost entirely be confined to mechanical arrangement. Quarterly or half yearly reports, I conceive, would answer every useful purpose, and give less trouble. Let the Committee of Papers be a Committee of Management, and by frequent visits to the Museum obviate any tendency to inaction on the part of the Curator. 3rdly. The non-removal, under any circumstances, of articles from the Museum, would impose a tantalizing restriction. A Museum, especially in India, is not the most favourable place for making minute observations, or recording results and circumstances. There may be several articles that the Curator would like occasionally to carry home to examine quietly in the privacy of his own study, and I should be sorry to cramp any Curator's convenience, by depriving him of this indulgence. To insist upon it, would be like the rule that holds in some libraries, that books should be looked at only on the premises. That rule may be a very proper one in Europe, but I do not think it at present applicable here. Apply the same rule to Numismatology, and it would be found very prejudicial. Had it been strictly acted upon in that branch, I question whether Dr. Wilson and Mr. James Prinsep, (the latter especially), would have effected such splendid results. Neither would I pay our Curator the bad compliment of implying by such a restriction, that he would not take proper care of specimens. Instead of this, I would permit him to carry away what specimens he required, for a reasonable time, the vacant space being occupied with a card or half sheet of paper, bearing the number and character of the article, and the date at which it was borrowed, with the words "Taken by Curator."

Quite concurring in that part of the Report, which states that the Curator's great object, should be generalization of several subjects, and not special devotion to minute observation of a sub-division, yet as I conceive that the two objects are perfectly reconcilable, I have no doubt that Dr. M'Clelland would pay due attention to both. Neither do I imagine that the claims of speedy and effectual mechanical arrangement would at all suffer in the hands of Dr. M'Clelland, or take up so much time as the proposal to tie down that gentleman's passing two hours daily in the Museum would seem to indicate. In conclusion--- as far preferable to the plan of sending in three months to Europe for a Curator, and procuring one who after his arrival in India would very likely become discontented at finding himself tied down for five years upon a salary which may sound imposing in Europe, but would be only a pittance for a man of education in India, and scarcely on a par with the pay of some mechanics, I would prefer closing for a twelvemonth*

* The objection to holding the office except on a permanent and independent footing is, that after accomplishing the first step in bringing the collection into order, the office would then hold out so much stronger inducements to those who are fond of sinecures, that a man who relied merely on fitness, might find himself no longer required. Witness the indifference of the Committee of Papers to the Museum as long as the Society had not the means to pay: but no sooner did the Government come forward with funds, than persons whose names had never before been heard

with Dr. M'Clelland, or any other qualified gentleman in India, to whom such a limited salary might be an object, should the conditions of offering the situation to the former be such as to make him decline it.

CALCUTTA,
15th February, 1840.

We do not blame persons for not being naturalists, but when they assume that character under the garb of a Committee, we must hold them responsible for their acts, particularly when directed against individuals whose pursuits might be supposed to be a protection, or when their opinions are calculated to mislead the taste and judgment of the public. The only inference to be derived from the foregoing report, which was got up no one knows how, is, that we have been neglecting the interests of the Museum for objects of more interest to ourselves---that when we ought to have been sitting in the Museum, we have been investigating "groups and families" at home; and every thing calculated to bear upon the disadvantage of this, is brought forward, while all that should excuse it, is suppressed or misrepresented. It is insinuated even that our paper on "Cyprinidæ" was written when we ought to have been doing something else, forgetting that it was presented to the Society nine months before the Committee had any claim upon our time; while they keep out of sight the fact of above 360 animals having been added to their collection during the few months we held office, a third of which were collected by ourselves in that short period. We have merely to add the following extract from our reply to our late just and liberal *masters*, and gladly leave them in possession of the Asiatic Society.

"As the report professes to have framed the duties of the office to which such new interest is attached on the established usage of other Museums, I must be permitted to point out the error into which the *Rapporteur* seems to have fallen.

"The Museum of the Royal College of Surgeons in London is placed under a Board of Curators, over which the members of the College have no authority. I allude to this Museum as one in which the Government have an interest, and in all other Museums to the support of which the Government contribute, the Curators are equally independent. This Board may not only cut and dissect the specimens in such manner as may be deemed essential, but may send them to lapidaries and others to do the same; and Mr. Clift, as well as Mr.

of in connection with natural history, produced their maiden report. Would any one be justified in reposing confidence where there is so little regard for appearance?—ED.

Owen, may make use of the results the same as if they had been derived from their own private specimens.

"The Museum at the India House is placed entirely, I believe, in the hands of its keeper, who may not only make such use of his descriptions of the objects contained in it as he conceives most likely to promote the ends of science, but exhibit those objects when necessary to the Societies of the Metropolis.

"Can the Committee of Papers reconcile this, with the stipulations they require from their Curator? e. g. 'that all *memoirs* or *papers** drawn up by the Curators for publication, as well as plates, models, &c. on subjects he may have investigated in the discharge of his duties, should in the first instance be placed at the disposal of the Committee of Papers; also, that all proofs of such Papers pass through the inspection of the same body.' The reason assigned for this very modest stipulation is perfectly ludicrous, and shows how unfit the Committee is to legislate in such matters, namely, that of a '*fly*-leaf having been prefixed without their knowledge or sanction to the last volume of Transactions, although containing nothing from which the Committee would dissent, the precedent is one they are desirous of avoiding.'

"The Committee of Papers should surely have been aware that it is the Secretary, and not the Curator, who must be held answerable for irregularities of this kind, and yet the odd remedy they would apply is, that of depriving the Curator of the literary property that every one has a right to enjoy in his own free labours. How that could keep 'fly leaves' out of the Transactions, I am quite at a loss to know.

"As the Committee do not profess to think much of the elaborate investigation of a group or family, we cannot be surprised that they should not be disposed to encourage such a waste of time; and hence the clause preventing the removal of objects of Natural History from the Museum. Why, it was only at the last Meeting of the British Association, that Dr. Buckland announced the intention of Messrs. Hutton and Henslow to continue the fossil flora of Great Britain, and of their requiring 'the *loan* of specimens from the Geological Society, which would be carefully returned after drawings had been made of them.'

"Again, the Committee require that all correspondence connected with the Museum should pass through the Secretary's office, 'in conformity with the practice of all similar institutions.' Here the Com-

* The only literary work a Curator is expected to perform in the execution of his duty, is the preparation of a catalogue of the collection under his charge. Whether that be a *memoir* or a *paper*, I must leave to the legal learning of those who would draw the distinction. Even with regard to a catalogue, I would advise the Committee to imitate the Council of the Zoological Society of London, and declare "that they do not hold themselves responsible for the nomenclature adopted, and opinions expressed in that publication."

mittee no doubt evince the same intimate knowledge of the practice of other institutions, as in the instances already referred to."

It does not appear to have occurred to the Committee, that the Curator being a naturalist can have little correspondence not connected with the Museum, so that to comply with this rule he should require his friends to address him through the Secretary.

" The Committee say, 'our collection of *minerals* is in utter chaos,' a statement which is not the fact, for they are all arranged; a Committee that would lay down rules for the direction of a Curator, ought to know the difference between minerals and rocks. 'Though rich,' say this Committee 'in *anonymous* specimens, valuable in themselves as illustrations of *abstract* mineralogy, but devoid of interest in a geological or geographical light, owing to the neglect with which they have been treated, &c.' We can easily understand that the Committee may have been ignorant of the names of many minerals in the collection, especially as they do not seem to know the difference between minerals and rocks, but it does not follow that such minerals are '*anonymous;*' in fact, the use of the term as the Committee have applied it, evinces a total want of information on the subject; a mineral is not *anonymous* because it is without a label, any more than a man would be so when without a card in his pocket, with his name written on it: a person acquainted with either minerals or men will always know them whether labelled or not. Yet this is the Committee who are ready to take the management of the Museum into their own hands, and as they say themselves, examine the claims of such candidates as may offer for the Curatorship within a period of three months!

" 'It appears,' they say, 'that the first object of the Society in remodelling the Museum, should be to form a grand collection of minerals and fossils, illustrative of the Geology, Geography, and Palæontology of our British Indian possessions.' But we are at a loss to know how *minerals* and *fossils* could illustrate *Geography*, and had always supposed that Palæontology was merely a branch of Geology; but perhaps the Committee intend to remodel the sciences, as well as the Museum. 'A few *existing* minerals;' (could there be any other kind? This is the report of a Committee of Papers of a learned Society, claiming an authority quite unprecedented over the labours of others, it is therefore of importance before their claims be sanctioned, to see how far the scientific character of the Society would be safe in their hands) 'and some superb fossils in our Museum are available for this object,' i. e., for making a grand collection; but as the things in question are already in the Museum, they are not merely '*available*' for the object in view, but constitute so much of the object itself already accomplished.

" The Committee continue, 'While waiting for these additions to our collection, he,' the Curator, 'should proceed to label those already in our possession.' It is within the recollection of the Society that

I stated eight months ago that I could do nothing with the geological collection until cabinets were first provided; these were accordingly sanctioned by the Society, but ordered by the Secretary from a native for less than he could afford to provide them; the consequence is, that they still remain unfinished. This is an instance of the ill effects of leaving the Curator dependent on the Secretary, or any one else, for things on which his own work depends; and as the circumstance is brought forward rather unfairly in the report of the Committee, I must be permitted to say, that had any member of that body required an *easy chair*, we may presume he would have obtained it at once from the best cabinet-maker, cost what it might.

"There is but one name attached to the report which can be at all held responsible, in a scientific point of view, for the sentiments embodied in it, and although Dr. Wallich may fairly be exonerated from any great authority on the subject of Museums, yet his own experience ought to have suggested the difficulty of making monthly reports on subjects connected with natural history, he himself finding a single report too much to accomplish in the five years that have now elapsed since his return from Assam."

Directions for preserving Marine Objects of Natural History.

During the expedition to China, there may be opportunities of adding to the very scanty knowledge at present in possession of the scientific world, regarding the productions of the eastern parts of Asia. A memorandum on the means of making collections of such objects as are most likely to be met with in ships, and along the coasts, may therefore be useful, especially to amateurs, who on such occasions may often be in doubt as to the objects they should choose, since they cannot collect all things that may offer. We are not aware that the marine plants of the eastern seas have ever been examined, the following observations on the method of collecting objects of this nature, may therefore be useful. They are extracted from a very good paper on collecting sea-plants, by Dr. Drummond of Belfast, in the Magazine of Zoology and Botany, 1838.

"The first object to be attended to in preserving marine plants is to have them washed perfectly clean before spreading. There should not be left upon them a particle of sand or other foreign body, unless in some rare instance a parasitic species may be thought worthy of keeping, on account of its rarity, or because it may add an additional beauty to the chief specimen. It is a good practice to wash them before leaving the shore either in the sea, or in a rocky pool, or, as is sometimes more convenient in some localities, in a rivulet discharging itself into the ocean, though, as will be afterwards explained, the last practice proves very destructive to the beauty of some species.

"The foreign bodies to be got rid of are fragments of decayed sea-weeds, sand, gravel, and sometimes portions of the softened surface of sandstone or argillaceous rock on which the specimens may have grown, together with the smaller testacea, and the *Corrallina officinalis, &c.* At Cairnlough Bay I experienced most trouble in this respect from the *Ectocarpi*, which confervæ were so generally diffused, as to be entangled with almost every other species of sea-plant.

"After the greatest pains which we may take to clean our specimens at the shore, there will generally be found much to do before they can be properly committed to paper, since foreign substances will continue attached to them with much pertinacity, even after we may have been satisfied that they are perfectly clean. It is therefore necessary to prepare each specimen by examining it in fresh or sea water in a white dish or plate, so that every thing foreign may be detected and removed.

"The next thing to be attended to is the quality of the paper on which the specimens are to be spread: and here a great error is generally committed, in using it thin and inferior, by which, if the specimen be worth preserving, it has not proper justice done to it. Much of the beauty, indeed, of many species depends on the goodness of the paper, exactly as a print or drawing will appear better or worse, as it is executed on paper of a good or an inferior kind. Some species, too, contract so much in drying as to pucker the edges of the paper, if it be not sufficiently thick, for example *Delesseria laciniata*, and this has a very unsightly appearance. That which I have from experience been led to prefer is a thick music-paper. It closely resembles that used for drawing, and the sheet divides into four leaves, of a most convenient size, each being about an inch and a-half longer and broader than a leaf of this Magazine. These, again, divided into halves answer for small species, and for large specimens we may use the entire folio. We have thus three regular sizes of paper, and this serves to give a uniformity and neatness to a collection not to be obtained by using papers at random, and of casual dimensions.

"Whatever pains we may have taken to clean the recent specimens, we shall often find, when spreading them, that some foreign particles continue attached, and for the removal of these a pair of dissecting forceps, and a camel hair pencil of middle size, will be found very convenient. These, indeed, are almost indispensable, and will be found useful on more occasions than can here be specified. A silver probe, with a blunt and sharp end, is the most convenient instrument for spreading out, and separating branches from each other, but any thing with a rigid point, such as a large needle, or the handle of the camel-hair pencil sharpened, will answer. A large white dinner-dish serves perfectly well for spreading the specimens in, and all that is farther necessary is a quantity of drying papers, and some sheets of blotting-paper, with three or four flat pieces of deal-board. Nothing answers better for drying than old newspapers, each divided into eight parts, but it is necessary to have a large supply of these.

"The beautiful and common *Plocamium coccineum* is one of the most easily preserved species, and may be taken as an example of the mode of proceeding with most of the others. The steps to be pursued are as follow.---

"1. The specimen is to be perfectly well cleaned.

"2. A dinner-dish to be filled about two-thirds with clean fresh water.

"3. The paper on which the specimens is to be spread, to be immersed in the water in the dish.

"4. The specimen to be then placed on the paper, and spread out by means of the probe and camel-hair pencil.

"5. The paper with the specimen on it to be then slowly withdrawn from the dish, sliding it over its edge.

"6. The paper with the specimen adhering to it, to be held up by one corner for a minute or two, to drain off the water.

"7. To be then laid on paper, or cloth, upon a table, and the superfluous water still remaining to be removed by repeated pressure of blotting-paper upon the specimen, beginning this operation at the edges, and gradually encroaching towards the centre till the whole can be pressed upon without danger of any part adhering to the blotting-paper, which probably would be the case, were the latter applied at once to the whole specimen.

"8. The specimen then to be laid on a couple of drying papers placed on the carpet or a table; two more papers to be laid *over* it, and then the piece of board, on which latter a few books are to be put, to give the necessary pressure.

"9. These papers to be changed every half hour or oftener, till the specimen is sufficiently dry. (A number of specimens with drying papers interposed, may be pressed at once under the same board.)

"Though the above method is in general the best, yet there are various species, and among these the *Plocamium coccineum* itself, which dry perfectly well by simple exposure to the open air without pressure being had recourse to at all; and some can only be preserved in the latter way, being so glutinous that they will adhere as strongly to the drying paper laid over them as to that on which they are spread. Pressure however, is necessary after they have dried, for the purpose of flattening them.*

* An indispensable requisite in the drying of marine or fresh water algæ is a portion of old rag, neither of a quality too fine or too coarse. When the specimen has been spread, as directed, upon the paper on which it is to remain, a piece of rag sufficient to cover it should be laid over, and then it may be interleaved under the boards for pressure. The rag prevents the necessity of so much care in taking up the moisture as Mr. Drummond requires, never adheres to the specimens, but when dry, leaves them, while most of the plants themselves stick firmly to the sheets on which they have been spread.—Eds.

" After these general remarks, I will now offer some observations relating to several genera and species, following the order in which they are arranged in the English Flora.

" I believe all the species belonging to the Fucoideæ are to be dried in the manner of land plants, after having been previously steeped for some time in fresh water to extract their salt and mucilage. *Cystoseira granulata,* which I have repeatedly found on the Larne shore, will adhere imperfectly if spread in water, but it is best treated as a land plant, to be afterwards fixed with mucilage. *Halidrys siliquosa, Fucus vesiculosus,* and *F. nodosus* require very heavy pressure. The air-vesicles of the first may be in part cut longitudinally to show the internal partitions, and of the two last, to diminish their diameter, but this must be done *after* they are dried, for if done in the recent state they contract and become disfigured."

A very important part in the art of preserving marine plants is to prune luxuriant specimens, especially such as without this would appear confused and unsightly, but some care is required to prevent the removal of parts on which the character of the species depend; some shrink by exposure to the air, but packed up under gentle pressure, they retain their form, and even when shrunken or dried badly at first, they may be restored to shape by moisture. When collected dry on the beach some are so rolled that they cannot be unfolded, and in that state are nearly useless; some are so thin as to dry readily, and others if steeped in fresh water give out their colouring matter and become changed in appearance. We should think the thick soft paper manufactured at Serampore would answer admirably for preserving marine plants. With regard to land plants no instructions are required.

The only way of preserving animals is by putting them into spirits. This may be conveniently practised with all the smaller fishes, reptiles, birds and mammals, all insects expect Lepidoptera, most of the molluscs and annulose animals may likewise be preserved in spirits; of the Radiata, the Echinodermata alone are to be preserved in any form, but of these the several kind of star fish and sea eggs are very easily collected and preserved, either in spirits or in a dry state.

The skins of the larger mammalia, birds, and fishes, can only be preserved; all the wild species of every class of animals from China and Japan are objects of scientific interest. The pipe fishes and sea horses (Syngnathus and Hypocampus) and the cuttle fishes of all kinds, especially the Calamary from which the China ink is manufactured are objects of especial interest, as well as the fresh water fishes of China. The extent and nature of the trade in the Manilla red fish, as well as specimens and the method of preserving and taking the fish, would be interesting.

Should room be scarce as well as paper for drying specimens in the ordinary way, the fruits and flowers of plants, with a small portion of the stem and leaves adhering, may be put into spirits.

Animals, such as fish, serpents, insects, squirrels, bats, &c. do not disagree with plants in spirits, but on the contrary mutually assist the antiseptic property of the latter.

Some little attention is requisite not to collect clumsy specimens, or many of the same sort of thing, as this would encroach upon the means of preserving other objects, and limit the variety and value of the collection.

Geological, of all collections, are of least interest unless connected with notes; each specimen should be characteristic of some prevailing rock, and ought to be rolled in paper, numbered, and notes regarding the formation to which it belongs made on the spot.

Nnmber every thing you collect, but mind not names, except such as are indigenous, which are to be recorded, as well as the uses and properties of things collected.

Objects of Chinese *Fauna* likely to be least known and most interesting, are reptiles of every kind, crustea, fresh water fish, land and fresh water shells, and the smaller mammalia; next to these, fishes and shells of the estuaries; above all, cuttle fish from which the Indian ink is made. The sea horses and pipe fishes, *starfishes and sea eggs* of every kind, leeches, worms, scorpions, centipedes, and *insects of all kinds,* except perhaps butterflies, from the difficulty of preserving them perfect, as well as the chance of their possessing fewer peculiarities than other objects.

Where room may be valuable and carriage difficult, nothing large should be attempted, and of all such useless curiosities the proboscis of the saw fish, polished shells, and mandarins tails should be eschewed; even the tail of Lin himself would not be worth its room in such circumstances.

It is useless to say any thing about birds, because every one will collect them, and perhaps every one will find himself in possession of precisely the same species; as will probably be the case with other things.

A small test box with articles enough in it for the cursory examination of waters, as turmeric and litmus paper, nitrate of borytes, acetate of lead, nitrate of silver, acetate of ammonia, prussiate of potash, a blow pipe with two or three acids, and as many alkalies, might be useful with collectors; we never travelled without it.

J. M.

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NATURAL HISTORY.

On Cyrtoma, a new genus of Fossil Echinida. *By* Mr. J. M'Clelland.

It is now four years since the discovery of a raised sea-beach was first announced, reposing on the face of the Khasya mountains, inclining to the north-eastern boundary of the plains of Bengal; more urgent occupations, as well as the want of proper facilities for working out the details on which the interest and importance of this fact depends, have hitherto prevented my doing more than merely alluding to it incidentally in different communications connected with my late visit to Assam.* I have since then endeavoured to collect as many specimens as possible of the animals which now inhabit the Bay of Bengal, as well as books and drawings of such as have hitherto been found either in a

* The interest already excited in Europe by this discovery has induced some distinguished cultivators of science, of whom we may mention Mr. Edward Charlesworth and Mr. S. V. Wood, to supply us with collections of secondary and tertiary fossils, for the purpose of assisting in working out its details. Their example, I hope soon to find will be followed by other eminent individuals. Such collections I shall always be happy to render available to any persons who may be engaged in pursuits to which they may be useful. At first it was my intention to deposit these collections, on the part of the liberal donors, in the Museum of the Asiatic Society, but as that would, under the late Rules of the Society, render them useless, as far as the object for which they were intended is concerned, I would ill discharge my duty by doing so.

recent, or fossil state, that by the study and comparison of these with the organic remains of the fossil beach, I might be enabled to arrive at some conclusion as to the condition of animal life at the period of its upheavement, and how far the inhabitants of a sea that had covered the present plains of India corresponded with, or differed from, existing forms.

It must be evident that if similar investigations are beset with difficulties even in Europe, where national institutions have been for centuries devoted to the collection and illustration of natural productions, the task must be almost hopeless in the present state of natural science in India. Nevertheless the subject is one of so much importance to the advancement of geological science, *and holds out such powerful inducements to further researches,* that I have felt desirous, even in the face of circumstances, to attempt a beginning, particularly as the words in italics are those of Sir John Herschel, expressed with regard to this subject. The difficulty may however be lessened by taking up the subject in parts, and the part we have chosen for this communication is not the least interesting or important.

Before going into the subject of the fossils, a few observations on the general characters and nature of the group of animals to which they belonged, will be necessary. *Echinida* seem to have been very abundant about the period of the chalk formation. Their first appearance is in the Oolitic formation, from this they ascend to the green sand, increasing in number and variety till the period of the chalk, in which we probably find they were more numerous than at any former or even subsequent time; from the chalk formation they are traced upwards through the series of tertiary rocks, some species becoming extinct and others appearing in their place. The structure and habits of such as now live are not yet sufficiently known to enable geologists to elucidate all that it would be desirable regarding extinct species, far less to enable naturalists to make any great advancement towards the natural arrangement of the order.

They are placed at the head of the class called Radiata, consisting of animals in which the several parts of the body radiate as from a centre. It is in the Echinida that we first perceive a tendency to that bilateral disposition of the several parts of the body which characterises the higher classes. Mr. MacLeay has observed that those who attempt to form accurate ideas of animal life by studying it only in the most complex shape, are like persons who would penetrate the depths of Newtonian philosophy without being previously acquainted with the simpler elements of mathematical science. An intimate knowledge of the structure and habits of the simplest form of animals is indeed no less important to the physiologist than indispensable to the geologist.

The first is enabled to trace from them the progressive development, and changes of organs according to their uses in different classes of beings, while the second, by a familiar acquaintance with the forms of the lower animals is enabled to decypher and explain the nature and character of great physical changes that have repeatedly altered not merely the condition of the earth itself, but remodelled from time to time the beings which have been placed upon it. Thus it is that a knowledge of the fishes, the reptiles, mulluscs, and polypes, the worms, and creeping things which are regarded with indifference by the vulgar, is calculated not only to enlarge the sphere of reason, but also to exercise a powerful moral influence over the human mind by rendering us better acquainted with the extent and beauties of the creation, and the infinite power and goodness of the Creator.

It is not my intention to write a popular discourse on this subject; for it is one with which even the learned are as yet but little acquainted, and the peculiar facts I am about to detail are chiefly unknown even to them. It is therefore necessary to prepare the reader, as I have had to prepare myself, by a consideration of the living forms which now represent in India, the fossils which form the proper subject of this paper. They are extremely common along the islands of the Malay coast, where they are called by the natives *sepe ka phul,* or shell-blossoms; Europeans, if they observe them at all, call them sea-eggs or sea-hedgehogs, according as they are found with or without spines of a certain size. The only two specimens for which I am as yet indebted to my European friends, were presented to me by Captain Lloyd, but as they were contained in a bottle with insects which I was desirous of placing in the hands of Mr. MacLeay, I sent them unexamined to that philosopher, who is now prosecuting his researches in New South Wales. They were found by Captain Lloyd on rocks in the Mergui archipelago, where they were said to be very numerous. I have since heard that they are also common on the coast of Rambree island, from which quarter we hope soon to receive specimens; but in case our solicitations have not been sufficiently urgent, we again entreat residents in that quarter to favour us with collections. As yet our observations have been confined to the naked crusts of some seven or eight species which we have been enabled to collect in the shops of dealers, all of them from the quarter above alluded to, except perhaps two contained in the Asiatic Society's collection, which may have come from the coast of New Holland; the one is an *Echinometra,** the other a *Scutella,* both different from any which I have known to come from the Bay of Bengal. Some *Echinida* are globular, or spheroidal, others are raised as a parabola from a somewhat flattened base, and some almost entirely flat. Their bodies, which are covered by a shell, are furnished with a powerful armature consisting of moveable articulated spines, which surround every part of the body, and serve also as organs of motion, with spiracles, which penetrate in bands through the shell, serving as respiratory organs; with a mouth and peculiar dental apparatus, with

* Named '*Echinus*' in the cabinet.

organs of digestion, consisting of an alimentary canal and stomach; they have also a vascular system consisting of heart, arteries, and veins, together with reproductive organs; it is highly probable that they are possessed also of a nervous system; this has not been yet proved, although it has been found in the starfish. Their skeleton consists of an external crust which surrounds the soft parts, and is one of the most beautiful structures with which we are acquainted. In a being so constructed, it is necessary that the skeleton or crust should, on the one hand, be such as to resist external violence, and on the other, to admit of the growth of the soft parts within. A sphere composed of small plates with concentric edges forming radii, would resist external pressure while it would be capable of being expanded from within, and would answer the object, but something is required to enable such a structure to stand alone and resist the gravity of its own materials. This is effected in the shell of the Echinus, or sea-egg, by means of the peculiar adjustment of the pieces of which it is composed, so that its mechanism might become as instructive to the engineer in affording new mathematical combination, as the leaves and flowers of certain plants have long since proved to the ancient artists, who first had recourse to them as principles of embellishment in their designs.

If we take the genus *Echinus* as the type, we find the shell spheroidal, somewhat flattened at the base, with five pairs of porous bands, like the meridians of a globe, extending between the two poles of the testa, these were thought to resemble the walks in a garden, and hence called *ambulacra* by the older anatomists. Each pair of ambulacra consists of a double vertical series of small plates placed together, so that the horizontal axis of one plate falls between that of the corresponding ends of the two opposite. Between the different pairs of *ambulacra* there are broader intervals not perforated, and hence called *anambulacra,* five in number; each of these spaces is also composed of two vertical columns of large plates, equal in breadth to two of the small series, and placed so that the horizontal axis of each small plate is opposed alternately to the axis of the large, and consequently also to that of the interval between the opposite large plates, so as to interrupt the horizontal joinings. Thus there are five large double series of plates, and five small, which only require to be placed alternately together in order to form a consistent moveable sphere, the walls of which may be composed of any number of detached pieces. Now as each plate in the large series is equal to two in the small, consequently it requires nothing more than to preserve the same principle of alternation in the axis of the different plates in order to attain the end in view.*

With regard to the growth of these animals, naturalists appear to have fallen into curious mistakes, and seem to think that it takes place only at the apex, by the formation of new pieces in that situation, rather than an uniform augmentation of all the different pieces composing the testa. It appears to have escaped preceding naturalists that the different plates of the testa of *Echinida* are nothing more than so many centres of ossification, which in large species become obliterated, the testa consisting merely of five pieces (exclusive of the oviducal plates) instead of many hundred, as writers on this subject suppose.

From an examination of different sized animals in various stages of growth, I have reason to believe that the consolidation of their testa begins at the base, in which situation

* Domes constructed of masonry cannot exceed the hemisphere, as the gravitation of the materials of the lower part of the fabric would be unsupported. What has been hitherto impossible to human ingenuity, might be accomplished from the model of the shell of an Echinus, in which we see the materials so adjusted as to overcome the influence of gravitation, the most prevailing law of matter.

the various pieces are first united, and as the animal advances in life the consolidation goes on from below upwards, and at the same time the expansion of the shell takes place by the deposit of new layers around the edges of the plates. Small papulæ also shoot out from the intervals that formerly separated the different plates from each other, thus obliterating in adult shells every vestige of distinct plates.

On the inner surface of the testa however, elevated ridges still mark the former lines of separation, and on holding the shell to a strong light the various pieces composing it become apparent, owing to the transparency of the central parts of the plates, while the margins are rendered thick and opaque by the accumulation of testaceous matter thrown out, and by which their union is ultimately effected. How long the animal continues to live after it is completely formed, we have not ascertained; but from the great variety in the size of the testa in such as we have met with, we should think that, like fishes, they continue to increase in bulk with their age. The largest Indian species I have seen were nearly five inches in diameter, but I believe *Echinus esculentus* attains a still larger size on the coasts of Europe. The large species which is very common in collections from the Maldive islands, and from the study of which much of my information is derived, appears to live for a considerable time after the different parts of the shell have been completely consolidated, still progressing in bulk, but at a certain period, which we should think corresponds with that at which the augmentation of the animal becomes suspended, a new set of actions then ensue, which are beautifully depicted on the shell of the species in question. We learn from the changes alluded to that these animals have an absorbent system that performs a prominent part in their development and decay, and that is subject to the same laws as the absorbents in other beings. A vertical fissure is observed to form over the situation of the suture, by which each pair of anambulacral plates are joined together in species that have attained a certain size, and this would seem to deepen with the advancement of age, and finally the globe or shell separates into five equal parts, the sections taking place from apices of the five oviducal plates which surround the anus, and descend from thence over the disc to the mouth. Thus the complicated and beautiful skeleton consisting of 540 pieces in the young animal, adjusted with mathematical precision, are gradually consolidated in the adult, and as life advances towards the close, the shell separates into five pieces, each equivalent to 108 elementary plates, but which are at this stage so firmly united, that if sufficient force be applied the parts fracture through the middle of the former plates, rather than separate at their respective junctions.

It is necessary now to compare these observations with the views generally received on the subject up to this time. Professor Grant has the merit of being the first comparative anatomist in Great Britain, whose works afford any thing like a complete view of what is known of the general structure of the animal kingdom, and has still the far higher merit of having himself contributed materially to our knowledge of the structure of animals both by his lectures and original researches. On this subject he observes in his lectures, p. 271, "In these animals," *(echcini)* "when we observe the manner in which the skeleton is constructed, we find the same component pieces which surround the body of the Asterias are developed, meet each other, *become consolidated by numerous layers*, and thus form the great globular disc." The words in italics were it not for the next sentence, would convey the true state of the case; but Dr. Grant continues, " The ambulacra of the Asterias are here bent up to meet the anus, and the integuments are spread out to enclose a sphere. The arrangement of those pieces in the Echinus is thus in perpendicular columns disposed in alternate pairs. This you can best examine when the shells have been well macerated and bleached, *and as the numerous sutures never anchylose,* the structure is equally obvious in the adult and in the young animal." A little further on, Dr. Grant observes, "The number of columns is very uniform in these animals, but the number of similar pieces composing a column varies with the species, and the age of the individual. The new pieces which are added as the animal enlarges, are inserted at the anal margin, where they are consequently always small, and they appear not to be added at any other point. The pieces are thus gradually pushed down towards the middle or base of the column by those which successively make their appearance at the upper narrow apex of each perpendicular series. *From the analogy of the articulated and molluscous classes I had formerly imagined that these plates of the Echinoderma were exuded from the surface of the skin and beneath the epidermis, and that they increased in every dimension by addition of calcareous matter to their inner surface and around all their margins. But the homogeneous internal structure of these pieces presents no trace of such successive depositions, and more closely resembles the porous texture of shells which are formed by one deposition, and which are periodically cast and renewed.*" Dr. Sharpey, Professor of Anatomy and Physiology in University College, London, in an article on Echinodermata, Cyclop. Anat. Phys. Part IX, 1837, speaking of the skeleton of sea urchins, observes that the calcareous matter is disposed in polygonal plates, which being *firmly joined one to another, form by their union* a shell approaching more or less to a speroidal figure ; by this Dr. Sharpey means, we presume, no more than what Professor Grant states in his outlines of comparative anatomy, "*that the plates are firmly joined or locked together by the re-entrant angles or sutures,*" particularly as Dr. Sharpey alludes to Echinus esculentus, in which Dr. Grant is of opinion the plates never anchylose. Professor Agassiz, the most recent writer on the subject, in an excellent paper in the Memoirs of the Society of Natural Sciences, Neufchâtel, observes, "*that in general the testa of the Echini is not so immoveable as one who had not observed them in a fresh state might be led to suppose. All the plates forming the upper part of the disc are often set in motion, sometimes they sink, sometimes they rise, and, in oblong species the longitudinal diameter is often extended beyond its ordinary length.*" As I have never had an opportunity of examining these animals in a fresh state, my observations will be of less value; yet if the motions alluded to by Professor Agassiz depend on a moveable articulation between the various plates, it is difficult to conceive how all traces of such articulations should be obliterated in the dead shell, and how after death different bony pieces should become soldered together, which during life remained separate and distinct from each other. The removal of gelatine and animal matter by bleaching would undoubtedly render the shell generally harder and less yielding than in a living state, but this would not account for the consolidation of all the different plates of which it is composed, if in a living state they were separate and capable of being depressed and elevated at the will of the animal. Since it is those plates only forming the upper part of the disc that are said by Professor Agassiz to be capable of being elevated and depressed, may we not infer from this circumstance that had the individuals examined by him been older than they were, such movements would necessarily have been more limited, especially as we have already stated, the consolidation of the plates commences at the base, and slowly advances upwards towards the apex, according to the age of the individual; a circumstance which may have led to the supposition that they never unite in this situation, thus accounting for the discrepancies on the subject. This peculiar mode of development may also have led to the supposition that the growth of Echini depends on the formation of new plates at the apex, from which they are gradually pushed down towards the base as new pieces are thrown out above, in proportion as the animal enlarges, for as the plates on the upper part of the disc are last of all consolidated, it is easy to *imagine* that they are all new. Professor Agassiz carries this view of the case much farther than Professor Grant, and refers the difference between Echini and starfish to peculiarities in the development of the new plates "since the large growth of the plates in the summits of the spheroid, combined with the contraction of the interradial planes would produce a starfish; while, *vice versâ,* the increase of the interradial planes and the reduction of the central plates in the starfish would produce a spheroid. Nor is this a mere hypothesis; we shall see hereafter that the essential difference between Echini and Asteriæ consists in the different modes of their growing." However important such general observations may be to the comparative anatomist, whose province it is to investigate the form and functions of organs in beings of different and sometimes opposite characters, they can only be useful to the naturalist as far as they are calculated to establish relations either of analogy or affinity. We can appreciate the very beautiful design of Dr. Grant in his lectures, of tracing the gradual advancement of animals from the simplest to the most complete forms, according to the more prominent characters of their organization in different groups, but in tracing the affinities of animals, the naturalist has a duty to perform which requires that attention should be equally paid to those peculiarities of species by which animals of different groups represent each other. Thus the observations of M. Agassiz seem intended to establish a direct affinity between *Asteriæ* and *Echini*, founded on the development of the plates of the testa, but before we can establish an affinity between two groups, it is necessary to trace the peculiarities of species composing them throughout their various phases, from their source in one group to the point to which they lead in another. It is customary to regard *Asteriæ* and *Echini* as closely allied, but no one has yet undertaken an analysis of the subject with a view to point out the particular species in the two groups which approach nearest to each other; for my own part, the only points of relation I can perceive between *Echini* and *Asteriæ* are, that both are radiated and both confined within a testaceous case, the mechanism of which however is quite different in the two groups.

In the Asterias, beyond the circular body and five concentric branches, we find nothing of the radiated structure, particularly in the skeleton. In the first place the form is flat, and the earthy pieces composing the upper and lower parts are quite different from each other in form and function, while those composing the lateral columns of the branches are not radiated but divergent, or at least arranged parallel to the rays; in some the pieces are imbricated like the scales of serpents, in others nodular like those of Saurions; in all this do the *Asteriæ* differ from *Echini*, every atom of whose skeleton forms a part of a spheroid. M. de Blainville appears to have named the plates composing the lower grooved surface of the Asteriæ ambulacral, and the upper plates inter-ambulacral, and supposes them to agree with those plates known in the Echini by corresponding terms. To establish the affinity between starfish and Echini, M. Agassiz thinks it will be necessary to represent the former as if it were globular instead of flat, and " as if the upper lateral plate of one ray was soldered to the upper part of the next ;" in other words, as if the axis of the upper and lower faces of the testa were altered, and the rays bent down, so that the apex of the upper surface of one should be made to fall into the vertex of the lower surfaces of two, and *vice versâ.* If we were to take the liberty of making so many alterations in animals, it would be a very easy thing to construct affinities ; but we think it the more philosophical course to study nature as we find her. Although my business on the present occasion is strictly with the Echinida, yet in seeking a place in that little known family for our new genus, we are desirous of examining in the first instance how the groups composing it are constructed, and what their true rank and position are, in the animal kingdom.

Before we place implicit faith in the above view of reduction of types, let us examine the principle on which it is founded, namely, that the *Asterias, Holothuria,* and *Echinus,* are subject to one law of development, and that law M. Agassiz tells us is discovered in the growth of the Echinus. The young Echinus has a small number of plates in each vertical series; they appear to be slowly increased in size by the deposition of calcareous matter at their circumference *until those that surround the mouth have completed their growth.* The superior plates continue to shoot out and grow from the top downwards, on the periphery of the body, which remains depressed so long as the inferior are the only plates consolidated; but in proportion as a greater number of plates become immoveable, and there is formed in the upper region a greater number of plates reaching down to the circumference of the spheroid, the testa becomes rounded, and finally assumes a spherical form. Thus M. Agassiz makes the growth to be at the apex. It is singular that so profound an observer should not have seen that instead of a spheroid, such a mode of development as that which he describes would produce a simple tube, and that as the proportion of circles are to each other as the squares of their diameters, so the growth of the different plates composing the shell of an Echinus must be augmented rather than diminished, as they fall from the apex towards the diameter of the disc. The views of comparative anatomists and naturalists being thus at variance with this simple law, I put the matter to the test by reducing the several parts of the testa of a large *Echinus* to a thin transparent film,* when the successive layers of deposit were every where observable around the margins of each plate, and this was observable in plates belonging to the base as well as in those of the apex of the shell, thus proving nature to be in the right, and showing the fallacy of supposing that the growth of these animals takes place only at the apex. With regard to the formation of new plates at the apex there can be no question, but it is too much to say that the number of plates in each vertical series depends on the size of the animal, or that they differ so much as some suppose in individuals of different sizes. In five individuals of the same species of Echinus, I find the smallest two inches, and the largest four and a half inches in diameter, yet the largest has but eighteen, and the smallest as many as fifteen plates in each corresponding vertical series, while those of three inch diameter have also eighteen, thus proving that the animal continues to

* See figs. 6 and 7, plate III. Fig. 6 represents the structure exhibited at the base, and fig. 7 at the apex of the shell. The layers of deposit are distinctly seen surrounding the different plates.

increase in bulk after the number of plates have been completed. Nor do we find the altitude between poles of the spheroid correspond with the age and bulk of Echini, as we might expect from the observations of M. Agassiz; for of the five individuals I have examined, the smallest has the same form as the largest, being depressed or flattened between the poles, while another individual, three inches in diameter, has an equal altitude with the largest.* M. Agassiz reduces the various forms of Echinodermata to three types, namely, the tubular *(Holothuria)*, spheroidal *(Echini)*, and starfish *(Asteriæ)*, but these types he observes may be reduced to one, in as much as the tubular form may be considered as an elongated spheroid, thus uniting the *Holothuria* with the *Echini*, and we have already seen how these last are united to the starfish by MM. Blainville and Agassiz. I confess that unless the object is to establish the above as a natural series of affinities, I cannot very clearly see how this reduction of types can simplify the subject; and if the object was to trace the series of natural affinities, it is singular that M. Agassiz though aware of the peculiar relation between the starfishes and certain genera of flat Echinidæ, in which the upper and lower surfaces of the body are distinct, should have laboured to establish a direct affinity between the globular Echini and the *Asteriæ.* The discovery by M. Agassiz of the bilateral disposition of the parts composing the Echinodermata is however a valuable addition to our knowledge, and will doubtless prove an important step towards the natural classification of the *Radiata;* but until we are far better informed regarding the habits and structure of these animals, and the investigation be undertaken by naturalists possessed of a clear perception of the difference

* Figs. 1 and 2, plate III, represent the elevation of two individuals, the one four and a half inches in diameter, the other three, though the altitude of both is the same.

between analogy and affinity, we can expect nothing but additional confusion from the mere alteration of names and groups.*

With regard to the situation of the Echinida in the animal kingdom, M. Cuvier placed them next the starfish, at the head of his fourth or last division *Radiata*, which embraces at least two very distinct classes of animals, one of which, the *Acrita* of MacLeay, presents but little of the radiated structure. Even the term Echinodermata which was applied by Klein to the Echini of Linnæus, and intended only for radiated animals whose bodies are incrusted and covered by prickles, has been extended by Cuvier to a whole class of animals, including the intestinal worms, the polypes, sponges, and infusoria. M. de Blainville has restricted the name to the Holothuriæ, Echinidæ, and Asteridæ, which nevertheless are three very extensive groups. With regard to the first I have no personal knowledge, being merely acquainted with them, from the description of authors. According to M. de Blainville, M. Bianchi was the first to detect the affinity of Holothuriæ to Echini, and he even names one of them *Echinus coriaceus*, but Pallas and some others consider that they ought to be placed in the class of Polypes near Actinia. Asteriæ appear to be more perfectly developed animals than those of either of the other two groups, and therefore deserve a foremost place, as well on account of a nervous system having been discovered in some of the species, as from the fact of the pieces composing their testa approximating to the structure of articulated animals. In the Echini, which of all Radiata present the

* The difference between the new genus *Diadema*, Gray, and the old genus *Cidaris*, is chiefly that the spines are smaller and more numerous; again, the genus Astropyga differs from Cidaris in the oviducal plates being longer, and the genus *Arabacia* is made to differ from *Diadema* in having no perforation in the large mammilæ. Now we require to be informed why such slight peculiarities should be considered of sufficient importance for the construction of genera as *Ophiocoma*, *Phytocrinus*, *Ganymeda*, *Melocrinus*. We luckily get rid of the genus *Diadema*, from the term having been previously applied to a genus of Cirrhopoda by Ranzani.

most perfectly radiated structure, every one of the numerous pieces composing their complicated skeleton forming a part either of the radius, or the surface of a spheroid. In the Asterias, on the other hand, although we see the radiated form more conspicuously developed in those branches on which the starlike figure depends, yet when we come to examine the structure of these animals more closely, we perceive nothing of that beautiful mathematical order which we observe in the Echinus. In the first place, the upper and lower surfaces present two distinct kinds of structure, in each of which the spheroidal disposition of the parts is quite lost. In the next place, the plates composing the rays are placed in rows which have no relation whatever to the properties of a sphere, but a very considerable tendency to the disposition of parts composing the annulosa, but whether this be an analogy or an affinity, we are not sufficiently prepared at present to decide. It is however important to find amongst the Radiata a group which all naturalists have agreed in placing at the head of the zoophytes, and in which the radiated structure affords at least an approximation to the limbs of the higher classes, and still more especially interesting when in this group alone, of all the numerous tribes of polypes, and infusoria which follow in the scale of nature, do we find any trace of a nervous system. Next in importance to a nervous system having been detected in the Asteriæ, is the fact of their having the dorsal and abdominal regions distinctly marked. In the Echinidæ, as we have already remarked, M. Agassiz has the merit of having pointed out for the first time a bilateral disposition of the parts, but we have seen notwithstanding how perfectly the spheroidal form is developed in every part of their structure, and that below them in the scale no tendency to the bilateral form has as yet been traced in the animal kingdom. In ascending however to the higher forms, we find not only the same signs of bilateral structure in the Asterias, but the disc extended at certain points into radiated extremities, and the dorsal and abdominal regions of the body which are lost in Echini again distinctly characterised. In the Encrinites, or fixed starfish, we find the abdominal region attached to a column for the support of a body, whose limbs as yet rudimentary are only sufficient for the collection of food. In the *Comatula* and *Euryale*, of Lamarck, we see a more highly developed system of extremities, the abdominal and dorsal regions still better marked, and the body left free without a stem or fixed support. Again our next step introduces us to the Asterias, in which we find the radiated limbs more highly developed and approximated to the structure of the Annulosa. Here the spines which were the only means of defence to the spheroidal body of the Echinus disappear altogether on the abdominal region, or are changed in form, and arranged along the margins of the groove, so as evidently to direct objects into the mouth, thus compensating for the immoveable character of the limbs.

The grooves on the lower surface of the Asterias indicate the change from the perfectly incased Echinides to the higher classes, whose intelligence and organization are sufficient to enable them to protect themselves from danger.

The annulose animals supposed by Mr. MacLeay to come nearest to Echinodermata are the Crustacea, and the osculent group by which the two are united is, he thinks, *Cirrhopoda*, but I have no materials for the examination of this part of the subject, and unfortunately Calcutta is not well adapted for collecting them without some intelligent and influential friends on the coasts. The Asiatic Society in a late injudicious report on the duties of Curator announce, that it is clearly within the scope of their influence to procure within a few months collections of specimens from every part of India. Assuming this to be the case, can any thing be more disgraceful than the fact of their collections being almost without a single specimen of any one of the extensive classes of animals now under review?

The presence of a nervous system in the Asterias, together with the peculiar form of the skeleton in which a tendency to advance from the radiated structure to that of the higher animals is evinced, having indicated their place at the head of the Echinodermata, it is extremely probable that the depressed pentangular Clypeasters will be found to connect the series of affinities with the globular Echini by means of the Scutellæ, in which we find the altitude of the body gradually increase from these to the new genus Cyrtoma; but as the majority of the species of all these intermediate groups are extinct, their natural arrangement becomes a matter of the greatest difficulty, and can only be attempted with any chance of success after the animals of existing species shall have been more known than they are at present. From the oval Echinus we may trace a connection to the elongated Spatangus, and from this form to the Holothuria. It is singular the little regard that has been paid to the natural affinities of the Echinodermata, considering the rank of those naturalists who have devoted themselves to their study. Thus M. Agassiz and others place the Holothuria at the head of the Echinodermata, and the Asterias at the lower end of the order, and Scutella next to Cidaris and the true Echini.

M. de Blainville, who professes to be guided by the general form and structure of Echinidæ, arranges them nevertheless according to the situation and character of the mouth, and introduces ten genera between the Galerites and the Ananchites, although the forms of these latter groups differ but slightly from each other.

It is in the form of the disc that all these animals destitute of moveable extremities or limbs afford the most constant and significant characters. In the Asteridæ we see the disc branched out into five equal points; in the Rotulæ the body is depressed, but the radiated points are small, and confined to one part of the disc; in the Scutellæ no projecting arms or radii are at all observable; but like the Rotulæ and Asteridæ the body is flat, and the upper and lower surfaces are distinctly separated from each other by a sharp, thin disc, and each surface is marked by a rosette peculiar to itself, the lower rosette still evincing an affinity to the fissures in the lower surface of Asterias. This latter character is strongly marked in our new genus *Cyrtoma,* which appears to follow the Scutellæ, and by its more elevated summit to connect that genus with Echinus, from which we pass to other forms without a distinct rosette on the base, as the *Nucleolites,* in which the disc itself becomes raised, still however presenting the elevated figure. The *Nucleolites* lead directly to the *Galerites,* and these last to the Spatangi. In the Echini we have the most perfect spheroidal forms, as well as the most perfect radiated structure, as far as the skeleton is concerned, of all the other Echinodermata. Here we find the peculiar ambulacral grooves, which were confined alone to the dorsal surface of the star-fish, converted into double bands of tubes, passing like the meridians of a globe from the base to the apex. In the absence of limbs extended from the disc, as in the star-fish, we find every part of the round and apparently helpless body covered with jointed spines which can be turned in any direction from which danger threatens, or wants may be supplied. The only difference between these animals and the Cidarites is, that in the latter the articulating pustules or tubercles for the joints of the spines have each a depression in the centre, probably for a ligament. Their separation on this account from the Echini is at least highly useful, the species of both groups being so very numerous as not to be distinguished without difficulty, but for this convenient subdivision. We observe at the extremities of the Echini and Cidarites (which are both regarded as one natural group) remarkable variations both in the axis and diameter of the body, which have led to the formation of many new genera, as *Diadema** and *Arbacia,* when the shell is depressed, Echinometra

* This term, though adopted by De Blainville, Gray, and Agassiz, has been nevertheless appropriated before for a genus of Cirrhopoda, as already observed page 169.

when it is oval, &c. From these irregular forms we again return by means of the Ananchites and Spatangi, which differ from the Scutellæ, and other genera connected by direct affinities, to the star-fish, in presenting no distinct rosette on the lower surface of the body; nothing in fact equivalent to the fissures of the Asterias is to be observed in these genera. In *Spatangus pilosus*, and those lengthened oval species, particularly *Echinonäus lampus*,* we think a change of character may be observed to the Holothuriæ, while the flattened form of *Spatangus bufo* evinces the return of the affinities again to the star-fish; but this last remark I merely suggest as probably correct. The very singular form Echinonäus lampus of De la Beche, found by that geologist in the green sand near Lyme, however unquestionably evinces a tendency of nature to change her form from the spheroidal incrusted Radiata, to the soft and elongated Polypes. From the genus Echinus, which may be said to be the culminating point of the former, we trace the change from the strong, unyielding bony spheroid, constructed with such wonderful precision of hundreds of thick pieces symmetrically arranged, to the various forms of *Spatangi*, in which the testa becomes thinner, and more various in shape, until its strength and spheroidal form is gradually lost. In *Echinolampus angulosus*, the recent species that approaches nearest to M. De la Beche's fossil already alluded to, we find the disc slightly elongated between the two posterior ambulacra, a change which is first perceptible in the Spatangi as well as most of the other groups which have lost the rosette on the lower surface, and have here been placed after the Echini, until at length we find the fossil Echinolampus present an almost complete transition to the Holothuria, which are elongated, soft radiated animals, in which the place of an external skeleton is supplied by a highly organised coriaceous skin.

* Transac. Geol. Soc. New Ser. 1, plate III. figs. 3, 4, 5.

The Holothuria have been usually stationed near to the Echinida, some naturalists placing them at the head of the Echinodermata, some at the end of the order, and some altogether doubting their connection with it, but none taking the trouble to examine the question; and the two most recent writers, MM. De Blainville and Agassiz, as if to prove how easy it is to retrograde in science, have placed the Holothuria before the starfishes, although the slightest attention to the philosophical views of Mr. MacLeay on the subject of affinities, should have shown that they were placed very nearly in their true position by Cuvier.

Before quitting this part of the subject, to which I trust the kind offices of friends in forwarding collections from the coasts will soon enable me to return, I must refer to an interesting analogy which I observed between the Echini and Chelonion reptiles, before I was aware that Mr. MacLeay had noticed similar relations between these groups. On the carapace, or bony plates composing the back of several tortoises, after the upper crust or tortoise shell is removed, we perceive deep lines or grooves marking the boundaries between the plates of the latter, exactly similar to the grooves already described on the testa of the Echini, characterising the five divisions into which the skeletons of aged individuals fall.

In both cases this appears to be owing to a peculiar function in the external envelope of the skeleton. In the tortoise, moreover, the plates of shell are radiated and raised in the middle, so as to represent spines, and in some, as *Testudo serpentina,* Lin. and *T. caretta,* Gm. they are actually accuminated to points. I now however find that guided by the peculiar circumstances of the nervous and osseous systems, as well as the general forms of the two groups, Mr. MacLeay, in the Horæ Entomologicæ, has made them occupy corresponding places in the respective classes to which they belong.

Having traced the affinities of Echinodermata sufficiently to discover the true position of our new genus, it is unnecessary to enter further into the question at present. It is one of those subjects that seems to have been almost altogether neglected, and it is a curious fact, that if we except the discovery of fossil forms which we owe chiefly to geologists, and the researches of comparative anatomists, the natural history of these animals remains in almost as much obscurity as in the time of Aristotle, who was acquainted with both sea-stars and sea-urchins, and who separated the latter from *Spatangi.* In his system he arranges them with Testacea, but he alludes to them in another place as equivocal beings, between the animal and plant; and to this day a similar uncertainty has prevailed on the subject, Cuvier placing them at the head of his zoophytes, and Mr. MacLeay, the first who has cast a clear light on the natural relations of animals, conceiving that they ought to follow the Crustacea, thus raising them to a higher rank than that in which they were regarded by either Aristotle or Cuvier. With regard to the Holothuria, they are still less known from their being less beautiful, and consequently less likely to attract the notice of collectors. Fortunately for science, it has been found within the last few years that although neglected and despised by enlightened Europe, various species of Holothuria have yielded a trade of considerable extent between most of the maritime nations of Asia and the Chinese, a circumstance which may now lead to their investigation.

In Crawford's Indian Archipelago, we learn that the *Trepang,* or sea-slug, called by Europeans *Beche de mer,* is found chiefly on coral reefs in the Eastern seas, and is highly esteemed in China, into which it is imported in large quantities. It is said to be an unseemly substance, of a dirty brown colour, hard, and rigid, scarcely possessing any power of locomotion or appearance of animation. It varies from a span to two feet in length, and from two to eight inches in circumference. The value and use of the animal do not depend on its size, but upon some peculiar property quite unknown to those who have been long and extensively engaged in the trade. In shallow water the animal is caught with the hand, but in deep water it is either speared or brought up by divers. It is then gutted, dried in the sun, and smoked over a wood fire. The fishery is carried on from the western shores of New Guinea and the southern shores of Australia to Ceylon, and within late years it has been extended to the shores of the Mauritius, and might be carried on successfully both in the Persian Gulf and Bay of Bengal, as we learn from Capt. Lloyd the animal abounds on all the sandy parts of the beach, between coral reefs in particular, on the Tenasserim coast, and adjoining islands. The whole produce goes to China. In the market at Macassar not less than thirty varieties are said to be distinguishable by well known names, and varying in price from five Spanish dollars per picul (133½ lbs.) to fourteen times that price. The quantity of Trepang sent annually from this port alone, is said by Mr. Crawford to be 7000 piculs, the price varying according to the species from 8 to 110 and 115 dollars per picul. There is also a considerable export of Trepang from Manilla and other ports. The first knowledge of this traffic appears to be due to Capt. Flinders, who in 1803 fell in with a fleet consisting of sixty proas, manned with a thousand men, on an expedition from Macassar to the Australian coast for Trepang, where Capt. Flinders had seen them in vast abundance. The Trepang, Capt. Flinders observes, is carried to Timor and sold to the Chinese, who there meet the proas on return from the expedition. Capt. Flinders remarks there are two kinds of Trepang, white and black; the black is sold to the Chinese at forty dollars the picul, the white or grey is worth but half that sum. The black sort was found by Capt. Flinders on the coral reefs near Northumberland islands, and were a colony established there in Broad Sound, or Shoal-water Bay, it might derive great advantage, he thinks, from Trepang. In the Gulf of Carpentara he observed only the grey kind. Capt. P. P. King, in his account of the survey of the intertropical coasts of Australia, says that he met with a fleet of proas in the Bay of Coepang, and learnt from the Raja in charge of them that a fleet of 200 annually leave Macassar for this fishery in January during the western monsoon, coasting from island to island, and having fished till the monsoon breaks up they return, steering north-west, which brings them to some part of Timor, from whence they retrace their steps to Macassar, where Chinese traders purchase their cargoes. Capt. King calculated that each proa carried 100 piculs of Trepang, worth 500 dollars.

On the Tenasserim coast, where these animals are thrown up by the sea, and may be had in great abundance without diving, Capt. Lloyd informs me he observed two kinds—namely, a white and a dark brown sort; the first is considered of most value. It is worthy of remark, that they are not found in such numbers as to attract notice so high in the Bay as Arracan, perhaps from the absence of sand and coral rocks. In the harbour of Trincomalee, I have been informed, they are numerous, are taken by divers, and yield some trade, the particulars and extent of which nothing appears to be known. Of the whole order of Echinodermata I have been only able to collect information regarding the existence of ten or twelve species in the Bay of Bengal; namely, 3 species of Echini, 1 Echinometra, 1 Echinarachnius, 1 species of Scuttella, 1 Echinolampas, and 2 species of Holothuria. There are probably many more, but these are all I have been able to discover in the shops, bazars, and collections, public and private in Calcutta.

Figs. 1, 2, 3, plate III, *Echinus concretus,* spheroidal, depressed, and flat at the base, verucose pustules in vertical series of 15 to 18, a large one on the centre of each plate, and a smaller one at either extremity of the obliterated junction of adjacent plates. Figs 1, 2, represent the manner in which the diameter of the testa varies in different individuals, without any corresponding variation in the altitude, as supposed by Dr. Grant and M. Agassiz. Fig. 3, c. c. c. c. c. is an upper view of the disc, shewing the fissures by which the testa is divided. Figs. 4, 5, represent the inner surface of one of the separated divisions; fig. 6, showing the structure of the testa at the base, and fig. 7, at the apex, when ground to a transparent film; d. d. the layers of deposit or growth of the anambulacral plates; 8, a vertical, and 9, a transverse section also reduced in the same manner to transparent films, for the purpose of showing the layers of deposit; fig. 10 the mouth.

I.—ECHINUS CONCRETUS,* J. M. t. iii. f. 1, 2, 3.

Shell spheroidal, below rather flat, about 18 anambulacral plates and spines in each vertical series, three spines to each plate placed in oblique rows, the largest spine situated in the centre of each series. Testa thick, strong, and solid.

Size from 2 to $4\frac{1}{2}$ inches in diameter.

HAB. Bay of Bengal.

II.—ECHINUS SULCATUS, J. M. t. iv. f. 1, 2.

Shell spheroidal, below depressed, and recurved round the mouth, apex elevated, about 22 anambulacral plates and spines in each vertical series. Three spines on each plate, above the disc the plates are divided horizontally from each other by a furrow, below they are consolidated. Ambulacra narrow. Alveolus, (fig. 2 a,) thin, continuous, and divergent.

Ordinary size about 1.3 inch in diameter.

HAB. Bay of Bengal.

III.—ECHINUS ALVEATUS, J. M. t. iv. f. 3, 4.

Shell spheroidal, below depressed, and recurved round the

* Authors in general think it sufficient to characterise the different genera of Echinodermata, contenting themselves with merely enumerating lists of species from rare works of reference in which they have been figured; such works indeed as are only to be had recourse to in the great national libraries of Europe. Lamarck's "Histoire Naturelle Des Animaux sans Vertébres" contains numerous descriptions of species, but these are for the most part insufficient; the form, the colour, and the spines which are lost from the bleached shell, constitute the principal characters enumerated in that work, which is also without figures. Under these circumstances I have described the above species from characters presented by the bleached testa, the part commonly met with, without regard to their bibliography. Should any of them prove to have been figured and described before, the names I have given to them may be rejected.

mouth, apex elevated, about 32 anambulacral plates with four equal spines on each plate, and four vertical rows of spines between each ambulacrum. Anambulacral plates detached from each other above the disc, below consolidated, ambulacra consisting of one pair of holes disposed zig-zag and close. Alveolus (fig. 4. a.) broad with a very small arch.

Ordinary size about 1.5 inch in diameter.

HAB. Bay of Bengal Received from Captain Lloyd.

IV---ECHINOMETRA MEGASTOMA, J. M. t. iv. f. 4, 5.

Disc oval and depressed at the ends, base arched and recurved round the mouth which is large, 13 anambulacral plates in each short series on the sides, and 15 in the longer series on the ends.

HAB. Unknown. As. Soc. Mus.

V.---ECHINOLAMPUS ANGULOSUS, J. M. t. iv. f. 6, 7.

Disc elongated between the posterior ambulacra; rosette consisting of two double rows of pores converging slightly, but not uniting towards the disc; united at the apex, which is also marked by four oviducal holes, testa thin, anambulacral series wedged out before they reach the apex.*

HAB. Bay of Bengal.

VI.---ECHINARACHNIUS CONCHATUS, J. M. t. iv. f. 8, 9.

Disc subpentangular, mouth large, and occupying the greater portion of the inferior surface, surrounded merely by a narrow flat margin, in the hinder part of which the anus is placed. Ambulacra lanceolate, and converging to a slightly raised apex, in which there are five oviducal holes.

HAB. Bay of Bengal. Received from Captain Lloyd.

VII.---SCUTELLA AFFINIS, J. M. t. iv. f. 10, 11.

Disc circular, mouth very small and central, surrounded by star-like divergent ambulacra; anus small, placed near the posterior margin, apex slightly raised, surrounded by a petaloid star, the pores of which are very fine, and four oviducal holes.

HAB. Unknown. As. Soc. Mus.

The results of the foregoing observations on the natural relations of Echinodermata may be stated as follows :—

1. In Asterias the radiated character is most conspicuous

* This fact must convince us that the growth of these animals cannot depend on the formation of new plates at the apex, since the anambulacral series in this species does not reach to that situation.

in the general conformation of the skeleton, but the parts of which the star-like figure is composed, evinces a tendency to pass from the radiated, to the annulose structure.

2. Such groups of Echinida as present a distinct rosette, and central mouth, with the ambulacral and other series interrupted at the disc, follow next after Asterias, connecting that group with Echinus.

3. That in Echinus every part of the skeleton presents aspheroidal structure, and the series of plates of which it is composed continue to grow as long as the animal lives, by means of layers of new deposit on their margins. That in some species the plates all become united, so as to form a thick unyielding shell, in which certain vertical fissures form as life advances to the close, and the skeleton separates into five sections like the ribs of a melon.

4. To the Echini and Cidarites, the Ananchites, Spatangi, and other groups in which there is no distinct rosette on the lower surface of the body, next succeed.

5. That some of these last forms become elongated on that part of the disc which lies between the two posterior ambulacra, and approximate to the Holothuria; while others become flat, and the disc either nodular or serrated as in *Rotula,* and thus evince a tendency to return once more to the branching depressed form of Asterias.

Having endeavoured to trace the affinities of Echinodermata, it will be seen that the interval between the starfish and Echinus is wider than has hitherto been supposed, and that the known groups which occupy this space are few compared to those which succeed the genus Echinus. There are however some, particularly of the *Scutellæ,* for distinct reasons already stated, that may be assigned to it; our new group Cyrtoma is evidently nearly allied to these, and must assist in rendering the circle of affinities in this place more perfect. The *Scutellæ* and *Cyrtomæ,* together with such other forms as may be found to possess a distinct petaloid star on the lower, as well as the upper surface of the body, may be included under the term *Disaster.** From the nature of the interval between Asterias and Echinus, and the crowded multiplicity of forms that occupy other parts of the circle, there are here probably many new forms to discover, in addition to those we shall now describe.

Approaching the Khasya mountains from the plains, at a distance of ten miles, their outlines appeared to us flat and unpromising; and the season being the early part of October, there was no great prospect of making geological observations of much interest. Nevertheless the flat uniform plains began even at this distance to lose their sameness, and rounded knolls rising out of jeels and swamp became common. They were found to be composed of yellow clay, with occasional boulders and corroded nodules of limestone. The clayey hillocks were not met with after leaving Chattuck, but others composed of coarse sand, gravel, and boulders in alternate layers were common, partially consolidated by iron, thick flakes of which in the form of oxide were very abundant. For the last four or five miles of the way even the sand hills disappeared, and the country still continued low. Indeed we proceeded to within two miles of the foot of the mountains in large boats, drawing two feet of water. From thence we passed over a low, richly wooded tract, composed of boulders and sand. On reaching the foot of the mountains the acclivity seemed to rise gradually about one foot in three or four on a slightly tortuous road. The first part of this ascent is composed of boulders, sand, and clay, with here and there masses of nummulite limestone standing erect as if forced upwards, many of them assuming the appearance of architectural ruins, to which the large creepers, air plants, and mosses which the moisture of the climate render abundant, give a very beautiful effect.

* Etym. Δις twice or double, and αςτηρ the star-fish.

Having gained about half the ascent, we found ourselves on a narrow ridge which leads to a more precipitous part of the road. It was here I found the first appearance of tertiary fossils, and from a memorandum recently received from Major Lister, I should suppose the altitude of the place to be at least about 2,000 feet high. In a few hours I succeeded in raising as many specimens of marine shells as I could convey. It was fortunate that I did so at once, as I have never been able to revisit the spot. During the few days we remained at Cherra Ponji, I made an excursion to an opposite part of the declivity of the mountains, distant probably ten or fifteen miles from the place at which I found the fossils, and here at about the same elevation I came again upon the organic belt, from which circumstance, as well as the nature and character of the organic remains, the presence of a raised beach could no longer be questioned, although several hundred miles from the sea, as well as several thousand feet above it. As the Assam deputation had to proceed on its journey the following morning after this further discovery was made, I can give little information more than an accurate description of the fossils obtained, and a few general remarks on the circumstances under which they are found.* In the first situation the remains were such as are usually found in sheltered sea coasts, subject to the ebbing and flowing of tides. In the second situation, which lies at least 12 miles to the north-west of the first, and consequently so much further from the sea, the animals most abundant are Echinida, which in a living state are chiefly found on the exposed open rocky coasts of islands and promontories, and never in estuaries or sheltered situa-

* Very copious geological notes were kept during this part of the journey to Assam, which I may have occasion to refer to in future papers on the Cherra fossils, should no opportunity offer for collecting better information on this interesting subject.

tions. The matrix in which the first were imbedded consisted of fine sand with layers of dark paste, like the alternate deposits that take place in estuaries. The Echinida, on the other hand, are imbedded in coarse sand, as well as in a greenish grey friable sandstone, which will probably prove to be equivalent to the green saliferous marls of the upper new Red Sandstone,* which here forms the most recent and superficial deposit next below the vegetable mould of the district. In future papers I hope to describe most of the more perfect specimens I have been able to collect during my hasty visit to Cherra Ponji, but I must regret the want of a suitable opportunity of following up this interesting discovery in a manner worthy of its importance.

GENUS---CYRTOMA,† J. M.

Disc oval and thin, arched to the apex; ambulacra petaloid, and either broad and flat, or more elevated, and placed on narrow ridges radiating from the apex to the disc. The two posterior ambulacra are closer together than the others, with an intermediate dorsal ridge leading to a dentated anus, and a depression or hollow between the latter and the disc. Inferior surface flat, mouth small and central, with five clavate ambulacra prolonged to margin.

OBS. All fossil from the Cherra Ponji beds.

NOTE.—They are nearly allied to the genus Clypeus, Klien and Agassiz (Echynoclypeas, De Blain,) which are all fossil from the jura, chalk, and tertiary deposits.

1. CYRTOMA HERSCHELIANA, J. M. t. v. figs. 1. 2. 3.

Apex either symmetrical or oblique,‡ and equal in altitude to about one-third of the shortest diameter; ambulacra converging, lanceolate, with five rows of holes in each. The anterior ambulacrum extends to the disc, the others to about half way between the apex and disc, to which last they are each prolonged by a narrow ridge.

* Vide our remarks on Mr. Murchison's Silurian System, page 21.

† Etym. from Κιρτωμα, that which is bent or convex, a hump or a tumour.

‡ This irregularity in some of the specimens has been doubtless occasioned by pressure, to which these animals were suddenly exposed in a fresh and plastic state, since the dead crust of Echinida becomes too brittle and unyielding after death to bear pressure without breaking.

I have named this species in compliment to Sir J. F. Herschel, for the interest expressed by that philosopher in the further investigation of the subject of these fossils.

2. Cyrtoma prinsepiana. J. M. t. vi. figs. 1. 2. 3.

Apex symmetrical, and equal in altitude to about half the shortest diameter of the disc. Petaloid star surrounding the apex, and the clavate star surrounding the mouth, each limb terminating in double rows of large ambulacral pores, which are continuous across a narrow rounded disc.

I name this species in compliment to James Prinsep, Esq., Secretary to the Asiatic Society of Bengal, whose departure from India in consequence of sudden and melancholy illness, is here felt as a public loss by all classes interested in the advancement of science.

3. Cyrtoma griffithiæ, J. M. t. v. figs. 4. 5. 6.

Apex symmetrical, equal in altitude to half the diameter, and surrounded by a petaloid rosette; ambulacra each composed of two rows of long transverse holes. Inferior ambulacra prominent and narrow. Disc thin and sharp. With large anambulacral plates on the lower surface.

This species is named in compliment to William Griffith, Esq., to whose subsequent visit to the Khasyah mountains I am indebted for it.

4. Cyrtoma dentata, J. M. t. vi. figs. 4. 5. 6.

Apex anterior to the middle, and equal in altitude to half the short diameter; anal ridge low and obscure; upper rosette flat; pores oblong, transverse and very close. Lower surface, concave; anal denticulations prominent.

Cyrtoma duracina, J. M. t. vi. figs. 7. 8. 9.

Apex anterior to the middle, and equal in altitude to half the long diameter; below flat; ambulacra and anambulacra raised on the edges and rough. Inferior rosette consists of sharp ridges without pores.

5. Cyrtoma depressa, J. M. t. v. figs. 7. 8. 9.

Disc nearly round, apex anterior to the middle, and scarcely equal in altitude to a third of the diameter; anal ridge prominent; three anterior ambulacra broad lanceolate, with two rows of transverse holes. Lower surface merely marked by five prominent ambulacral ridges without pores.

6. Cyrtoma astrobola, J. M. t. v. figs. 10, 11, 12.
About one-sixth part of an inch in diameter; disc oval; mouth and anus large, but the ambulacra are not developed,

I should describe this last as a new genus, if I had the least doubt as to its being the young of some one of the foregoing species. Its oval disc, the situation of the mouth and anus, together with the circumstance of its occurring with the other forms, leave no room to question the fact of its being a young individual of this group. It may indeed be the young of some one of the foregoing species that had but escaped from its ovum a few hours, at all events a few days only before its destruction, the causes of which were connected with such mighty physical changes. At all events, the circumstance is one of deep interest, for we might have expected that a succession of deposits would have buried it much deeper in the earth than the superficial bed in which its remains have been discovered. There are however a great many elements to be taken into account before we can come to conclusions in subjects of this nature; and where the materials are so abundant it would be a national reproach to leave them unexplored, when their investigation might prove of so much importance in casting further light on the history of the earth. One new fact is however established in zoology by the fossil embryo in question, namely, that the mouth and intestinal aperture of young Echinida are developed before the ambulacra appear; and it is curious enough that while recent species are so abundant, we should first acquire a knowledge of this circumstance from one that has been so long extinct.

Notes illustrative of the Geology of Southern India.—By Lieutenant R. Baird Smith, *Bengal Engineers.*

The universal prevalence of primary rocks, with the general quiescence of the agents of active reproduction tend to give a degree of monotony to the geology of Southern India, and to deprive it of that interest which naturally attaches to activity and variety. The features of its hills and its vallies alike exhibit indications of the long continued reign of the decomposing and abreading powers of the natural world. The fantastic turret-like peaks, the results of the unequal disentegration of the granitic masses of which they are composed, so frequently crowning the summits of the one, are the trophies of ages of resistance on their part to atmospheric encroachments, while the boulder-like masses and crumbling deposits met with in the other, tell the same tale of long resisted but yet resistless power. But amid these signs of decay we see nothing of those active reproductive agencies which so abundantly characterise more diversified regions. No great rivers are seen bearing on their waters the fragments of one continent to re-create or increase another; no inland lakes or seas are gradually passing away from the face of the earth, year by year perceptibly approaching the time when fruitful fields will replace their " waste of waters," and when their solitude and silence will yield to the glad voices of the labourers rejoicing in the luxuriance of these new born lands.

Equally quiescent are all ignious agents, for no volcanoes are here in active operation, and the existence of subterranean forces is only occasionally indicated by slight tremblings of the earth within very limited districts. Yet even with this monotony the geology of Southern India is not devoid of interest, since its very peculiarity in having been so long free from any powerful disturbing agents, either aqueous or igneous, has admitted of the full display of those phenomena which result from the unchecked sway of the decomposing influence of atmospheric agents. These are neither trivial nor uninteresting, since to this source there seems now but little doubt that the formation of the laterite, so long an apple of discord among the observers of Southern India, is to be traced. A mass of observations gleaned from many well developed lateritic localities both on the coast and inland have recently been made public in an interesting paper on this formation by Dr. Clark, H. M. 13th Dragoons; and by the careful examination and discussion of these, the question of its origin seems to me to be satisfactorily answered. Before this paper came to my knowledge, a conviction that the laterite was the result of the aggregation of the decomposed constituents of the rocks which it usually overlies, was forced on my mind by observations in several of those identical localities whence I find Dr. Clark has gathered a considerable portion of his information; and it was with pleasure that I found a conclusion based on limited data, supported by an examination so extensive and so ably conducted as that of Dr. Clark. In the vicinity of Bangalore where both the lateritic and lithomargic formations are largely developed, an opportunity was afforded me of studying them in detail. Many of the protruding masses of sienitic granite and gneiss which are the prevailing rocks, exhibit nature as it were in the simultaneous acts of decomposition and aggregation. Their surfaces are usually covered with a coating of dark coloured and weathered matter resulting from the felspar or hornblende, studded with small undecomposed and ferruginous pebbles of quartz, while round their bases the laterite forms a regular talus of variable size. It is usually of the compact quartzose and distinctly marked variety: sometimes however it assumes the cavernous or vesicular structure, the dark red matrix exhibiting a series of small cavities. One example was of peculiar interest, for in consequence of the existence of a basin-shaped hollow in the side of the rock, the materials necessary for the formation of the laterite had collected there and a small nest of it formed. The circumstances of the case excluded from consideration both the aqueous and igneous causes, whose aid has usually been called in to explain the origin of laterite, and the clear evidence of its being due to the slow but certain operation of atmospheric agents amounted to demonstration. The bewildering effect of a multiplicity of contending opinions gives to such simple yet well marked observations on the point at issue, additional value and interest.

As the resultants of decomposition, it is natural to expect that the character and composition of both laterite and lithomarge will be very variable, since the constitution of the parent rocks will necessarily influence that of the derivatives. Hence it has been found by observation that those rocks in which the proportion of quartz to felspar and hornblende is considerable, decompose into laterite, while those in which quartz is less abundant usually exhibit the lithomargic character. The same specimen sometimes presents both of these formations, the one passing imperceptibly into the other and clearly establishing the position that they are effects of the same cause modified by concomitant circumstances. These circumstances are externally the variations of heat and moisture, and internally the greater or less degree in which the constituents of the rocks predispose them to be affected by the oxidising influence of the atmosphere. Throughout nearly the whole of Southern India sienite prevails, and with it laterite is very generally associated. But sienite contains hornblende as one of its principal ingredients, and the large quantity of oxide of iron this contains peculiarly disposes it to yield to atmospheric action. Hence then follows the disentegration of the mass; the felspar furnishes the alumina necessary for the matrix, and the quartz resisting decomposition, and becoming ferruginous from the infiltration of the iron, forms the imbedded pebbles, and thus a laterite results. Dr. Clark from his own observations has subdivided the laterite into three classes, the lithomargic, the quartzose, and the detrital. The first is distinguished by the large quantity of lithomargic earth present in it, which deprives it almost wholly of tenacity, and gives it a cavernous appearance; the second, by containing numerous rounded pebbles bound together by a clayey cement, occasionally also cavernous; the third, by being merely a congeries of pebbles not firmly aggregated, but yet exhibiting the features of laterite. My own observations induce me to believe that this classification will include nearly the whole of the varieties of this very variable formation, as I have never met with any prominently beyond its range. To Dr. Clark's most interesting paper* I would refer those who may wish to see the grounds on which the present theory of the formation of laterite rests, fully illustrated; my sole intention in alluding to it having been to confirm the accuracy of his observations on those localities which we had similar opportunities of examining, and to contribute my limited store of facts for the elucidation of a point which has so long engaged the attention of geologists.

The depth to which the decomposing influence of the atmosphere will reach even through the solid rock is well exhibited when sections are exposed in excavations, an opportunity was afforded me for observing during the sinking of a shaft for a mine in the vicinity of Bangalore. The lithomargic earth commenced at eighteen inches or two feet from the surface, and as the excavation proceeded the sides of the shaft exhibited it beautifully variegated in colour. At about 15 feet it began to get slightly more tenacious, and the felspar appeared as white earth. Gradually to the depth of 20 feet, the rock approached nearer and nearer to its natural undecomposed state, though even at that depth it was still crumbling. When the excavation ceased at about

* Madras Journal of Science, December, 1838.

22 feet, the rock seemed to be pegmatic, as nothing but quartz and felspar were distinguishable, and judging from its appearance the atmospheric action had probably reached a farther depth of 8 or 10 feet, making in all from 30 to 35 feet of solid rock penetrated by this destroying power. It may be mentioned as an interesting fact, that the contents of the excavations in this vicinity were frequently auriferous, and small quantities of gold were obtained by washing. This is by no means an unfrequent occurrence in the Mysore country. In blasting sienite at Chinapatam, a village about 40 miles from Bangalore on the road to Seringapatam, I occasionally observed considerable quantities of gold disseminated in small particles over the fractured surfaces, and at one time in the vicinity of Wynaad this metal was obtained from a rich yellow earth in quantity sufficient to employ a number of labourers, and to yield some return.

Travelling eastward from Bangalore towards Oossoor the country presents but little either of natural beauty or scientific interest. The beds of the nullahs occasionally exhibit a variety of laterite, whose formation seems to have been materially due to the transporting agency of water. The prevailing rock being the sienitic granite, its decomposition has supplied a large quantity of quartzy pebbles which are strewed over the fields in every direction. A rush of water after heavy rains transports these to the adjoining nullahs, whose clayey bottoms form a matrix in which they become imbedded, and during the dry season the whole hardens into a compact mass, exhibiting the characteristics of one of the varieties of the laterite. Detached and water-worn fragments of the other varieties were occasionally met with, but no extensive deposits were observed in situ.

The hills in the vicinity of Oossoor were found to be composed of the universal sienite, exhibiting occasionally with the addition of mica the striated appearance of gneiss. Large veins of pure white quartz and dykes of greenstone traversed the main rock in different directions, without however having caused any alteration at the planes of junction. In many places the sienite had completely decomposed the hornblende into a dark red impalpable earth, and the felspar into a similar white one, the quartz was in ferruginous pieces undecomposed, with highly vitreous lustre and splintery fracture.

Passing from Mysore into the Barramahal district the primary rocks still prevail. The features of the adjoining country are now however altered, and the comparatively flat and uninteresting plain is exchanged for mountain scenery at once bold and beautiful. Lofty and precipitous hills rising abruptly from the plain, sometimes clothed with rich verdure and covered with trees and shrubs to their summits, at other times presenting scarcely one solitary green spot to relieve their desolate and rugged nakedness, bound the view on every side, and the traveller following the road which winds along their bases passes through a series of valleys where kaleidescope-like, each turning brings new beauties before him. On approaching, Kisuagherry, the principal town in this district, the distant hills occasionally exhibit the ribbed-like appearance characteristic of columnar basalt. The town itself is overhung by one of these, but an examination of it, effected with considerable difficulty and risk, proved that the ribbed appearance was due, not to the existence of columns but to linear deposits of earthy and fungoid matter, the dark colour of which, alternating with the natural colour of the rock, produced when viewed from a distance exactly the effect of a columnar arrangement. These deposits were formed along the lines by which little streamlets of water trickled down from the summit of the hill, these having doubtless led to the partial decomposition of the rock, and the formation of soil sufficient for the fungi to vegetate in. Nests of hornblende and greenstone were abundantly met with, and the whole of the sienitic mass was traversed by veins of pure quartz. The cause of the constant occurrence in

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primary formations of these segregations of simple minerals in the rocks of which they form constituent parts, is a most interesting, but as yet unsolved question, and one attended with peculiar difficulties when experimentally investigated, from the circumstance that the phenomena in question require periods of such extent for their development, as to make it impossible to institute in the laboratory any experiments which would be strictly, and in all points analogous to what obtains in nature. In their original state of igneous fluidity, the operation of the attractive affinities of the molecules of which the different minerals forming granitic rocks are composed would be free and uninterrupted, as has been satisfactorily shewn by the "pyrochemical" experiments of Maesterlich, and others, who have succeeded in obtaining crystals of the minerals alluded to, from the igneous fusion of their constituents. But, the obtaining of these in their crystalline state, only as detached and individual substances, leaves us still in doubt as to the causes of some of them occurring massive and disseminated. Thus among the others, a curious and most interesting fact stated by Mr. Babbage in his "Economy of Machinery," appears to warrant the conclusion, that such segregations take place when the substances are in a state of aqueous fluidity; for he remarks, "Flints after being burned and ground are suspended in water in order to mix them intimately with clay, which is also suspended in the same fluid for the formation of porcelain. The water is then in part evaporated by heat, and the plastic compound out of which our most beautiful porcelain is made remains. It is a curious fact, and one which requires farther examination than it has received, that if this mixture be suffered to remain long at rest, before it is worked up, it becomes useless: for it is then found, that the silex, which at first was uniformly mixed, becomes aggregated together in small lumps. "This parallel," he adds, "to the formation of flint in the chalk strata deserves attention."* Could an analogous observation to this, on the aggregation of the constituents of minerals in a state of igneous fluidity be obtained, a most important light would be thrown on their occurrence in detached and massive portions in rocks of igneous origin. In the present, as in many other instances, geology must claim this boon from the sister science of chemistry.

At Mallepandy, a village about ten or twelve miles from Kisnagherry, a beautiful specimen of epidote, of the usual dark green colour, was found imbedded in a mass of true granite, which was here observed, though not to any considerable extent. The sienite was found to be peculiarly large grained, and the crystals both of the hornblende and felspar distinctly defined; on one fragment of the rock, which had been precipitated from the higher ground, a large quantity of iron pyrites in cubical crystals was observed. The country between this village and Wanianabaddy presents the same general features, veins of porphyry outcrop at about a mile from the latter place, exhibiting occasionally small nests of chlorite. The road in many places passes over the underlying granite, which is more abundant here than usual, and the large quantity of mica scattered over its surface causes it to glitter in the light of the sun like burnished silver. Many water-worn fragments of different rocks, greenstone, basalt, compact and vescicular, reddish coloured sienite, so small grained as readily to be mistaken for sandstone, are found strewed over the sandy plain surrounding Wanianabaddy. They are brought most probably from the distant hills by the Palar river, which during the monsoon

* Note. Will carbonate of lime treated as above with alumina segregate similarly to silex? If it does, then may not the occurrence of layers of nodular kunkar in clay be explained on the same principle as the occurrence of like layers of flint in chalk? The question admits of an experimental reply, and an effort to obtain this is now in progress. R. B. S.

comes down with great violence, and often devastates the adjoining country.

The aspect of the valley between Wanianabaddy and Amboor is monotonous and uninteresting. At the latter place I was much interested by the marked development of the phenomena of crystallisation in the structure of the trap dykes, which traverse the neighbouring hills in great abundance. It is unnecessary however to describe these in detail here, as I have elsewhere done so at considerable length.* It may therefore suffice to remark, that the trap invariably on being fractured exhibited cleavage planes, and separated into obtuse angled rhomboids; that fissures traversed the dykes always at right angles to the cooling planes or sides of the including sienite; that the direction of cleavage was perpendicular to that of fissures; and that the trap was evidently altered at its planes of junction with the sienite. In attempting to trace the cause of these phenomena we are carried to the unexplored domain of modern science, for their development is dependant on the action of molecular forces, whose origin and mode of operation are alike enveloped in much mystery. Mathematical analysis† has been successfully employed in demonstrating that, granting certain postulates, the phenomena of crystallisation may result from the adjustment of electrical forces; and observation tends apparently to confirm such a theory, by shewing that crystals do actually result from the action of forces derived from this source. But, we are still required to apply these conclusions with diffidence, as their verification cannot yet be considered as effected. The existence of electricity during the passage of trap dykes from their ori-

* "On the crystalline structure of the trap dykes in the sienite of Amboor, &c. &c." Madras Journal of Science, July, 1839.

† M. Mosotti sur les Forces qui regissent la constitution interieures des corps Whewell's Hist. of *Induc. Science*. *Sommeville Conn. of Phys. Science.*

ginal state of igneous fluidity to that in which they now exist, may safely be concluded, from the experimental truth, that variation of temperature is one of the most fruitful sources of this agent; and should it ever be satisfactorily shewn that a subjection to electric agency confers on the particles of matter that peculiar polarity, which disposes them to group themselves in determinate figures, and under determinate laws, no element will be wanting for the application of such a principle of explanation to the present case.

The plain of the Carnatic is diversified by the occasional occurrence of connected, as well as detached hills. A peculiar feature is to be remarked in several of those in the immediate vicinity of Vellore. Individual hills are observed to rise abruptly from the plain, like islands in the midst of an ocean of sand, of the most perfectly conical shape, and wanting only the crater, with its accompanying cloud of smoke, to complete their resemblance to existing volcanos. These hills are usually at some distance from the connected ranges, and as an explanation of the peculiarity, it might be conceived that the upraising force had in the one case acted on a line to produce the range, while to produce these insulated and conical hills it had been concentrated in a focus or point.

At Palleconda, a small town about 14 miles south-west of Vellore, I crossed a tract of country which has been described by Dr. Benza, an observer who has added considerably to our knowledge of the geology of Southern India. The plain on which the town stands is sandy, and strewed over it there are many weathered masses of sienite, which natural sections afforded by the deep nullah beds prove to be the underlying rock of the whole. Traversing this there are as usual dykes of trap and porphyry. The latter is of a peculiar kind, the porphyritic crystals being of felspar imbedded in a matrix of quartz.

Investing a portion of this quartz-porphyry, were found crystals of an ore which I am inclined to believe was specular iron ore. Its characteristics were highly metallic, inclining to adamantine; colour dark grey, nearly black; hardness between 7 and 8; fracture splintery; structure laminated; specific gravity not numerically determined, but high; crystalline form a flat rhomboid. In the adjoining hills felspar of the sienite was occasionally of a pink colour, and dendritic on the surface. Transported masses of greenstone, basalt, mica, and clay slate were found in the vicinity of the streams, though none of these rocks were observed in situ.

The country between Palleconda and Vellore, while it exhibits no variety in geological structure, is interesting from the singularly wild and beautiful character of its mountain scenery. On the summits of the hills the tor-like masses of the sienite are grouped in the most varied forms, sometimes shooting up like spires, at other times strewed around like the ruins of some extensive edifice, or again standing square and solid, like the massive walls and donjon keep of some robber chieftain's tower. The valleys are covered with similar blocks piled on each other in the wildest confusion, the whole seeming to tell of mighty convulsions, rather than of the slow and scarcely perceptible operations of the agents of disintegration and decay.

A monotonous and uninteresting plain, with but little to attract the attention of the geologist, extends from Vellore to Madras. The same sienite which forms the distant hills underlies the whole of this plain, outcropping at several points. It was met with immediately under the sand during the progress of an artesian well sunk in the immediate vicinity of Madras, which after passing some little distance through the rock was abandoned; and indeed it is singular that considering the geological configuration of the district it was ever undertaken at all, since it is scarcely possible to conceive one less calculated for the success of such an attempt. The immediate succession of a close grained, hard, compact, primary rock of unknown thickness to a bed of porous sand, would effectually prevent the percolation of water to any depth exceeding that of the sand itself, and consequently the formation of those interior reservoirs on which the economical value of artesian wells depends. There are no porous strata beneath the sienite, nor is the sienite itself a cavernous rock like certain limestones in which water may collect in large basin-shaped hollows; hence the attempt must have been made with but little consideration of the principles by which such operations ought to be guided, and hence also an additional motive for the encouragement of the study of a science which promises to obviate such unnecessary expenditure of materials, money, and time.

CALCUTTA, *9th April*, 1840.

Remarks on the characters and habits of Ursus labiatus, with a figure, Plate VII.—*By Lieut.* S. R. TICKELL, 31*st Regiment, Bengal Native Infantry, Junior Assistant to the Agent of the Governor General on the South-west Frontier.*

ORDER III. CARNASSIER.

FAMILY, CARNIVORA. *Tribe*, PLANTIGRADES.

Genus, URSUS. *Species*, LABIATUS.

Ursus labiatus, Cuvier, Blainville — U. longirostris, of Teidm.—Bradypus Ursinus, Shaw—genus Prochilus of Illiger—the Long-lipped Bear, L'Ours—Bhaloo of Hindoostan and Oorissa—Baloo and Banna of the Koles—Beer Mendee of the Orangs—Anonymous animal of Pennant and old writers—(the Reench of upper India I imagine to be the Black Bear of the Hills, another species.)—PLATE VII.

Teeth $\left.\begin{matrix}3.1.6\\3.1.7\end{matrix}\right\}$ of a side.

The Bhaloo is one of the commonest animals of the Jungle Mehals, Singbhoom, Chutia Nagpore, and all the central parts of India; and affords a constant source of amusement to the sportsman, who follows them among their rocks and fastnesses. In Singbhoom they are exceedingly numerous, and equally so at Sumbhulpore, the species in question being, I believe, met with throughout the Madras and Bombay Presidencies.

A large male or dog bear is a powerful, and at times dangerous animal. He measures up to 5½ feet from the snout to the rump, and stands about 3 feet from the ground to the centre of the back. The weight I never ascertained, but it is a sufficient load for four men. The limbs are huge and bulky, and the size of the head and neck, encased in massive muscles and clothed in long shaggy hair, adds to the animal's formidable appearance. The large prolonged muzzle is covered with short grizzly brown hair, which reaches to within an inch of the eyes, a crescent of the same colour, varying in different species from a dullish white to a dirty cream colour, extends across the sternum, or collar bone, to the outer edge of the fore arm. The rest of the fur is a deep shining black. The hair on the forehead is smooth and parted, lengthening as it reaches back till it hides the ears, and falls shaggily on each side the cheeks, a short beard also hangs from the chin. The fur of the body is about six inches long, and on the centre of the back still longer, forming there a thick, compact hunch; on the fore part of the legs and feet it is shorter and sleeker, and the belly is thinly clad. The tail is about seven or eight inches long, lies close to the buttocks, and is seldom or ever erected. The genital parts are shaped much as in a dog, but the animal voids its urine backwards. The nostrils are flat and wide, flabby, moveable, and constantly wet. The lips, but especially the under one, are thick and fleshy, and capable of great extension, the bear contorting them in grimaces, similar to those of many species of baboon, when affected by surprize or anger. They have five toes to each foot. The fore claws are long (about three or four inches) and exceedingly powerful; the hind ones are much shorter. In all four feet the points of the claws tend towards a centre. The mammæ are six, two pectoral and four ventral. The fore leg or arm of the bear bows much outward, so that the animal appears to tread on the outer rim of the sole of the paw. The hinder legs are much smaller and shorter, presenting a caricatured likeness to those of a very squat and corpulent man. This gives it a heavy slow gait. In running it moves in a rough canter, shaking up and down; but it is surprizing with what speed it gets over bad ground, regardless of tumbles down the roughest places. The teeth of the bear are numbered at the heading. The incisors are small, with flat crowns; the canines are large and powerful, but not trenchant behind, as in the feline species; behind them follow in the upper jaw three very small insulated false molars with flat crowns, and behind these on each side three large compact molars, of which the first has a slanting surface, presenting a trenchant edge, triangular with three tubercles; the second molar is flat and square, with four tubercles in the crown; and the last molar long and oval, with five tubercles and an obscure ridge along the centre. The lower jaw has six small flattened incisors, a large hooked canine on either side, followed by three very small flattened and insulated false molars, a triangular trenchant molar, and three flat oblong ones obscurely indented. The marks on the bear's jaw teeth very soon wear out by age.

The skull of the bear is almost as large as that of a full sized tiger. The occiput is much developed, containing a large brain. The nasal orifices are very full. The zygomatic arch large, giving room for most powerful muscles, and the ascending ramus of the lower jaw is likewise adapted for vast strength in the development of the masseter and pterygoid muscles.

The ears of the bear are rounded, and of proportional size. The sense of hearing is good. The scent is its keenest sense; and the eyesight, judging by the smallness of the member, and the animal's general action, must be defective, or at least very short. The eye is small and round, and when the animal is excited, appears almost starting from the socket.

The power of suction in the bear, as well of propelling wind from its mouth, is very great. It is by this means it is enabled to procure its common food of white ants and larvæ with ease. On arriving at an ant-hill the bear scrapes away with his fore feet till he reaches the large combs at the bottom of the galleries. He then with violent puffs dissipates the dust and crumbled particles of the nest, and sucks out the inhabitants of the comb by such forcible inhalations as to be heard at two hundred yards distance, or more. Larvæ, especially the large ones of the *Atembeus Sacer*, are in this way sucked out from great depths under the soil. Where bears abound, their vicinity may be readily known by numbers of these uprooted ants' nests and excavations, in which the marks of their claws are plainly visible.

The bear likewise eats fruits of various kinds, coming out at night in great numbers under such trees as have begun to drop their ripened produce—the bur, peepul, jamoon, bél, and mowhooa; but mangoes they do not appear to relish. When thus congregated they now and then attack each other, and their roarings disturb the neighbouring villagers. They likewise rob birds' nests and devour the eggs. Those that I have reared from cubs eat flesh, whether cooked or raw, fowls, birds, feathers, legs and all; also reptiles and insects; their chief food was rice and sour milk, but vegetables or fruit of all kinds they eschewed. This was of course only the effect of education.

In concluding these remarks on the conformation of the bear, it may be observed that the Bhaloo of India has not the property of extending the tongue mentioned by naturalists in describing the Malay or Thibet bear, which in other points it closely resembles.

The sucking of the paw, accompanied by a drumming noise when at rest, and chiefly after meals, is peculiar to all the Ursus family, and has been often described and speculated on. The idea that the bear does it to suck fat out of its paw has been, I believe, exploded; I should imagine it merely to be a habit peculiar to the whole race. Some bears, the property of Dr. Egerton of Calcutta, which I saw many years ago, used to be as fond of sucking and humming away at the hand of any person, as at their own paws.

The voice of the bear is loud and deep; when irritated he sends out abrupt startling roars, putting to flight sometimes the best shikarree elephants, who are not moved at the hollow, guttural sounds of a roused tiger; when wounded it whines and groans in a most lamentable manner, and the voice has then a strong human expression. It is only during rage or pain, that bears are ever heard. They have no calls to each other, as other animals have, who wander alone through forests at night time; but during the heat of the day, far down in the fissures of rocks, they may be plainly heard puffing and humming while sucking their paws. The cub is at all times most vociferous, and the cries when the little animal is distressed by pain or hunger closely resemble those of a peevish wayward child. The female, or bitch bear, scarcely differs from the male except in having a duller and rougher coat. The period of pairing and gestation is very uncertain; it commences about the end of the rains and ceases about April. I have killed she bears with cubs still blind in November, and again while yet pairing with the male late in March. About December or January is the common period, I imagine, for bringing forth. They go with young about seven months, and generally produce two at a birth. The young are blind for three weeks, and covered with very short, soft hair, which after two months begins to assume a rough, crisped appearance. When born they are about the size of Newfoundland pups, and take upwards of two years in reaching maturity. While young the bear is a fractious but amusing animal, full of antics, and droll awkward gestures. The male is easily reared, the female is much tenderer. They are capable in general of being thoroughly tamed, will take to any kind of food, and are delighted by any one wrestling and romping with them; though when nearly full grown, they are rough playmates. When the cubs have acquired some strength the mother takes them forth on her back, and in time weans them by teaching them to scratch up and devour white ants. They ride about on her in this way until of a tolerable size, especially if pursued or in danger, and stick so close into the long fur of the female's back, as to be with difficulty discovered until close. The old one on these occasions is sometimes very fierce, rushing out on the unwary passenger and cruelly wounding him. Many instances of death occur in this manner, where these animals are numerous, among those people whose occupation is to cut firewood in the jungles. In the hot season and during the rains the Bhaloos resort to high rocky spots, lying during the day deep down in inaccessible caves, with which the clusters of granitic rocks in Singbhoom and the Jungle Mehals are every way permeated, and coming forth in the shades of evening, to pass the night wandering through the open country. During the cold weather they avoid the chilly glooms of these caverns, and keep out in the plains of brushwood, in the thickets on the banks of nullahs, or along the ravines which fall into them. Very deep jungles of tall forest trees and heavy grass, or large hills, they do not appear to frequent so commonly, probably from fear of the tigers, who will destroy and devour them. The Koles have assured me that they have met with the half eaten carcases of very large bears in places haunted by tigers. This latter animal drops from an overhanging ledge of rock on the bear's back as it passes below, and quickly overpowers all resistance by seizing it at the nape of the neck, tightening its bite till respiration ceases, at the same time encircling the bear's arms within his paws, so as effectually to prevent its using its claws to scratch him off.

These animals afford, as I have said, good sport if properly pursued. Elephants are more in the way than of use, becoming unmanageable if charged by a bear, and not being able to traverse with sufficient speed the rocky places where they are found. The most certain method in the hot season is to lay wait for them on foot, before daybreak, at the bottom of the low rocky hills they infest, so as to intercept them while returning from their night's rambles; in this manner four or five at a time may be seen leisurely coming over the plain. When they perceive the ambuscade they gallop about to various points, endeavouring to gain the hill, but are repulsed by the line of beaters drawn round the foot; at length as the day gets heightened, they make a headlong charge through, and if not shot or disabled in the attempt, gain the rocks where they speedily go to earth, and cannot again in most cases be dislodged. In the cold season when they lay out in the scrub, or "johar jungle," the shooters lay in ambush in convenient spots, and a line of beaters enclosing about a quarter of a mile of ground drive the bear forward.

It is very rare that the Bhaloos show much fight on these occasions. They appear bewildered by the shouting and drumming of the beaters, and only bent on urging on their headlong course. At times however some of these animals afford a strong contest, charging all that stand before them, and inflicting cruel wounds. Few who have frequently pursued this sport, but have stories of narrow escapes to relate; the length of the fur deceives the aim of the sportsman, and body blows, except immediately behind the shoulder, appear to have no effect; the head is the most vulnerable part, and a single ball striking between the eyes at the root of the muzzle is of more effect than volleys poured into the carcase.

Another successful way of shooting them is to sit up during the night time in the trees, the fruit of which they come to devour. It requires however much patience, caution, and silence. The sportsman should mount very shortly after sunset and secure a good position, the lower down the better consistent with being well concealed. As the gloom of night deepens, the puffing of the bears slowly approaching may be heard, and they shortly after emerge cautiously and gradually from the dark shades of the jungle. If three or four are collected under the tree and one be shot, the rest will not immediately take to flight, but run to and fro with loud roars, attempting, if they have seen the shooter, to charge or climb up the tree. This, unless it be an exceedingly accessible one, they take an infinite time to do, and afford an unerring aim at the head. Two or three more reports of the fowling piece drive them off altogether, nor will they return to that tree again for several nights. The bear is a bad climber of trees, and cannot ascend them at all unless very rough and gnarled, when he hooks himself up with his long claws; in the midst of the branches they get on better, but descend backwards like a man, looking helpless and miserable. Trees are often much injured by their attempts at climbing, the back of the lower part of the trunk being rent in every direction by the animal's claws. The popular opinion appears to be that the bear destroys the object of its attack by hugging it to death; if this be true it refers to other species than our subject, which has never recourse to such means. The Bhaloo, if surprised or attacked closely, rears upright on his hind legs, striking out swiftly with the fore paws, the claws of which cut long deep gashes, and uttering short abrupt grunts the whole time. If he can however surprise a person, so as to approach him unseen through the underwood &c. his attack is silent and quick. The victim is laid prostrate by a blow of the paw, and cruelly bitten and shaken in the jaws of the animal, who will sometimes not relinquish the attack until life is fled; this is an event of rare occurrence, but happens at times when the bear has young ones, as has been before mentioned.

The Silurian System. *By* R. I. Murchison, Esq., F.R.S., F.L.S.[1]

The coal measures at Shrewsbury are described by Mr. Murchison as fringing in the form of a broken, narrow, devious zone; the promontories of Silurian and Cambrian systems extending from the Breidden hills on the west, to the Wrekin on the east, the base line, or lower edge of which is determined by the headlands and bays of the ancient rocks. Sometimes the carboniferous strata are so completely isolated by these protruding inferior masses, that they consist rather of a number of patches than a continuous band. By this disposition the coal measures repose unconformably and successively upon rocks of various ages, from the flanks of which they dip in an opposite direction, and where not obscured by overlying drifted materials, they are seen to graduate upwards into the lower new red sandstone, passing at slight angles of inclination beneath that formation. The principal outcrop of the coal is in a semicircular bay, of which Shrewsbury and Coedway are the eastern and western extremities. Where most developed, this formation contains three seams of coal, which in descending order consist of *half yard*, *yard*, and *two feet* coals; the quality, thickness, and number of these beds vary in different places, but it may be stated as a general rule, that the lowest, or two feet coal, is the best. "The most remarkable feature of this coal field, and one quite new to geologists when I announced the discovery, is a band of limestone, varying in thickness from three to eight feet, which lies between the seams of coal." The bed occasionally branches into two, an upper and a lower;

[1] Continued from p. 50.

the upper, cream-coloured, with a splintery conchoidal fracture and dull lustre; the lower, though essentially the same, is cellular, the cavities filled with crystallized carbonate of lime and black bitumen, and veins of calc spar and sulphuret of iron are also disseminated through it. "On first examination," says Mr. Murchison, "I was struck with the strong resemblance of this rock to certain lacustrine limestones of France and Germany, which by their imbedded organic remains are known to have been formed under fresh water; and when I further discovered, in 1832, that nearly all the fossil remains contained in it were of terrestrial and fluviatile origin, I named it fresh water limestone. The characteristic fossil of this limestone is a very minute discoid univalve, resembling on first inspection *Planorbis nautilus,* Flem., and with this is associated a small bivalve, having the form of a *Cyclas,* and also a small *Cypris.* In addition to the above named fossils, the remains of fishes have been discovered, the most remarkable of which is a new species, *Ctenodus Murchisonii,* Ag. and *Megalichthys Hibberti.*" We shall presently see how these organic remains enabled Mr. Murchison to identify another bed of limestone, in a very different part of the country, as belonging to the same age, and formed under the same circumstances with the one just described. Among the plants of the Shrewsbury coal measures, the most curious is one nearly allied to the grasses, named *Cyperites bicarinata,* and which is also found in the culm-bearing strata of Devonshire; a plant intermediate between *Lepidophyllum lanceolatam* and *L. Najus* of the Newcastle coal field, and hence called *L. intermedium,* it is supposed to be allied to the coniferous genus *Podacarpus;* also *Lepidastrobus variabilis,* Lind. and Hut. supposed to be the organ of fructification of a *Lepidodendron,* it is also found in Newcastle-on-Tyne coal beds; a *Lycopodites,* the same as in Bohemian coal fields; *Neuropteris cordata,* Brong. also found in Devonshire culm-bearing strata, St. Etienne, and Alais in France; *Nuropteris gigantea,* common to the culm-bearing strata of Devonshire, and to all the European coal fields; *Odontopteris obtusa,* found also in Terrasson in France; *Pecopteris abbreviata,* also found near Bath in England and Valenciennes in France, and two other species of the same, *P. lonchitica,* Lind. Hutt. and *P. blechnoides,* Brong. common to all the European coal fields. Upwards of three years after Mr. Murchison had communicated his views regarding the fresh water limestone of the Shrewsbury beds to the Geological Society, certain carboniferous rocks were described by Mr. W. C. Williamson, with notices of numerous fossils which had been collected. From the silence of Mr. Williamson regarding Mr. Murchison's observations in Shropshire, it would appear he had been unacquainted with them, and had therefore no suspicion that the calcareous rocks he was describing bore any relation to this peculiar coal measure limestone. Professor Phillips having visited Manchester, he was furnished with a complete general section of these beds, and at once detected the little microscopic planorboid shell of the Shrewsbury rock, and following up his inquiries he found other corresponding points; and by these researches clearly proved that the limestone and red marls of the coal formation at Ardwick near Manchester were identical with the Shrewsbury beds described by Mr. Murchison.

"The upper carboniferous zone of Lancashire is thus identified by mineral characters and by organic remains with the Shrewsbury coal field, from which, however, it differs in exhibiting a much greater developement of limestone, and with this increase of calcareous matter we perceive a corresponding increase in number and variety of the remains of animal life, particularly in the *testaceous mollusca,* whose existence could not have been prolonged without an adequate supply of carbonate of lime." Similar circumstances showing the increase of fossil shells where calcareous rocks prevail, will be pointed out amidst the more ancient strata. It is further interesting to observe in these rich fossiliferous beds of Manchester, the occurrence of a fish, *Palæoniscus Freieslebeni,* characteristic of the magnesian limestone; another member of the coal formation associated with some peculiar animal remains, and with many plants and other fossils common to the ordinary coal measures;

an intermixture which affords zoological proofs that the zone in question is made up of transition strata connecting the new red and carboniferous systems. At the same time, (if the species be correctly determined) this discovery tends to modify one of the strongly defined stratigraphical characters assigned to fossil fishes by the researches of M. Agassiz; for whilst occasionally some few species in other classes of the animal kingdom are known to have lived on through various successive periods, each species of ichthyolite is supposed by that author to be peculiar to the formation in which it is found imbedded. Now in the preceding chapter it has been shown, that the formation of the lower new red sandstone, having a maximum thickness of nearly one thousand feet, is interpolated between the magnesian limestone and the coal measures, in both of which formations, thus widely separated, we now find *the same species* of fish. It has, however, been my object to show, that no violent interruption of the series of deposit of this age has occurred in Shropshire or Staffordshire; and hence we might well imagine, why under such conditions, animals of the same species should have continued to exist during a very long period. But at Manchester, the stratigraphical relations are different from those described in the central counties, the red sandstone and marles, including the equivalent of the magnesian limestone before mentioned, being unconformable to the upper coal measures and fresh water limestone: yet notwithstanding this dislocation, which interrupts the perfect sequence of deposits, there is still a complete transition in mineral type and organic contents."

Regarding the rocks of the upper coal measures in Shropshire, Mr. Murchison observes they are seldom inclined more than five inches in a yard, except where the coal dips at high angles beneath the oldest members of the new red sandstone and dolomitic conglomerate. Among the numberless faults that affect the strata, the chief one runs from north-north-east to south-south-west, and is a downcast of seventeen yards on the dip, whereby the limestone is thrown down nearly to a level with the thin coal; as the coal approaches Shrewsbury it becomes thinner and more disjointed; a patch of it forms a broken and elevated trough extending to Longden, where the coal rises to within a few yards of the surface, resting on purple greywacke grits of the Cambrian system, but is not worked. This purple greywacke advances from Lindley hills to the narrow promontory of Lyth hill, round which the coal measure is folded, and forms an irregular base; and hence the coal which occurs at one spot in consequence of the older rocks lying at certain depths, is cut out at other points by the protrusion of these ancient formations. The upper coal is the only seam which has been found near Shrewsbury, most of the old works having effected little more than the clearing away of the basset edges of the mineral as it rises on the sides of the underlying Cambrian rock. "Mr. Hughes however has made, and is still making, trials upon the dip of these beds, by which the coal has recently been won beneath the lower new red sandstone. Though the shaft sections vary considerably in different parts of this tract, the following may be taken as one of the fullest exhibitions of the measures sunk through at Wellbatch.

		Yds.	feet.	inches.
Portions of Lower New Red.	Reddish clay,	3	0	0
	Sandstone of dull brownish red colour,	3	0	0
	Red and green shale with fragments of plants,	20	0	0
	Top rock (grey sandstone,)	3	0	0
	Curdled poundstone (a mixture of sand, clay, containing plants),	5	0	0
	Kind cold (shale),	4	0	0
	Coal,	0	0	9
	Poundstone,	1	0	0
	Kind cold,	5	0	0
	Coal,	0	0	1
	Curdled poundstone,	1	0	0
	Four yard rock, a greenish white hard sandstone,	4	0	0
	Light coloured poundstone,	1	0	0
	Cold,	4	0	0
	Coal,	0	0	1
	Poundstone,	1	0	0
	Cold,	7	0	0
	Coal, the uppermost seam of the other sections,	0	1	8
	Total,	62	2	7

"In this spot the limestone is no longer worked, but it has been reached beneath the last mentioned bed of coal, which is therefore proved to be the uppermost of the three seams before mentioned. In sinking to the limestone, the shafts passed through a course of small concretions of calcareous clay iron stone, called 'Rattlers,' in which I observed nests and coatings of mineral pitch, and veins of white calcareous spar. This may represent one of the thin Manchester limestones. There being no natural denudations in this district, it is only from an occasional trial shaft, like this, that I have had any opportunity of judging of the precise structure of the beds passed through, and it is therefore probable that in the section at Pontesbury and in other parts of this coal-field, the overlying strata may contain other thin courses of impure concretionary limestone which have escaped the notice of the miners, and if so, the analogy between the Shropshire and Lancashire beds may be still more complete, even to agreement in mineral characters. This portion of the field is indeed exceedingly dislocated, it being difficult to find a spot exceeding a few yards in width, in which the strata are not full of faults. This is specially observable on the sides and slopes of Lyth hill, the promontory of purple greywacke or Cambrian rock which has been alluded to, and which, as we shall shew, is penetrated in many points by trap rocks. Between Lythwood and the brook at Wellbatch, a distance not exceeding half a mile, there are four principal upcasts upon the dip of the strata, the greatest of which is a rise of forty, the least of about eight yards. It is to be remarked, that, here the beds are inclined to the north-west, sloping away from the Lyth hill promontory, so that between the coal works at Coedway and these near Shrewsbury the coal strata dip *on three sides towards a common centre.* The coal which is worked at Uffington, three miles north-north-east of Shrewsbury, is a beautiful illustration of the manner in which this zone, following the sinuosities of the more ancient rocks, reappears at intervals upon their flanks, for there the same purple Cambrian sandstone as in the Longmynd, Lyth hill, &c. (the most ancient rock in this region and underlying the whole of the Silurian system) rises in an insulated mural form, constituting Haughmond hill. The little patch of coal measures occupying the low ground between that hill and the river Severn, contains the usual fresh water limestone of the district, associated, however, with one seam only of workable coal, as proved by the following section :---

Shaft section of the Coal-pits at Uffington.

		Yds.	feet	inches.
	Drift clay with boulders or red gravel, - -	14	0	0
Passage from Lower New Red into coal measures	Red clods, - - - - - - - - - - - - - -	5	1	0
	Poundstone, - - - - - - - - - - - -	1	0	0
	Red clods, - - - - - - - - - - - - - -	2	0	0
	Grey clods, dark colours above, light below,	2	2	0
	Poundstone, - - - - - - - - - - - -	1	0	0
	Red curly rock, - - - - - - - - - - -	1	1	6
	Grey clod, - - - - - - - - - - - - -	2	0	0
	Red rock with grey partings, - - - - - -	2	2	0
	Poundstone with some red (red marly clay,)	1	1	1
	Bassy coal (mush or impure coal,) - - -	0	0	6
	Poundstone, - - - - - - - - - - - -	1	0	0
	Coal, - - - - - - - - - - - - - - - - -	0	0	6
	Poundstone both tender and strong, - -	4	0	0
	Hard white and brown rocks (sandstone,) -	3	0	0
	Clumper beds, Rattlers (concretions), red and white cold, - - - - - - . -	5	2	0
	Mush, or impure, coal, - - - - - - - -	0	1	0
	Limestone of similar structure, and containing the same organic remains as that of Pontesbury, - - - - - - - - - - -	1	0	0
	Reds, - - - - - - - - - - - - - - - -	5	0	0
	Blue clods and roof of coals with plants, -	7	0	0
	Coal, - - - - - - - - - - - - - - -	1	0	0
	Poundstone, - - - - - - - - - - - - -	2	1	0

" Beneath this lies a whitish sandstone rock with brown stripes and other measures overlying the only bed of good coal, which is worked at a depth of thirty-five yards below the limestone.

" In the work, at Uffington an effort was lately made to find the lowest of the two coals, which in so many parts of this district occur below the limestone; but like the upper coal it proved to have thinned out and disappeared, for at a few yards beneath the coal, the trial shaft reached the purple schistose greywacke (Cambrian) inclined in nearly a vertical position. *A slight acquaintance with the mineral structure of this part of the country would at once have checked the further prosecution of a work which had reached the lowest rock, the fragments thrown up at the mouth of this shaft being identical in structure with the adjacent rock of Haughmond hill; but notwithstanding such palpable evidence, the speculator* continued *to sink* for fifty additional yards in these ancient beds, and was surprised that no change of metal was met with, *though the youngest geologist would have told him that no change could occur where strata, of infinitely older date than any connected with the carboniferous system,* were in a vertical position. To point out more clearly the folly of this and similar attempts, I annex a small general section of this little carboniferous patch, showing its relations to the ancient and barren rocks on which it rests. The coal strata here dip north-north-west at a slight angle, and, as appears in the diagram, they are subject to many faults, the chief of which run from north-north-east to south-south-west. From Uffington we must travel some miles to the east or south before we reach any other patch of coal, the intervening tracts being occupied either by old Cambrian rocks rising to the surface, or covered by the lower members of the new red sandstone and great accumulations of gravel. It is probable, however, that on many points the coal has never been deposited, since we occasionally see the lower new red sandstone reposing directly upon the older rocks.

"One small deposit is found at Dryton, on the south-western slope of the Wrekin; and in the more superficial parts of it, near Longwood, coal was long ago extracted; but it has more recently been followed to a greater depth at the former place, where two seams are now in work; the shaft is thirty yards deep, eighteen of which are sunk through overlying detritus of red sand and pebbles, &c. The uppermost of the beds of coal is two feet, the lowest three quarters of a yard thick, separated by clods and sandstone, and there are no traces of the limestone or of the third bed of coal. The dip is three inches in a yard to the south-east.

"On the south bank of the Severn, the bay formed in the older rocks between the ridge of the Caradoc on the east, and Lyth hill on the west, abounds with carboniferous patches, which vary in the amount of their productiveness, precisely in the ratio of the depth at which the underlying rock is found. For example, at Cound, Pitchford, and other places, where these old rocks (upper Cambrian) occasionally protrude to the surface, the adjacent carboniferous strata are mere shreds, sometimes covered by the newer red sandstone, but towards the centre of the trough the coal strata thicken, and at Le Botwood, near Longnor, we again meet with nearly the same development as in the Pontesbury field. These beds dip east-north-east 10°, or away from the contiguous promontories of older rocks. The shaft at Le Botwood is sixty-three yards deep, passing through shales, limestone, and coal. The shale or roof of the coal is particularly rich in the plants, and those which I collected were identified by Professor Lindley, and form part of the list previously given.

"The limestone at Le Batwood is extensively burnt for lime, and is identical with that of Pontesbury and Uffington, containing also the Microconchus carbonarius. It is about two yards thick, and lies from eighteen to twenty yards below the surface. A three feet bed of coal, found at eleven yards below the limestone, is of a sulphureous quality; and six yards still lower is a seam, twelve inches thick, of good coal. In the limestone, besides the usual shells, the remarkable species of fish *Ctenodus Murchisonii* (Agassiz) was found by the very Rev. Archdeacon Waties Corbet; and Professor Phillips detected, in the shale, remains of the *Megalichthys Hebberti, &c.*, on the western edges of this bay. Amid the older rocks, coal has been worked near Pulverbatch, Wetrains, &c.; and on the eastern side it has been detected, and was partially worked in former days, running up in small transverse valleys towards the Caradoc and Acton Burnel hills. One of the most curious of these thin patches is displayed on the west bank of the brook at Bitchford. The whole carboniferous series is there represented by a bituminous breccia, from ten to twelve feet thick; which is partially covered by the new red sandstone, and rests upon the highly inclined edges of a greenish greywacke sandstone (Cambrian rock), similar to that of the Longmynd.

"The highly inclined edges of these Cambrian rocks, which rise to the height of only from twenty to thirty feet above the brook, are, on the western side of it, covered with the carboniferous breccia arranged in horizontal layers; but as the works were abandoned when I visited the spot, I could not observe the junction between these beds and the inclined edges of the older rocks. This breccia is composed of fragments of the underlying Cambrian rock, on the surfaces of which are casts of ferns and other coal plants, the whole being cemented by bitumen and decomposed sandstone. The beds were formerly much quarried, and the breccia being transported to Shrewsbury, and there subjected to heat, a liquid bitumen was extracted, which, when prepared, was sold as a medicine, under the name of "Betton's British Oil." Contiguous to this quarry is a well, on the surface of which is a constant accumulation of bitumen exuding from the adjoining strata. It will hereafter be shown that where points of trap rocks penetrate the adjacent strata of the Cambrian system there are frequently bituminous exudations near the points of contact.

"From the preceding details respecting the carboniferous deposits near Shrewsbury, it appears, that the coal was formerly worked in those spots only where it actually rose to the surface; and that, even at the present day, the speculation has not extended to any considerable distance beyond the mere outcrop. In the small irregular troughs at

Longnor, Uffington, Longdon, Le Botwood, Pitchford, &c., where it is evident from the nature of the sides of the trough, and also by the shallow depth at which the Silurian and Cambrian rocks are met with, that no coal can exist, further trials would be absurd.

"An examination, however, of the country on the south bank of the Severn, has convinced me, that coal may be profitably extracted to a certain extent in the tract lying between the Pontesbury and Asterley coal-pits, and the escarpments of the dolomitic conglomerate, and lower red sandstone of Cardeston and Alberbury. Trials in this district or in the adjoining tract, south-west of Cardeston, could be made at small expense, it being highly probable that if the coal measures are not cut off by the rise of older rocks, which is discountenanced by the form of the country, they are only covered by the thick accumulation of gravel and argillaceous clay which overspreads this depression. At the same time that we give apparent good reasons for finding the thin or upper coal strata within a limited area, it is fair to state, that practical observation militates against the supposition of any great expansion of coal beneath the lower new red sandstone on the right bank of the Severn. In no one of the present works does it appear that the seams of coal become thicker, or increased in number, when followed downwards on the dip. And although these trials have hitherto proceeded to so short a distance, that no very decided conclusions can be drawn, yet it must be allowed that they weaken the supposition of the thin or upper coal-measures graduating downwards into richer fields. We might, indeed, surmise that this zone of coal, which judging from the nature of the limestone, was probably accumulated in a lake or near the mouths of rivers, has merely resulted from a very *partial* accumulation of vegetable upon its shores, and that *beyond* the drift or range of these small gatherings of wood we should look in vain for a mineral formed out of such materials. It might also be said that as these carbonaceous zones of the plain of Shrewsbury differ so essentially from the largely productive tracts of coal in the absence of the underlying deposits of carboniferous limestone, millstone, grit, &c., we ought rather to presume, that the mineral thus wanting in its accustomed associations would be fully developed, On the other hand, it may be contended, that according to analogies elsewhere, carbonaceous matter formed upon the natural edges of such a basin would naturally thicken towards its centre; or, in other words, that as a certain amount of vegetable matter had been accumulated upon the shores of these ancient rocks, still larger quantities were probably washed down their shelving sides into the depths of a capacious bay or estuary, on the opposite limits of which we actually meet with other and highly productive coal-fields, rising from beneath a cover of new red sandstone. I do not throw out such suggestions as an inducement to proprietors, north of Shrewsbury, to endeavour to penetrate the thick and massive deposits of which the overlying new red system is composed, although it is by no means impossible that a coal-field may there lie hidden, which when the more *accessible* coal strata in other tracts shall have been exhausted, may prove of value to future generations. Such inference is rendered more probable by the observations in the next chapter, which show, that a band of coal measures of the same age, passing similarly upwards into the new red sandstone, and containing a limestone identical with this of the Shrewsbury plain, distinctly *overlies* the edges of the most productive of all the Salopian coal-fields, and hence it is no strained inference that carbonaceous masses equally thick may also be found expanding beneath this upper coal of Shrewsbury, though most probably at some distance from the outcrop, and if so, necessarily at *vast depths* under the new red sandstone of the plain of Shrewsbury. Observations leading to similar inferences, and extending their application to other extensive tracts in the central counties, will be found in subsequent chapters; again, however, I would repeat that much caution, and many preliminary trials towards the edges of this great basin are required before such speculations are attempted, since it is one thing for the geologist to show the *natural position* of the coal, and another for the miner to determine where it has been locally accumulated in any quantity worthy of the industry of man. This latter point may be most safely ascertained by following the coal seams upon their dip from the points where they are now known, and if they continue to thin out in their extension beneath the red sandstone, then, indeed, deep sinkings in the central parts of the basin north of Shrewsbury would be absurd. The proofs which will be adduced in the eleventh chapter, of the thinning out of the coal seams of the Oswestry field where they dip under the lower red sandstone, point to the necessity of much circumspection in all such operations.

Passing from these practical hints, I would conclude with a few general theoretical reflections. These poor and thin stripes of coal measures have been dwelt upon in some detail, and similar patches will again be adverted to in the following chapter, on account of their peculiar character and high geological interest, in aiding the proofs of a descending passage from the lower new red sandstone into the carboniferous system. Constituting the youngest member of that system, they fill up an interval in geological chronology, precisely in that portion of the series in which much obscurity previously existed; for, with the exceptions in the north of England, pointed out by Professor Sedgwick, it was the prevalent belief of geologists when my researches commenced (1831), that in all *other parts* of England, a great break existed between the new red system and the coal measures, the phenomena of disruption in the environs of Bristol, being assumed as the true types or patterns of the general order. These upper coal measures of Shropshire are further remarkable in bringing to light, for the first time in Great Britain, a peculiar limestone interstratified with coal seams, and which from its prevalent organic remains and mineral composition, I have referred to fresh water origin. Though never exceeding eight or nine feet in thickness, and sometimes dwindling away to two feet, this band is so remarkably persistent, that when followed along all its sinuosities the length of its course is about forty miles; and even in a straight line from Coedway, near the Breidden hills, to Tasley and Caughley, near Bridgenorth, where it will presently be described, the distance is not less than twenty-five miles; and yet throughout such a space this little stratum preserves the same structure, and contains the same microscopic shell, *Microconchus carbonarius.* The subsequent discovery by which the limestone of Ardwick, near Manchester, was identified with it, has given to this stratum a considerable additional importance, in carrying out over so wide an area the evidences adduced in this volume of the passage of the coal measures beneath the new red sandstone of the central counties. Besides the zoological proofs of this limestone having been formed in fresh water, I have already stated, that in mineral characters it strongly resembles the lacustrine limestone of central France, and I may now add, that the origin of the rocks in the two countries is probably connected with similar causes. For as Auvergne is a region which has been eminently subjected to volcanic action during past ages, so its extensive formations of finely levigated limestone are supposed to have been the produce of hot springs (the usual attendants on volcanos), holding calcareous matter in solution, and depositing it amid the fine silt of ancient lakes; in like manner the whole of the surrounding region of Shropshire, in which limestone occurs, is absolutely perforated by intrusive rocks of igneous origin, and hence it is a fair deduction, that the peculiar limestone of this tract may likewise have been the result of volcanic hot springs. Other analogies will strike those to whom the phenomena in central France are familiar, such as bituminous exudations and sources of mineral pitch which issue from the surface at those points where eruptive rocks protrude; but these comparisons belong more properly to subsequent chapters. Difficult as it may be to reconstruct in imagination the condition of the surface of this part of our island during the period of the coal formations, the limestone and associated beds (whether formed exclusively in pure fresh water, or in bays in which fresh predominated over salt water) afford convincing proof of the existence of neighbouring dry land, from which rivers flowed, transporting terrestrial vegetable remains, and entombing them with shells, the greater part of which must, unquestionably, have lived in fresh water. That such streams, however, were *near* the sea, and that in fact they soon passed into estuaries, will be presently rendered evident by details of the undeniable alternation and intermixture of fresh water, terrestrial, and marine remains in Coalbrook dale, which tract, though only distant a few miles from that under consideration, exhibits a vast expansion of the carboniferous strata; thus leading us to suppose, that whilst the Shrewsbury deposit has been simply formed by streams issuing from the Cambrian and Silurian regions, and giving rise to lakes to which the sea had little or no access, the greater carbonaceous masses of Coalbrook dale have been accumulated by the same waters where they united to empty themselves into an estuary! The north-eastern edges of this great marine bay were formed near Manchester, its western margin being marked by the zone of carboniferous limestone which bounds the coal-fields of Oswestry, Chirk, and Ruabon. An inspection of a general geological map of England will indicate the extent of the area, which now appears as a vast trough of new red sandstone encircled by carbonaceous deposits. Further observations upon the origin of these coal-fields occur in the ensuing pages, particularly in the concluding part of the eleventh chapter, where a small map will be found, explanatory of the probable physical geography of this region during the period at which the accumulation of the carboniferous deposits took place.

Mr. Murchison here remarks in a note, that these central coal fields contain fossil fishes, molluscs, and entomostraca, identical with, or closely allied to those of Burdie House limestone, which was once supposed to be of much greater antiquity than the coal measures. The identity of fossils in both strata, and the circumstance of the Shropshire and Lancashire rocks being placed at the upper series of the coal formation, and found to graduate upwards to the new red sandstone, are good inductive proofs of the beds in both being equivalent, and also of the true age of the Scotch rock, whose isolated position had rendered its rank doubtful in the series of ancient strata.

In the next chapter Mr. Murchison passes, as he himself expresses it, from the thin, and slightly valuable coal tracts around Shrewsbury, to the great productive coal field of Shropshire, in which are found nearly all the members of the coal formation. Here Mr. Murchison refers to the labours of Mr. A. Aikin, published in the Geological Transactions, as well as to those of Mr. Prestwich, now in progress of publication in the same work. The principal and most productive part of this district spreads out on the north of the Severn, flanked on the south by the old red sandstone and upper silurian rocks; to the west by a thin zone of lower silurian rocks, and by the trap rocks of the Wrekin and Grecal hills; but from the north-west and east this tract is bounded and overlaid by the lower new red sandstone; the passage of the coal measures into that formation is not however so clear, as in the Shrewsbury field, being generally concealed by accumulations of drifted matter; no attempts like those of the Earl of Dartmouth (p. 18), have yet been made to overcome these obstacles and follow out the coal beneath the red sandstone. Here Mr. Murchison's remarks may be regarded as an instance of how near scientific induction amounts in value to the costly experience of practical operations in these matters. If we make a transverse section from the coal works at Donnington across the hills to the east, we see that where the rocks are nearest to the line of red sandstone, the coal strata dip to the east, or beneath the adjacent sandstone. This coincidence of inclination in the red sandstone and coal measures may be observed at several points. On the north and on the south, and at Brasely, Mr. Prestwich has detected a passage from the upper carboniferous strata into the lower new red sandstone, similar to the one described in the Shrewsbury field. At Tasley, a single thin bed of impure and poor coal is worked by windlasses, at depths varying from 12 to 30 yards, and in the overlying strata is a bed of limestone, about three feet thick, identical with the fresh water limestone of the Shrewsbury field. This coal contains, in some parts, thin laminæ and veins of white calcareous spar, an appearance which Mr. Murchison observes is of frequent occurrence in the upper secondary and tertiary carbonaceous deposits in various parts of Europe; an observation of some importance is, that it is this peculiar calcareous character of the Singra coal that has rendered such samples as have hitherto been received from that particular bed of Palamow coal inferior. Mr. Murchison remarks, that although seldom seen in the best or most ancient coal, yet he has seen this peculiarity in other parts of Shropshire and also in the Dudley field, where the lower beds of new red sandstone begin to pass into the upper beds of the coal measures.

Mr. Murchison next passes to the consideration of the lower or productive coal and iron field; and his own words are of so much importance in the following remarks, that we shall quote them as they stand. "It is not easy to give a very precise notion of the structure of this portion of the field without entering into a variety of details foreign to my purpose. The labours of Mr. Prestwich however teach us, that the mineral characters of the same strata often change completely within very short distances, beds of sandstone passing horizontally into clay, and clay into sandstone; that the coal seams wedge out or disappear; and that sections at places nearly contiguous often present the most marked lithological distinctions. These observations, which coincide with my own in various other coal fields, demonstrate the hopelessness of determining the respective ages of such rocks in different localities by shafts and sections, or by a mere comparison of their mineral characters. Even the coal itself constantly tapers away, and disappears amid the shales and sandstones, constituting what are locally termed "symon-faults," the character of which, as distinguished from true faults, is, that the coal wedges itself out and disappears. Mr. Murchison next adduces several sections to show how little persistent parts of beds of coal are, and how much they vary in different parts of the same field; the united thickness of the mass of coal in any one shaft never being dependent on the number of the seams.

"A section of the Hill-Lane Pits, near Madeley, may be given as an instructive example of the succession in one spot where the strata are pretty fully developed. In a shaft two hundred and thirty yards in depth, we are presented with twenty-one carbonaceous beds, of which the eleven uppermost are sulphureous and impure. Upper coals, similar to those at Caughley and Tasley, alternate with clays, marls, sandstones both argillaceous and calcareous, and with calcareous breccia or conglomerate. Some of these beds may represent the upper coal measures of Manchester. The lower coals, or those extracted for use, which in this shaft are reached at a depth of about one hundred and ninety-eight yards, are named in descending order.

	Feet.	inches.
1. Viger coal, ...	1	8
2. Two foot coal, ...	1	8
3. Little Ganey, ...	0	7
4. Lower Ganey, ...	1	6
5. Best coal, ...	2	5
6. Randle coal, ...	2	8
7. Clod coal, ...	1	4
8. Little flint coal, ...	2	6
9. Coal under crawstone, ...	1	0
10. Lancashire Ladies' coal, ...	0	9
Total of good coal in this shaft,	15	11

"In the above list the beds which separate the seams of coal are omitted. The following table will explain to the reader how little the beds of coal are persistent, and how much they vary in their dimensions in different parts of the field, the united thickness of the mass of coal in any one shaft never being dependent upon the number of the seams.

Pits.	Thickness of coal. Yd.	feet.	inch.	No of beds of coal.
Hadley,	15	0	0	16
Sned's Hill,	14	2	2	12
Malinslee,	11	0	10	13
Longley,	11	2	6	11
Dawley	14	0	0	16
Lightmoor,	13	2	0	17
Madeley,	10	2	10	24 (21 to 24.)
Braseley,	7	0	9	13

"The ironstone so largely worked in this field is both concretionary and flat-bedded, but for the most part in the former condition, and the various courses of it are known under these names: *New mine* (peculiar to Madeley) *Crawstone, and Pennystone,* occurring generally; *white and blue flats,* in the north and middle districts; *Chanestone* and *yellowstone,* in the middle tract; *ballstone, brickstone, and blackstone,* in the northern district. The *Ragged Rabins* and *Channe Pennystone* are of irregular occurrence. Of these twelve courses of ironstone more than seven are never found in one locality. In taking a general survey, it may be said, that both the coal and iron are much more abundant in the northern than in the southern part of the field. Mr. Prestwich has indeed remarked the difficulty of identifying any particular stratum of the upper portion over a considerable area, whilst he has found the lower measures stronger and more persistent. Among the various rocks which alternate with the coal and iron, the stone of the Willey or Shirlot obelisk is an example of a coarse variety, while the sandstone occurring immediately above the "flint-coal," is of remarkably fine quality for architectural purposes, the monument erected to the late Duke of Sutherland on Lilleshall hill being built of it. Some of the grits associated with the lower coals pass into coarse conglomerates containing fragments of quartz rock, trap, Silurian and Cambrian rocks; and in the lower measures some of the beds of shale afford excellent fire clay, long celebrated in the manufacture of pipes and pottery.

"The ores of iron are peroxides in the sandstone, argillaceous carbonates in the shale, and sulphurets in the coal. The sulphuret of iron is the most abundant mineral, and next to it the sulphuret of zinc or blende, which appears in the ironstone nodules of the Pennystone measures both in granular and crystalline form. Petroleum is of constant occurrence in the upper as well as lower measures; the chief source of this mineral at Coalport, which formerly afforded one hogshead per diem, being in a thick bedded sandstone of the upper measures. This supply has, however, much decreased with the opening of the new coal works. Other tar wells have been discovered in the lower coals at Prior's Lee. In some pits, as at Dawley and the Dingle, the petroleum exudes in such quantities that the works are necessarily boarded up or "plated" to prevent its infiltration upon the workmen. Besides these minerals titanium exists in the iron ore."

Of the fossils of Coalbrook dale coal field, Mr. Murchison remarks that upwards of 50 species of plants have already been discovered, consisting of *Euphorbiaceæ, Dycotyledons* of doubtful characters, *Palmæ,* Monocotyledons of doubtful affinity, Equisetaceæ, Filices, Lycopodiaceæ, &c., the greater part of which are figured in the British Fossil Flora by Messrs. Lindley and Hutton, others by foreign fossil botanists, Sternberg, Adolphe Brongniart, &c.; of these six species are common to this and other coal fields in Shropshire, and the Museum of the Natural History Society of Shropshire and North Wales, recently established at Shrewsbury, contains an extensive series of these remains.

The animal remains consist of three species of *Fishes*, namely, *Gyracanthus formosus, Megalichthys, Hibberti*, and *Hybodus* of Agassiz. Of *Crustacea, Cypris, Limulus trilobitoides;* and three small species of undescribed Trilobites, different from any species of those animals which we shall afterwards see that Mr. Murchison found to be so numerous in the rocks of the Silurian system. Of *Mollusca*, upwards of forty species have been found in this coal field, most of them described and figured in Phillips' Geology of Yorkshire, or in Sowerby's Mineral Conchology, as belonging to the carboniferous limestone, but all these fossils are different from those of the Silurian system. Insects have also been found in a fossil state in the ironstone concretions of this coal field, two of which, published by Dr. Buckland in his Bridgewater Treatise, have been supposed, according to Curtis and Samouelle, to resemble African or South American forms. A figure of one of the wings of an insect is given by Mr. Murchison, and although only a fragment, is upwards of two inches in length. It was supposed to be a plant, and was sent to M. Adolphe Brongniart, who immediately perceived the transverse nervoures were unlike any thing in the vegetable kingdom; and on being referred to M. Audouin it was pronounced to be the wing of a neuropterous insect, closely resembling the living Corydalis of Carolina. Mr. Murchison pays a high tribute to Mr. Anstice and Mr. Prestwich, the first for his collections of the fossils of this coal field, and the second for his researches into their character, as well as the relations of the alternating beds in which they are found. This copious list of fossils, Mr. Murchison observes, enables us to speculate with certainty on the conditions under which the various strata of this coal field were accumulated. Here we find the forms of many terrestrial plants and even of insects, entombed amidst a variety of shells, and some crustacea, the greater part marine, but others, such as *Uniones,* and *cypris,* unquestionably of fluviatile origin. From these circumstances Mr. Murchison concludes that this tract of Coalbrook dale must originally have been an arm of the sea, into which streams of freshwater discharged materials derived from those lands the contiguity of which has been previously inferred from the existence of fresh water limestone in the adjacent coal fields. This view is also (Mr. Murchison remarks) quite in accordance with that of Mr. Prestwich, who is of opinion that the alternation of marine and fresh water shells do not prove as many relative changes of land and sea, but that the coal measures were deposited in an estuary into which a considerable river flowed, subject to occasional freshes; a position rendered the more probable by the frequent alternation of coarse sandstones and conglomerates with beds of clay, and shale containing the remains of plants.

The rock called millstone grit, which forms the basis of coal-bearing strata in other districts is here wanting, unless we consider the grits, conglomerates, and sandstones containing seams of coal and courses of iron stone its equivalent. These strata repose on the peculiar limestone of the coal measures, but even this last rock is limited in Coalbrook dale district, so that the greater portion of the coal-bearing strata reposes in the southern part of the district on old red sandstone, and in other situations where this is wanting, on Silurian rocks. The limestone of this coal field is described by Mr. Murchison as occurring in eight beds, having an aggregate thickness of eleven yards, but varying individually from 5 to 26 inches each, and are associated with impure limestone and shale, amounting in all to upwards of one hundred feet. The limestone is of a dark grey or black colour, in which, as well as in the absence of a concretionary structure, it is quite unlike the Wenlock limestone of the old Silurian system.

It would be extremely important indeed if we could establish good distinguishing characters between the limestone of the coal measures and that of the more ancient formations, but this, if a matter of difficulty in England, is at least an equally difficult thing in India. It is true the subject has here been as yet little investigated, but we cannot place the least confidence in those practical men who employ names without thinking of their meaning, and speak confidently of lias, and carboniferous limestone, primitive limestone, &c., according as they happen to suppose any particular specimen they meet with in India to be one or other. The limestone so abundant in Kemaon, as to form the greater portion of that mountainous district, is so much like the limestone of the coal measures at Cherra Ponji, that no one unacquainted with the peculiar relations of the two rocks would suppose them to be at all different. The geologist however perceives the vast difference between them at once; the one reposes on clay slate, the other on sandstone; the one occurs in thick continuous beds, the other alternates with shale; the one abounds in fossils which scientific men alone would think of looking for, and in the other the geologist alone would know that he might look for fossils in vain. Speaking of the difference between the limestone of the Silurian system and that of Coalbrook dale, Mr. Murchison says that the organic remains which are in great profusion in the latter, consist of shells and corals which are characteristic of the carboniferous limestone in many other parts of Great Britain, and *never* occur in the inferior limestones of the Silurian system. Among these the most prominent are the large *Productus hemisphericus* and many corals, including *Lithodendron sexdecimale* (Clodocora of Ehrenberg) which is so abundant that it constitutes the greater part of the layers of black calcareous shale which divide the beds of limestone. The black limestone in which these remains are found is overlaid by a sandstone which separates it from the productive coal beds, and is underlaid by strata belonging to the lower limestone.

Mr. Murchison particularly alludes to a specimen of *Lithosortion floriforme*, a species of coral two feet five inches broad, by one and a half high, which appeared in a quarry to retain the original position in which it grew, and conveyed the impression that it had remained undisturbed beneath the sea, while fine red sand at one time, and mud at another, were deposited around it.

These corals are also found in the limestone of the Cherra Ponji coal measures; and in a large heap of limestone collected by Mr. Inglis of Chattack for the purpose of burning for lime, I found the first fossil I had observed in a similar rock in India, thus indicating the presence of a coal district. The object of the journey would not however admit of my visiting the quarry, but there can be no question that the rock alluded to is connected with the numerous indications of coal formations that have been found in that vicinity. One other corresponding character may be mentioned between the Cherra Ponji coal beds and those of Coalbrook dale, namely, that the coal measures do not graduate downwards into the older rocks. The limestone of Cherra, which alternates with beds of sandstone and shale, seems to rest immediately on the old red sandstone, as in the Coalbrook dale beds. Mr. Murchison observes that the carboniferous limestone has not in Coalbrook dale any regular downward passage into the old red sandstone, as in other districts; on the contrary, the old red terminates at the southern end of the tract, and has never been found beneath the coal measures. On the north bank of the Severn the underlying stratified rocks throughout the productive coal field consists of various members of the Silurian system.

Mr. Murchison concludes his observations on this coal field by a notice of the faults and dislocations occasioned by trap rocks. The district affords proofs of having been raised up from beneath the surrounding new red sandstone in separate wedge-shaped tracts, the most remarkable dislocation being that which bounds the coal field to the east. The coal measures along this line are not less than one thousand feet thick, and as some of the lower seams of coal are thrown up to the level of the overlying strata of new red sandstone, the upcast is thus shown to have exceeded one thousand feet, though to what further extent has not yet been ascertained. It will be recollected that we formerly explained the elevated position of the Cherra coal measures in precisely the same way that Mr. Prestwich and Mr. Murchison now account for the great upcast of the Coalbrook dale field,* the only difference in the two cases being, that in India the dislocation is not confined to the coal measures, but extends to the old red sandstone, the whole series of which, with the coal measures reposing on them, having been at Cherra Ponji thrown 3000 feet above those which have been recently found by Major Lister and others at the bottom of the same mountains. It is of much importance to draw comparisons between geological phenomena of this nature in remote parts of the earth, as tending not only to put our theories to the test, but also to correct and give confidence to our views, which however complicated they may appear when derived from a narrow field of observation, become gradually simplified and important in proportion as our data become general.

The millstone grit, an important member of the coal measures being absent in the Coalbrook dale district, we shall select Mr. Murchison's description of it from other parts of the work.

In his description of the Knowlbury basin, Mr. Murchison

* See Report of a Committee for investigating the Coal and Mineral resources of India. Calcutta, 1838, pp. 24.

says that millstone grit consists of pebbly, quartzose conglomerate and thick-bedded hard sandstone, which rises at many points from beneath the productive coal field. It is most expanded in the sterile tract which lies between the northern slopes of the basalts and the limestone hills at Oreton. When the limestone is wanting, the millstone grit rests immediately on the old red sandstone. (See p. 118.) In Oswestry coal field the millstone grit or peculiar sandstone of the coal measures is largely developed, rising into broad ledges between the productive coal field and higher hills of limestone, from whence it turns round the coal field, cutting off the productive districts from the older rocks. In most situations the strata dip at very slight angles beneath the coal, rarely however they are much inclined. From Oswestry the millstone grit advances in low hills to the edge of the great plain of Shropshire, and exhibits the following succession of strata in the descending order:—

1. Light coloured siliceous sandstone, containing a stratum some feet thick, of a porous rock made up of fragments of chert, imbedded in a matrix of fine white clay, or decomposed felspar and silex (kaslin). This bed resembles that which occurs on a larger scale in the north-western prolongation of these carboniferous tracts at Halkin in Flintshire. It is here underlaid by whitish or pinkish sandstones, sometimes freckled with spots of decomposing oxide of iron: other and lower beds forming the summit of Sweeny mountain are coarser, containing distinct pebbles of quartz. The finer varieties of these siliceous sandstones, whether of whitish pink or deep red colours, afford excellent building stones, and are capable of being wrought into the ornamental parts of architecture.

This millstone grit, with its light coloured and whitish building-stone, ranges over the grounds of Porkington, rising up in large masses to Sallattyn mountain, where it rests upon the limestone. Towards the bottom of the formation these sandstones become partially calcareous, and present a honey-combed aspect, due to the unequal disintegration of their surface. Occasionally the rock may even be termed a sandy limestone. Fragments of encrinites and corals are also found in these beds, announcing their approach to the calcareous masses beneath. Such masses of calcareous red sandstone are seen also at Ponty-Cefn, occupying a broad zone between the limestone and the productive coal-field. They are, however, completely separated from the underlying limestone by a very thick development of pure sandstone, often of a deep red colour, and they may therefore be considered as subordinate to the millstone grit. The red sandstone, or lowest member of the formation, is well exposed to the east of Sweeny mountain, resting directly upon the great carboniferous limestone, in which position the red rock has the thick bedded structure, and exact appearance of many varieties of the new red sandstone, thus affording one of numberless examples which will be found in this work of the impracticability of defining the age of strata by mere lithological aspect.

As the red variety of the millstone grit to the east of Sweeny is in juxtaposition with the lower new red sandstone, the exact line of demarcation between the two formations becomes difficult, particularly where the surface of the lower grounds is much encumbered by detritus. The *apparent* similarity of the red rock of the millstone grit to that of the lower new red being likely to mislead speculators who do not comprehend the structure of the district, I would therefore repeat, that the first mentioned rock distinctly *underlies the coal measures,* and reposes on the limestone, and hence that any effort to seek for coal beneath it would be absurd.

Nothing could add to the importance of this last observation, or point out more clearly than the foregoing remarks of Mr. Murchison, the advantage of a scientific knowledge of rocks in the examination of districts in search of coal, as well as in all operations that may be had recourse to for its recovery.

The following observations on the character of coal, and the various forms the mineral assumes in the same district, is of much practical importance, and should point out the error of deciding upon the quality of coal from specimens alone, unless we know them to be taken from the main bed. Where there are numerous mines in a district the main coal will be well known, but in a new country where no information is to be had, but what is to be derived from natural sections, the difficulty is only to be overcome by geological investigation, and however sceptical we may be as to the practical value of geological science, the authority of Mr. Murchison ought to be a sufficient guarantee for its absolute necessity in all researches undertaken for the discovery, and ultimate working of new coal beds.

Of the Brown Clee Hill coal field, Mr. Murchison observes, these carboniferous tracts, the loftiest in Great Britain, are surrounded on all sides, and separated from each other by the old red sandstone ; and as it rises to a considerable height above the flanks of these hills, the thickness of the overlying coal measures can at once be read off by any geologist. Their dimensions are further proved by numerous works which penetrate them, and in consequence of the old red sandstone dipping inwards from the sides of each of the hills, the coal is seen to lie in broken basins of shallow depth.

In some parts of the field there are three beds of coal, " the uppermost being about two feet, and the second, called *batty coal*, about three feet thick, and the third, or *single coal*, about two feet and six inches in thickness.

The two upper coals, usually pyritous and of a very inferior quality, are separated from each other by only about nine feet of clod shale. The *batty coal* indeed is frequently near the surface, the uppermost bed being often wanting. The only seam worth extracting is the single or bottom coal, which lies in some places twelve feet beneath the *batty coal;* but this depth varies in different parts of the hill. The intervening strata consist of clod and shale, known by the workmen as *petticoat* measures, horse-flesh measures, &c. and of one band of sandstone, about nine feet thick, called level rock. *Much of this coal, particularly that of the upper beds, is in a half-consolidated state, the vegetable fibres appearing prominently in the mass, and giving to it the appearance of charcoal.* Coals of similar character are much less frequent in the Titterstone Clee field, where they are termed *mother*, but they often occur in the poor and thin coal tracts of Shropshire. Now the variety of coal described in italics has been found to characterise the uppermost beds in nearly all coal fields where the newer series of the formation is complete; and as the description above quoted applies precisely to several samples both of Cuttack and Palamaw coals, sent to Calcutta for trial, we may conclude that the samples in question are but the surface or *batty* coals of those districts, which from their woody appearance have hitherto in India been erroneously named *lignite.* This fact not only establishes a very wonderful identity between Indian and English coal fields, but casts a new and important light on the value of the former, which under the supposition that the mineral they contain was a lignite rather than a true coal were neglected, or their value left in doubt and uncertainty.

We shall conclude the practical details in our present notice, by the following remarks of Mr. Murchison on the Brown Clee coal field, where operations have been carried on under circumstances similar to those which would probably be found to prevail in some of the Indian coal fields.

Coal has been wrought on these hills from time immemorial, and numerous old shafts attest the extent of these operations, by which indeed nearly all the best coal has been extracted. As the ground, however, has never been regularly allotted, each speculator having begun his work where he pleased, and abandoned it when he encountered a difficulty, it is impossible to say how much of the mineral has been wasted, and what quantity may remain beneath in unconnected and broken masses. On the sides of the Abdon Barf most of the present shafts are shallow, but in former times it appears that a pit was sunk to a depth of seventy yards, first, through a considerable thickness of disintegrating basalt, and afterwards through the *batty coal* to the ironstone measures.

The deepest shafts in the Clee Barf are eighty yards, the shallowest fourteen to fifteen, and between these two extremes, there are pits of intermediate depths. They are all worked by the common windlass, a single man sometimes raising coal from a sixty yard shaft, aided by the counterpoise of only an oaken block or "Jack." Owing to their lofty position these coal works are almost entirely free from water, which, except where it lodges in the decomposed basalt, termed "gravel," percolates as rapidly as it falls through the numerous cracks by which the hills are fissured. The workmen, however, have to contend with rather an unusual natural obstacle to mining, in the winds which blow with great force against this lofty and unprotected district, and which not only render the labour at the pit's mouth difficult, but, without certain precautions, would, at times, entirely stop the works. The most violent winds are from the west and south-west, and during their prevalence the galleries are filled with powerful gusts, accompanied with much noise. This furious ventilation prevents, of course, the collection of any fire damp, so that the Brown Clee miner is compensated for working in these cold and noisy chambers by the absence of all noxious gases.

The coal measures of these hills are intersected by a vast number of small faults, one set of which trend from north to south, the other from east to west. In the Abdon Barf there are four principal faults, two of which have north and south direction, the other two from east to west, cutting the former at right angles. The north and south faults range along the coal measures on the eastern slope of the hills, where no basalt overlies them, one near the junction of the coal with the old red sandstone, the other passing within two or three hundred paces of the cap of basalt. The two transverse faults (termed facing faults) are about eleven yards in width, and affect all the measures and faults up to the edge of the basalt, and are therefore of the most recent date. The north and south faults are upcasts towards the basaltic summit; the principal or lower south and north fault being an upcast of twenty-six yards. The upper north and south fault is only an upcast of about six yards, and neither of the east and west faults exceeds that amount of dislocation. Besides these, there are innumerable minor north and south faults, which are all upcasts, reckoning from the old red sandstone of the surrounding low country as a base line.

In the Clee Barf the faults are not large, and unlike the Abdon Barf the coal has been proved, if not worked out, under every part of it. In this hill most of the faults are more or less from east to west, producing small and trifling upcasts to the south. The fissures resulting from these dislocations are filled with an indurated breccia of coal measures (clods, shale, sandstone, &c.), the miners persisting that no fragment of jewstone or basalt was ever found in them.

The most extensive of the east and west faults are those by which a large mass of the old red sandstone has been heaved up to the same level as a portion of the coal, so as to occupy the depression between the two basaltic summits, and thus to separate the coal measures into the two small tracts described.

The bare recital of these various dislocations may have caused my readers to infer, that the same beds of coal must be found at many different levels, and they will doubtless also perceive that such disturbances, added to the ascertained fact of the thinness of the coal seams, must ever render the Brown Clee coal field of slight economical value.

The action of the wind in the galleries is checked by a pipe, one end of which reaches the extremity of the working ground, and the other is fixed in a "suff" to a vertical cylinder which rising to the surface terminates at the pit mouth in a wooden trough-shaped funnel. The result of this simple machinery is, that a strong column of air being forced down this cylinder, the wind collected in the chambers is expelled by the shaft mouth, or in other words, an equilibrium is established.

It is believed by the workmen that the wind enters the galleries through the cracks on the sides of the hills. The men at work at the pit's mouth shelter themselves from the tempest by hurdles secured to large blocks of basalt.

The results of Mr. Murchison's views on the Salopian coal fields are, that the Shrewsbury district was formed by rivers emptying themselves into lakes, all the fossils being fresh water and terrestrial. Coalbrook dale, which contains a mixture of fresh water terrestrial and marine remains, is referred to an estuary origin, while the Oswestry fields, in which nearly all the animal remains are marine, were probably formed on the shores of an open sea. The observations of Macculloch and Hatchet distinctly prove that it is the resinous principles of plants which mainly contribute to the formation of coal; and the geologist finds in the most recent and superficial beds in which plants have been buried the vegetable matter they contain to have lost a portion of its original properties, approaching more or less to the first stage of mineralization, termed brown coal. Mr. Murchison refers to beds younger than the London clay, in which vegetable bodies have been found in a condition approaching to that of coal, and the Indian geologist will find hundreds of trunks of trees washed out of the sands of the Bramaputra in Assam, in which the *form* of the woody fibre and cellular tissue alone remains;

their character is however so completely lost that whole trunks are found crumbling to pieces, which present the fracture and other characters of coal. With such phenomena before our eyes, it is no wild hypothesis to suppose that if many parts of the basins of great rivers were elevated and laid dry, we should find along their course a succession of changes from the decaying drift wood down to coal itself. Thus it is, says Mr. Murchison, that throughout the whole series of sedimentary strata wherever impressions of plants occur, there also do we find some traces of the existence of coal commencing. In tertiary periods, when the relations of land and water were approaching to their present condition, we have many proofs of similar accumulations. In the deep gorges of the Alps we find carbonaceous matter piled up with alternating layers of sandstone and shale, on which are impressed the forms of various plants; and in some places containing fluviatile and terrestrial shells. These were evidently heaped up by rivers and lakes; while other accumulations of a similar nature pass under strata charged with marine remains, little differing from those of the present day. This state of things would have been produced in a condition of the globe diversified with continents, rivers, and lakes as at present; and although the plants found in the condition alluded to are chiefly different from those that now exist, yet they belonged to Dicotyledonous classes. Descending from tertiary to newer secondary rocks, all the animals and plants which are found in the strata are dissimilar to those now living, and they are such as to prove frequent alternations from land to sea, a condition of the surface less favourable to the production of vegetables than animals. From this period we descend into the ancient strata in which the fossil plants are not only different from those of the present day, but also from those of intermediate periods. The vegetation of this distant epoch presents an exclusively tropical character in the most northern latitudes in which coal formations have been found.

Whether therefore we descend, says Mr. Murchison, from deposits lodged in lakes and estuaries, or ascend from the rocks of the coal measures, we meet at successive stages with distinct vegetable forms which were drifted at each successive period from adjacent pre-existing lands, forming the materials out of which coal has been elaborated.

[To be continued.]

Notes on the Distribution of Soils in the Goruckpoor District.—By DAVID LISTON, ESQ.

[With a coloured Sketch Map. Plate VIII].

Gorukpoor District is bounded on the west and south by the rivers Gogra, Dewa or Surjoo; and three-fourths, or it were perhaps more correct to say seven-eighths, of the Zillah are watered by that great river and by the Raptee and other tributaries which fall into it from the north. On the east, the district is bounded by the great Gunduk, and the remaining portion is intersected and watered by tributaries and branches of that noble stream. But what seems rather a remarkable circumstance, the lands under the rule, so to speak, of the Gogra and its subordinates, are in general all of a description of soil called *Bangar*, that is of a dry siliceous nature, and requiring irrigation for the production of rubbee or winter crops, whilst the lands bordering on the Gunduk and its branches or feeders are what is termed provincially *Bhat*, a soil retentive of moisture, producing cold weather crops without artificial watering, and a very notable portion of it being calcareous matter.

The little Gunduk may be considered as the boundary of the Bhat or calcereous deposit to the west, as I believe I am correct in stating, that this description of soil does not obtrude to the left-side of the river in its whole course, beyond what may have been an old bed of the river, or where back water from it may have been stagnant during wet seasons. The little Gunduk falls into the Dewa, and therefore, agreeably to the general observation above made, the lands upon it should partake of the nature of those on that river; though the main portion of its stream comes from the lower range of the Nipal hills, and is thus so far independent of the great Gunduk, it also draws a part of its supply from the latter river in the rains, and the lands bordering on it are of a mixed nature; in fact we may consider the characteristic of the soil bordering on the little Gunduk as calcareous when nearest the great Gunduk, but siliceous as it approaches the Dewa.

It strikes me that the portions of the country where siliceous soils prevail, abound more in kunkur beds or ridges than where the calcareous soils are met with, however they may only be concealed in the latter case; but admitting the matter to be as now stated, a query arises as to whether the lime incorporated with the soil in the Bhat division of the country has in the Bangar portions been drawn down, while the country was in a state of submersion, to form the kunkur beds which are there met with? Another question occurs—how came the kunkur bed to be formed at all? Were the nodules in which it is generally found, formed on shells as nuclei? In looking at some of the kunkur knolls in this district, one would readily fancy they originated in this way, the ground work of them being from the materials of shell fish, &c.

As this Bhat deposit is confined to the country of the great Gunduk and its branches, being bounded on the east, as I am well informed, by the Bhogmuttee in Tirhoot, and extending down the little Gunduk in that portion of the country to nearly opposite to Mongyr (and let it be observed there are two little Gunduks, one to the east and another to the west of the great Gunduk) the appearances now mentioned might be accounted for by supposing a series of high floods in the great Gunduk, which caused it to fill and overflow its own bed, and that of other streams to which it may have had access, occasioned, say, by the bursting of barriers in the upper portion of its course, (and it drains a great portion of the Nipal territory) behind which masses of loose calcareous matter may have accumulated, and which the water as it escaped swept along with it. But though such hypothesis would explain the fact of a pretty uniform sheet of calcareous matter covering the region now spoken of, it will not clear up all the appearances, for there are alternations of soil, as of Bangar over Bhat, to be met with in some places, which shew that various changes in the condition of the tract have taken place.

North of Selempoor, and on the left bank of the little Gunduk, small eminences abound; these have generally been selected as sites for villages, and are Bangar, or siliceous earth, while the lower lands are Bhat. But I am told in digging wells on these elevations, after the Bangar strata are penetrated, Bhat earth is met with. Did then a uniform sheet of siliceous soil at one time cover this section of the country, which has subsequently in great part been washed away? If so, how come these knolls to form exceptions? Or if not, how came they in their present places?

The Bangar countries, so far as I have observed, undulate more than the calcareous districts, and the water shews a disposition to collect into shallow lakes. The water in the Bhat countries rather affects to form itself into streams, hollowing out for itself in the rains canal-like beds, through which water that would otherwise be stagnant is drained off into the larger rivers. The Bangar country is more congenial to the human constitution, and I may add to horses and dogs also, than Bhat lands are; the inhabitants are better grown, stronger, fairer, handsomer, and the children more gamesome in the former, than in the latter. In the calcareous damp lands goitre prevails, idiots are common, and in general the people are feeble in mind and in body.

The following analyses of some soils will serve to give a more definite idea regarding the land in different parts of the country than is to be got from more general observations.

Analysis of BANGAR SOIL *from Selempoor (specimen long gathered.)*

Water of absorption	1·75
Taken off by filtering solution in distilled water	2·75
Carb. of Lime	0·2
——— Magnesia	0·25
Ox. Iron.	2·2
Alumina	9·75
Silex	80
	9·69
Loss.	0·31
	1·00

This specimen was gathered from a patch of uncultivated ground, but which would grow good poppy or sugar cane, &c.

Analysis of a stiffer Soil (MUTTEEAR BANGAR) from a lower site in the same neighbourhood (specimen had been exposed to rather damp weather before being manupulated.)

Water of absorption	5·3
Taken off by solution in distilled water....	3·5
Carb. Lime	1·0
—— Magnesia	0·5
Ox. Iron	2·75
Alumina	13·6
Silex	71·25
	9·79
Loss.	2·1
	100·0

Analysis of BHAT SOIL *from Perruna (specimen long gathered.)*

Water of absorption	3·25
Taken off by filtering solution in distilled water	2·5
Carb. Lime...	25.3
—— Magnesia	2·0
Alumina	7·0
Iron	0·25
Silex	57·75
	98·05
Loss.	1·95
	100·0

Soil adapted for growing Falginee indigo (i. e. sown in March, and not irrigated) as in the Tirhoot factories, which are generally on this kind of land, and confined to the calcareous region upon the great Gunduk.

It may also be worth stating, that matter deposited in the reservoir of an Indigo factory supplied with water from the Gogra, when treated with dilute muriatic acid (2 water and 1 acid) shewed a loss of 7·5 per cent.; so that river seems to bring down much more lime than the soil in its neighbourhood, i. e. six or eight miles from it contains; again, matter deposited in a reservoir supplied from the little Gunduk at Selempoor when similarly treated to the above, shewed a loss of 27·5, and thus seems to carry with it mud as rich in lime as the soil about Perowne.

D. LISTON.

NOTE.—Mr. Liston's paper opens a wide field for researches of immediate interest to geology, agriculture, and medicine, and the results to which he has been led are already of deep importance to each of those branches of science —ED.

Annals of Natural History; or Magazine of Zoology, Botany, and Geology.—Conducted by Sir W. Jardine, P. J. Selby, Esq. Dr. Johnston, Sir W. J. Hooker, *and* Richard Taylor, Esq.

The November number of this Journal contains an article by M. K. E. Von Baer, (translated from Wiegmann's Archiv, part 2, 1839) on Animal Life in Nova Zembla, which we have transferred to our pages. 2. A paper on the fructification of Lycoperdon, Phallus, and their allied genera, by the Rev. M. J. Berkeley, M. A. The development of the reproductive organs of Trichogastres and Phalloidei was quite unknown till Klotzsch examined a species of the former group, *Rhizopogon virens.* In *Lycoperdon cœlatum,* or *L. gemmatum,* Mr. Berkeley found the reproductive organs correspond with those of true *Hymenomycetes.* Of the genus *Phallus,* Mr. Berkeley had only an opportunity, of examining *P. caninus,* which also corresponded with Hymenomycetous fungi. 3. Horæ Zoologicæ, by Sir W. Jardine, Bart. Notes on collections, and remarks of correspondents on the habits of foreign birds. Mr. James Kirk remarked that a species of Crotophaga inhabiting the island of Tobago differs from the habits usually ascribed to other species, of hatching in concert. 4. Conclusion of Extracts from rough Notes of a Journey across the Pampas of Buenos Ayres to Tucuman, by James Tweedie, Esq. 5. On Laurus Cassia of Linnæus, and plants producing Cassia Bark of commerce, by Robert Wight, M. D. reprinted from the Madras Journal of Literature and Science, 1839, No. 22. The question being referred to Dr. Wight by the Madras government whether the Cassia bark is yielded by Laurus Cassia, Lin. or some other plant, Dr. Wight first shows that Linnæus confounded three distinct plants under the above name, which should therefore be expunged from botanical nomenclature. Two of the species included under the term Laurus Cassia yield cassia. The one considered by Dr. Wight to be *Cinnamomum iners,* Nees, and the other *C. aromaticum* of the same author, but the list of Cassia plants is not confined to the two in question, but Dr. Wight believes extends to nearly every species of the genus. There is one, a native of the Malabar Coast, the bark of which is exported, and three or four other species are natives of Ceylon, exclusive of the Cinnamon proper, all of which greatly resemble that plant, and in the woods might be mistaken for it, and peeled, though the produce might be inferior. Thus we have from Western India and Ceylon alone, probably not less than six plants producing cassia, with as many more species of Cinnamomum, all remarkable for their family resemblance, and possessing aromatic properties. 6. On the discovery of Fossil Teeth of a Leopard, Bear, and other animals in a pit situated in the crag formation at Newbourne, in Suffolk, by Charles Lyell, Esq. F.R.S., V. P.G.S. Mr. William Colchester, of Ipswich, having pointed out to Mr. Lyell these teeth, one was observed to be a carnivorous mammifer, and on submitting it to Mr. Owen, he found it the posterior grinder of a leopard, nevertheless Professor Owen observes the teeth of feline animals agree so closely in every thing but size, that the identity of the fossil with any existing species could not be affirmed on the evidence of a single tooth; the fragment, however, is decisive evidence that a feline animal as large as a leopard existed at the geological epoch of the rock in which it was found. Mr. Searles Wood selected from amongst a collection of fishes' teeth from the same formation others, referred by Mr. Owen to a kind of bear, hog, and a large ruminant of the size of the red deer; these fragments are all more or less worn, and as no remains of terrestrial quadrupeds have been previously met with in this formation, Mr. Lyell thinks that as Mr. Wood had found two species of fresh water shells, and estuary species, in the same vicinity, a river may have washed these, together with the bones of land animals, into the open sea. 7. On the occurrence of Fossil Quadrumanous, Marsupial, and other Mammalia in the London clay, near Woodbridge, in Suffolk, by Charles Lyell, Esq. F.R.S., V. P.G.S. Mr. Colchester found in a bed of sand near Woodbridge, which he supposed to belong to the London clay formation, a tooth which he conceived to be that of a mammiferous quadruped. Mr. Lyell requested Mr. C. to conduct him to the spot, where Mr. L. found the deposit to consist of brown clay laid open to a depth of 12 feet, and below this sand in layers, yellow and white, which had been pierced to a depth of 12 feet without reaching the bottom. Precisely at the junction of the clay and sand, Mr. L. found numerous teeth of sharks, similar to those which had been found with the mammalian tooth. Mr. Lyell considers the bed in which these remains were found as belonging to the Eocene period, as they underlie the crag, and contain septaria, shells, fruits, and bones of turtles, such as characterise the London clay. The tooth on being shewn to Mr. Owen, was pronounced to be a molar of an opossum, about the size of *Didelphys virginiana.* When subsequently Mr. Owen instituted a more minute and extensive comparison, with a view of giving an anatomical description of the tooth above mentioned, he discovered clearly that it was not a *Didelphys*, but the molar of a monkey of the genus *Macacus*, constituting at once the first terrestrial mammifer which had been found in the London clay, and the first quadrumanous animal hitherto discovered in any country in tertiary strata as old as the Eocene period. Soon after this Mr. Searles Wood visited the spot where the tooth was found, and prevailed on Mr. Colchester to search in the sand that had been previously thrown aside from the bed containing numerous teeth of sharks; the result of his examination was the discovery of a lower jaw, referred by Mr. Owen to the genus *Macacus.* Pursuing his researches, Mr. Colchester afterwards met with another jaw which Mr. Charlesworth has since described as the jaw of an opossum, a genus to which it will be seen Mr.

Owen also considers it in all probability to be allied. Lastly, Mr. Owen referred other teeth subsequently found by Mr. Colchester in the same deposit to insectivorous bats. The next article is Mr. Owen's description of the above interesting relics.

In the December Number of this publication, the first paper is a description of a shell bank in the Irish sea, by Edward Forbes, Esq. Mr. Forbes has been in the habit of making observations on the character and number of species resorting to this scollop bank, which lies five miles from the northern coast of the Isle of Man, his attention being chiefly paid to the manner in which the varieties of molluscs live and associate together. The bank is about twenty fathoms below the surface of the sea, and is thickly covered with *Pecten opercularis,* among which there are a few common oysters and other Pectens, as *P. maximus* and *P. varius.* The edge of the bank is gravelly, and chiefly occupied with univalve shells, as *Murex erinaceus, Trochus zizyphinus,* and *Natica alderi.* Between the bank and the shore, but nearer the latter, there is a great tract of fifteen fathoms in depth, where Laminaria and other marine plants grow, and which is covered with stones of considerable size, consisting of porphyry, sienite, granite, slate, and limestone.

The testaceous mollusca here most abundant are *Pecten opercularis, P. distortus, Modiola vulgaris, Hiatella rugosa Chiton cinereus, Buccinum undatum, Trochus zizyphinus, T. tumidus, Nassa macula, Lottia pulchella.* Mr. Forbes then enumerates lists of the different species that visit the bank, and notices whether they are gregarious or solitary, regular, or only accidental visitors. Mr. Forbes' object in conducting these observations are no less with a view to the advancement of our knowledge of the habits of animals, than of their subservience to geological science. Supposing the bank converted into a fossil bed, the relative proportion of bivalve to univalve remaining would depend on the part of it examined. Of Echinodermata we should probably, Mr. Forbes thinks, find the sea-urchins only, and as they generally fall to pieces like chitons, we should be obliged to determine the species from fragments. This however we do not find to be the case with fossil species, which are generally very complete with the exception of the spines. Mr. Forbes is right in regarding such observations as calculated to promote equally the interests of both geology and zoology.

The next papers are,—a continuation of Dr. Johnston's remarks on the British Nereides, in which several new species, and three new genera of these interesting annulose animals are described with much taste and ability. A continuation of Mr. F. Walker's description of British Chalcidites. An excellent paper on the Anatomical Structure and Organization of the Stems of Plants, by Dr. M. J. Schleiden, translated from Wiegmann's Archiv. part 3, 1839. On the Fungi of the neighbourhood of Bristol, by H. O. Stephens. On the Arctium Lappa and Bardana, of Sir J. E. Smith, by C. C. Babington. A continuation of the late lamented Mr. Cunningham's account of the Botany of New Zealand. Information respecting Botanical Travellers, &c., with Bibliographical Notices and Proceedings of Societies. From the latter we extract an account of Mr. Griffith's collection of Insects of the Khasiah mountains, by the Rev. F. W. Hope, President of the Entomological Society;* also a notice of the remarkable diffusion of Corraline Animalcules from the use of Chalk in the arts of life, by Professor Ehrenberg.

The January number contains a short paper on the distinctions of two species of Allium, by C. Babington, Esq. A notice of some Fungi collected by C. Darwin, Esq. during the expedition of the Beagle, by the Rev. M. J. Berkeley, M.A., F.L.S. Zoological notices by Dr. A. Philippi. Remarks on Dr. Philippi's paper, by J. E. Gray, Esq. Notices of

* These we believe formed no part of the collection made by the Assam Deputation, as Mr. Hope supposed, but were found by Mr. Griffith's private collectors in the Khasia mountains when he himself was employed in Boutan. The Entomological collection made by the Assam Deputation is still, for ought we know, in possession of Dr. Wallich.

Botanical Excursions in the neighbourhood of Trieste, by Edward Forbes, M.W.S. On the habits of Apterix Australis, by the late Allen Cunningham, Esq. Characters of four new Cape Orchidaceæ, by Prof. Lindley. On the occurrence of *Squalus spinosus*, Lin. on the coast of Yorkshire, by Arthur Strickland, Esq. Remarks by Sir W. Jardine, Bart. on the Habits of the Crotophaga continued. Continuation of information respecting Botanical, Travellers, with several interesting bibliographical notices, from which we make a few extracts, as well as from the Proceedings of the Zoological Society for March, 1839, in which we find several Indian species of Insects described in a paper by the Rev. F. W. Hope.

The Edinburgh New Philosophical Journal. Conducted by Professor Jameson, *No.* 55, *October* 1839, *January* 1840.

The January number of the Edinburgh Philosophical Journal contains the Researches of Professor Reich on the electrical currents in metalliferous veins, first discovered by Fox in the copper veins of Cornwall, and published in the Philosophical Transactions 1830, ii. p. 339. A fresh surface being formed on the opposite points to be connected, and on each of these a copper disc was kept firmly pressed by means of a strut, when the naked end of a copper wire spun over with silk was kept pressed on the copper plate by means of a clamp. Near the points of contact between the two wires Schweigger's multiplicator, with a very sensible double needle, was placed. The following are the results deduced from forty-eight experiments.

I. Two ore-points separated by a non-metalliferous mass, or between which occurs a cross vein, or the vein is worked out, give rise to an electric current in a metallic wire connecting them.

II. Two ore-points in uninterrupted metallic connection with one another, induce no electrical current through a wire connecting them.

III. If only one disc be connected with an ore-point, and the other with the timbering, or held in the hand, there is no effect produced.

IV. If an ore-point is connected with masses of ore already won, a current sometimes manifests itself, sometimes none.

V. When an ore-point is connected with a non-metalliferous rock, frequently no current—frequently, however, a current, though always feeble, yet distinct,—takes place in the connecting wire.

In several cases Professor Reich found no trace of deviation in the force of the electric current.

A paper on the Glaciers of the Alps, by M. J. Andre De Luc, from the Biblioth. Universelle de Geneve, 1839, forms the next article. M. Agassiz, in a paper which recently appeared in the same work, ascribed the movement of glaciers to the expansion of water; but M. De Luc considers that water infiltrating into the fissures beyond a certain depth cannot be frozen, and consequently cannot expand, since ice is so bad a conductor of caloric that water at a depth of a few feet in it will not congeal. He ascribes the movement of Glaciers to two causes, namely, the accumulation of snow on their upper surface, and the melting of the ice.

Previous to the year 1812, the lower extremity of the Glacier des Bossons was surrounded with pines, the size of which indicated that they must have been in undisturbed possession of the soil for ages. But in 1812, when a succession of six cold summers commenced, the glacier made successive advances both in length and breadth, and this progression continued till 1818, when it had destroyed the pine forests and covered meadows which it had never reached before. In 1820 it began to retire, and in 1822 had retired considerably, and left the surface of the meadows covered with blocks of stones and rocks of great size. M. Agassiz supposes that by rolling stones beneath them, glaciers polish the surfaces of the rocks over which they pass, but this observation is not confirmed by M. De Luc.

This number also contains another interesting paper by the same author, on the transverse valleys or openings in chains of mountains by which rivers escape, together with an article by the late Professor Hoffmann on rivers which break through mountain chains. M. De Luc alludes to the erroneous supposition of a late traveller, who thought the Indus and Sutledge the only two rivers in the world which traverse gaps at right angles to the mountain-chains in which they rise, and instances the Rhone, the Rhine, the Danube, the Elbe, the rivers of Asia, Africa, and America, as examples of a similar course. M. De Luc alludes to the remark of Addison, who after observing the source of the Rhone in the very heart of the Alps, and the numerous clefts and rents by which it escapes, "could not but think it has been guided by the particular hand of Providence." The Elbe finds a deep passage of surprising aspect through the mountains which divide Bohemia from Saxony, the particulars of which are described by De Luc. The Rhine crosses the Jura chain, between Mont Terrible and the Forèt Noire, where the mountains are almost perpendicular. Again the Rhine encounters the Eifel, a chain of mountains through which it passes by a gorge. M. Ami Boué states that the first narrow passage of the Danube is a rent which cuts a mountain across, and in its course passes several similar defiles called Les Portes de Fer, the opposite sides of which all appear to correspond, as if they had formerly been joined, and now merely broken by their gaps.

The Tigris issues from Diarbekir by a long defile, which arrested the march of the Greeks under Zenophon from the narrowness and steepness of the rocks.

The Irtisch and Yenisei, two great rivers in Siberia, both traverse a continuation of the lesser Altai chain.

Burchell mentions six openings in mountain-chains which run across Southern Africa, called *kloof* by the Dutch. The *kloof* of the river Hex is a sinuous defile, on each side of which mountains rise in majestic forms, the strata of which appear to have been subject to much disturbance. The Roodezands kloof, or red sand kloof, through which the Berg flows, is a narrow defile, presenting a superb appearance.

In America, the Susquehanna, which descends from the crest of the Alleghany chain, cuts the Blue mountains in Pennsylvania. The Potomack passes in the same manner through another crevice in the same chain, as does the river James in Virginia. M. De Luc then alludes to the Tennessee, which perforates three mountain chains. The description of a gap in the Blue-ridge is next quoted from the American Journal of Arts and Sciences, vol. xix. In South America the Orinoco forms the great cataracts of Maypuris and Aturès, where it passes through a fissure in a chain of mountains. The Amazon follows a longitudinal valley of the Andes for 200 leagues, and finally issues in the direction of Borja by a very narrow pass, twenty-five toises broad, and two leagues in length.

Hoffmann states that all large rivers of the globe burst from transverse fissures, termed gates or passes *(Pforten)*, and there is hardly any important chain of mountains which is not at some point cut through transversely to its line, of bearing.

The greatest range of mountains in the world, he says, the Himalaya, is broken across by the Brahmaputra. We have ourselves seen some of the great defiles of the Himalaya, and can bear witness to the magnificence of the scenery, as well as to the narrow and precipitous character of the fissures by which numerous rivers escape. The Gogra, on the northern boundary of Nipal, issues from a fissure so narrow and precipitous as to prevent the possibility of forming a foot path within it. This defile extends across a succession of mountain chains from the source of the stream to its exit from the mountains, a distance of fifty miles. The five great branches of the Brahmaputra emerge from lateral fissures in the Himalaya into the valley of Assam by as many gaps or Doars. We have never approached sufficiently close to any of them to become acquainted with their local scenery, but this is probably equal to the pass of the Gogra, if not still more magnificent. It does not appear from the papers of MM. De Luc and Hoffmann that any attempt has been made to assign a cause for this universal peculiarity, although we think it may be accounted for by the following consideration.

Mountain chains are usually extended along the centre of continents, where they run more or less parallel with seas. The waters which their lofty summits attract from the atmosphere would thus be conducted along their narrow vallies, instead of falling from their sides to fertilize, as they do, extensive portions of the earth, which would otherwise be uninhabitable. We cannot be surprised therefore that Addison, De Luc, and others, should have perceived something like the hand of Providence in directing the course of the Rhine through the chasms that appear to have opened for its escape, and that the attention of philosophers should be now awakened to equal indications of design in the lateral defiles by which nearly all the great rivers of the earth emerge from their mountain barriers. With the exception of MM. De Luc and Hoffmann, we are not aware of the subject having specially occupied the minds of geologists, and they seem to have merely noticed the effect, without regard to the causes to which it may be ascribed.

The power of water in overcoming resistance, is in proportion to the velocity of its current, or the obliquity of its fall; the fall must always be more rapid in a direct than in a circuitous course, and hence there must be a tendency in all rivers to effect the shortest passage to the sea. Where mountain barriers are in question, no hydrostatic power could of itself effect a breach; but when this power is conjoined with the effect of earthquakes, we can at once understand, from innumerable instances of the power of such combined agency, how fissures in the sides of mountain-chains may be effected for the transmission of great rivers. Here also we perceive a *use* in earthquakes which we were not aware of before, for without their agency in effecting lateral fissures in mountain chains for the transmission of fertilizing rivers, three-fourths of the earth would be uninhabitable. Thus whatever mystery the cause of earthquakes may be involved in, and whatever local and temporary desolation and dismay they occasion, we have the most conclusive natural evidence of their good effects as the agents of salutary changes and diversity on the surface of the earth. Mr. D. Liston's paper on the deposits of the Gogra and other rivers, which will be found in our present number, shows how the character of the most flat, and apparently uniform, plains may be diversified in their influence over plants and animals by the various rivers which pass over them, depositing earths of various kinds, some suitable for one form of vegetation and some for another; and some again exercising a peculiar influence over the health and constitutions of animals, thus affording scope for the exercise of human reason, enterprise, and industry, which would be altogether wanting, but for the lateral fissures in mountain chains—the salutary results of earthquakes, phænomena which, from the neglect of physical science, have been hitherto regarded only as calamities.

We are glad to see the Structure of Fishes' Scales become the subject of research in Europe. The notice of Dr. Mandl's labours which we have seen, is contained in the January number of the Edinburgh Philosophical Journal, from the Ann. des Sciences Naturelles, and although the most important part of the work is omitted, or that which relates to a description of the scales examined, still we may gather something of interest from Dr. Mandl's views and opinions.

Dr. Mandl observes, that the merit of having first called the attention of naturalists to scales, is due to M. Agassiz; but being *deprived* of the aid of the microscope, not only the organization of the scale remained concealed from him, but he inevitably confounded scales of the most different forms. Nothing, says Dr. Mandl, can be more different than the scales of the Muges, Atherines, and Cyprini, though all comprised in the same order by M. Agassiz, on account of a supposed conformity of structure of their scales. Yet Dr. Mandl thinks the study of scales may be made the foundation of a natural arrangement of fishes; just as much we should say, as the study of any other part admitting of an equal facility for examination. It is singular how completely averse the naturalists of the Continent are to the adoption of the more general method of viewing subjects of this nature. An organ, whether it be a tooth, fin, wing, or scale, an eye, or a mouth, can only become the foundation of a natural system of classification when it is found to present peculiarities sufficient to mark the structure of the species to which it belongs. Scales appear to Dr. Mandl to be sufficient for the natural classification of fishes, but the microscope is required to reveal their form, and in consequence of not having used it, the results of M. Agassiz are in some degree vitiated.

In all ordinary cases, the value of characters depends on their being easily accessible and plain. If, for instance, we have as many points to take into account in determining between two scales, as between two entire specimens of the animals they belonged to, the difficulties of the case would remain pretty much the same, while there might be additional chances of error on the side of restricting our means of comparison within too narrow limits. It is in researches regarding fossil fishes, that the form of scales has proved so important, and it may be doubted whether the results would be rendered more striking under a more rigorous use of the microscope.

"M. Agassiz, in recent times, has strongly drawn the attention of philosophers to the form of scales, by assuming them as the basis of his classification. After having said a few words, in the work quoted below, on the structure of the skin, he speaks first of the position of scales, and then of their form.

"M. Agassiz explains the different forms of imbrication, without entering into details on the disposition of the skin, and continues thus: 'It results from this that the position of the scales varies much; however, we can usually distinguish pretty regular series, which enable us to determine their position with accuracy, particularly in the case of imbricate scales. The series are disposed obliquely from the fore part backwards, from the middle of the back to the middle of the belly; these series may be called *dorso-ventral.* It is necessary further to distinguish the *superior and inferior demi-series,* and I would call those which extend from the lateral line to the back *medio-dorsal,* and distinguish the *anterior and posterior medio-dorsal,* according as we wish to indicate those which are directed from backwards, or those which are inclined from behind forwards. The same thing should be done with the series below the lateral line, which I call *medio-ventral,* such as extend from the lateral line backwards or downwards, being the *posterior medio-ventral,* and those directed forwards *anterior medio-ventral.*

" 'Scales,' continues M. Agassiz, 'are contained in the mucous cavities, or in small bags formed by the chorion, to which, however, they do not adhere by means of vessels.' We may observe that this point by no means appears to us to be settled; we shall afterwards bring forward observations which contradict the idea. 'They are formed of corneous or calcareous plates or leaves, superimposed on each other, and which are secreted at the surface of the chorion; these leaves successively attach themselves to the lower surface of the preceding ones, to which they become soldered by layers of indurated mucus.' This is Leuwenhoek's idea, only he called these leaves *scales.* 'In order to form an accurate notion of this development, it must be first examined in genera of fishes, in which the scales appear to present these dispositions in the most simple state; for example, the eel, blennies, cobitis, and leuciscus. . . . It is easy to convince oneself that the concentric lines of the anterior edge and those of the posterior edge are continuations of each other.' Nothing can be more opposed to M. Agassiz's opinion than the scales mentioned, the concentric lines of which are nothing more than insulated cells.

" 'After macerating scales for some time in water, they can be easily divided into a great number of plates or leaflets, more or less thick, and of different sizes, but all retaining the shape of the scales. These leaflets are disposed above each other in such a manner, that the smallest occupy the centre of the scale and form its exterior part, while the largest, with their margin projecting beyond the preceding, are soldered successively to their lower surface. We thus see evidently that the concentric lines visible on the surface of scales are simply the edge of the leaflets composing them.' The fact related by M. Agassiz can refer only to the leaflets of the lower bed, which are separated by maceration; his conclusion, therefore, is founded on a false interpretation, which, in other respects, without the aid of the microscope, cannot be correct. All the modifications observed in the form and nature of the surface in scales, arise from the form of the augmenting leaflets, and the manner in which they are placed above each other. Layers of enamel are deposited on the outside of some scales (as among the Ganoides).

"With regard to the longitudinal canals, M. Agassiz calls them furrows. 'There are grooves at the margin of their outer surface, which correspond to each other in the different leaflets, and multiply during the growth of the scale.' In describing the different external forms which the contour of scales presents to the naked eye, M. Agassiz likewise mentions the lobes, and continues thus: 'When these lobes are hardened in the form of small teeth or very sharp serratures, and are only found in the last leaflet (the preceding successively disappearing as they become blunter), scales are then produced having a simple serrated edge; but when they are found on many consecutive leaflets, the edge of the scale is covered with numerous rows of points, and it is then very rough to the touch.'

"We shall afterwards see that our explanation of these points differs materially from that given by M. Agassiz; that we find them to be distinctly organized formations, composed of an envelope and a dentiform body, which presents roots, different surfaces, many degrees of developments according to position, and different forms in different families of fishes.

"Lastly, M. Agassiz establishes the principal divisions of the class of fishes according to the form of the scales. 'I believe that I have found,' he says, 'in the differences presented by scales, a means of tracing more exactly the natural affinities of all kinds of fishes. It cannot at least be disputed that the animals of this class possess, in their scaly integuments, a character peculiar to themselves, and not found to exist in any other class. The following are the orders and the names of the principal families: 1st Order: The PLACOIDES.—Thus named on account of the irregularity of the solid parts of their integuments; these consist of masses of enamel, often of considerable dimensions, at other times reduced to small points, such as the rings of the rays and the different shagreened surfaces of rays and sharks. 2d Order: The Ganoides.---The character common to all these is the angular form of the scales, which are composed of two substances, namely, corneous or osseous leaflets placed one above another, and covered with a thick layer of enamel. M. Agassiz includes many families both recent and fossil in this order, such as the Sclerodermes, Gymnodontes, Lophobranches, Goniodontes, Silures, and Sturgeons. 3d Order: The Ctenoides.---The scales are formed of plates pectinated on their posterior edge; the pectinations of these numerous plates superimposed on each other, so that the margin of the under one projects beyond that above it, rendering these scales rough to the touch. This structure is particularly remarkable among the Chenodontes and Pleuronectes. Here likewise are arranged the Percoides, Polyacanthes, Scienoides, Sparoides, Scorpionoïdes, and the Aulostomes. We shall afterwards have an opportunity of learning that these combs are very far from being simple plates, so arranged that the under ones always project beyond the upper: we shall see that they are true teeth, all the development of which admit of being traced. This structure must needs have escaped M. Agassiz's observation, in consequence of the insufficiency of the means he employed. For the same reason, this distinguished observer has not discovered the form of the teeth in many of the families he has placed in the following order. 4th Order: The Cycloides.---The families belonging to this order have scales formed of simple plates, with a smooth border; a structure which does not prevent their surface being frequently ornamented with various designs, imprinted at once on all the scales on their outer part, which is not covered. Here we must place the Labroides, Muges, and Atherines, Scomberoides, Gadoides, Gobioides, Murenoides, Lucloides, Salmones, Clupeæ, and Cyprini. We shall subsequently see that this order contains families whose scales present the most strongly marked differences. Assuredly we cannot assimilate the scales of the Cyprini to those of the Gobioides, nor arrange the Muges with the Atherines; the Muges present distinct teeth, although it may be true that the scales are not rough to the touch. In the family of the Cyprini there is room for sub-divisions. In this case also, a simple magnifying glass produced quite an insufficient enlargement of the objects for such investigations. We shall revert to this interesting point, which has acquired great importance since M. Agassiz's inquiries regarding the form of scales.

"In finishing the history of researches into the structure of scales, we shall only remark, that nearly all authors have shared in the ideas of Leuwenhoek; and that it was impossible for them to comprehend truly either the form or organization of scales, from not having employed the most powerful means of investigation, that is to say the microscope, which has procured more complete results for us.*

Chap. III.—*Scales considered as affordiny Characters for Classification.*

"The most important question in the study of natural history, is the determination of natural characters, that is to say, of characters which bring together the inherent properties of animals,—which are proper to them in their natural state,—and which can be studied either by observing an entire body, or only a few detached parts, and that always without the assistance of other sciences. Now, what is most important in these researches, is precisely to determine characters in intimate relation with the nature of the animal, its organization, the anatomy and physiology of its body, which are, in short, essential, and undergoing no change with the accidents of habitation, food, &c.

"It is the just determination and appreciation of these characters which can furnish us with true and precise notions of species, genera, and families, and enable us to avoid the errors committed by those who imagine they have found, in the most insignificant details, sufficient characters to constitute a new species. Have we not thus seen botanists make two different species of the same flower, as it happened to grow on the sides or in the bottom of a ditch, and might, from this cause, more or less differ in the brilliancy of its flower? Do we not daily see ichthyologists and zoologists creating new species according to changes of colour, size, &c.,—changes which are altogether accidental, and depend entirely on the influences of climate, food, &c. But, apart from the small value attaching to such characters as these, there is still another point most commonly overlooked by naturalists, on which we wish to say a few words.

"Any property whatever, which constitutes a natural character, may vary in different degrees, and thus constitute in its successive changes a continuous series. Relations unite all the members of this series; no one is separated from another by a real difference, and each member of this series may be replaced by another of the same series, without changing the nature of the being. Thus, for example, white

"* The second chapter of Dr. Mandl's paper is devoted to the explanation of the structure of scales. This we have been obliged, in the mean while, to omit, as it requires a greater number of illustrative figures to render it fully understood, than we can at present find room for. The omission, however, is less to be regretted, as it in no way affects the interest or value of the two other chapters, each of which is complete in itself.—Editor. Edin. Phil. Jour.

and red colours, with all their variations, may be found in roses without distinction, and yet no new species be created. All the shades between white and red, form in this case, then, a natural series, the members of which may be substituted for each other without changing the nature of the rose.

"Professor Mohs has made a very successful application of these principles to mineralogy, or, to speak more properly, these ideas of natural characters and the series they constitute, owe their origin to this distinguished philosopher. The creation of the systems of crystallization, such, for example, as the tessular, rhomboidal, pyramidal systems, &c., gave birth to as many natural series, containing a multitude of members, all of which may be substituted for each other, but which are in themselves essentially separated, and cannot be confounded. Thus it is of little importance, for the determination of a species, whether the mineral be crystallized under the form of a cube, or any other derived from that; but never can it present, for example, a pyramid form, for there is no transition between a cube and a pyramid.

"It is only characters, then, which distinguish series, and which admit of no transition, that can authorize us to establish distinctions between beings, and create new species. Whenever there is a passage between the characters of a new individual and those of one previously known, we cannot make a real division. Unhappily the neglect, or perhaps the ignorance, of these principles, has led many naturalists to create a multitude of species founded on distinctions quite futile, and (if I may be pardoned the expression) altogether foolish, producing an incumbrance of new species sufficient to cause disgust for the study of natural history.

"There is only one way to remedy this abuse, that is to study true natural characters, to observe attentively the series they constitute, and to make a rigorous application of them in the classification of animals. Scales appear to us to offer one of these natural characters for the classification of fishes. The intimate connection subsisting between the tegumentary appendages and the organization of the animal, of which we have already spoken in the former chapter, affords a very strong argument in favour of our opinion. We do not wish to rest our case on the reason that, because fishes can live when deprived of their fins, but not when deprived of their scales, it therefore follows that scales have a greater physiological value than fins. Such an argument would be too imperfect and inconclusive.

"The physiological importance of scales has but little to do with our present purpose; we only want to know, in this case, whether they can afford a distinctive character between different individuals. Now, scales preserve the same form, not only in the same individuals but in all the individuals of the same species; they are essentially different in individuals of another family; they constitute different series of form, series which are very distinct in themselves, but the members of which offer all the degrees of transition which unite them to each other. Scales may therefore serve as a natural character in the description and classification of fishes.

"The merit of having first called the attention of naturalists to scales is due to M. Agassiz; but being deprived of the aid of the microscope, not only the organization of the scale remained concealed from him, but he inevitably also confounded scales of the most different forms. It is thus that M. Agassiz states,* that, in the family of the Cyprini, 'all the body is covered with scales formed by a pretty considerable number of plates with the edges smooth and entire; grooves or furrows, more or less numerous, extend from the centre of growth to the edge of the scales,' &c., and he arranges the Cyprini in the family of the Cycloides; but these furrows are canals—these entire and smooth edges of the plates are nothing else than lines resulting from the fusion of the cells, lines which are repeated on all the scales. We thus see that, from the organization not being well known, a characteristic description of scales could not be given, and some were confounded with others which yet offered true marks distinctive of families. We find an example of this in the memoir of M. Agassiz above cited.

"This distinguished savant supposes (l. c. p. 48,) that the relations which connect the Muges and Atherines with the Cyprini have entirely escaped Cuvier, on account of the too great importance which this celebrated naturalist attached to the presence or absence of spiny rays on the back. M. Agassiz had therefore to seek some character common to all these fishes, that he might be able to bring them together, and he says that he discovered this character in their scales, which are all composed of plates of growth with entire edges, and which he calls Cycloides.

"Now nothing strictly can be more different than the scales of the Muges, Atherines, and Cyprini. The difference is so great, that it alone determined us to place the Atherines in a separate family, a measure which had previously been hinted at by Cuvier, and which he would not have hesitated definitively to adopt, had he known the particular characters presented by their scales. We have seen with pleasure that our opinion is supported by Professor Nordmann, who makes an entirely distinct family of the Atherines, as well as of *Mullus*.

* Memoirs de la Societe des Sciences Naturelles de Neufchatel, t. i. p. 34.

"We can no longer affirm, with M. Agassiz, that Fitzinger has done wrong in separating Cyprinus from Cobitis. We shall not here discuss the reasons which determined the latter to effect this separation, but it is certain that the microscopic inspection of the scales justifies it completely, and that this difference alone authorizes a distinction to be made between these two genera.

"We shall not say more in this place in confirmation of our opinion. The examples adduced already demonstrate sufficiently, that the detailed study of scales by the aid of the microscope, can alone reveal their forms. Of this we find a convincing proof in the incomplete results M. Agassiz obtained by studying them with the naked eye. His vast knowledge, and the care with which he conducted his researches, could not compensate for the insufficiency of his means of observation.

"Another question here arises; how far can the scales afford marks of distinction between species, genera, and families? It will be readily understood, that the detailed and continued study of a great number of well preserved individuals, can alone decide this. It may even be found that the same form reappears in different families, and that the other characters must concur in effecting a classification, in the same manner as the same form of crystallization recurs in minerals altogether different. Hitherto, we have found the forms very distinct and characteristic in each family. If we have not been able to prosecute our researches to the distinction of genera and species, it is for want of a sufficient number of individuals; at the same time we do not believe that we will require to renounce the attempt altogether. Our ulterior observations will throw light on this subject. Meanwhile we have been able to establish differences between families, whose scales M. Agassiz considered identical, as has been proved in the preceding pages."

The following observations on Microscopic Animals in Cretaceous Rocks, by Professor Ehrenberg, we give entire.

On the Calcareous and Siliceous Microscopic Animals which form the chief component parts of Cretaceous Rocks. By Professor C. G. Ehrenberg.*

"In the year 1836, the author communicated to the Academy, that, in the course of his examination of chalk and other limestones, he had found a characteristic feature in the smallest grains of chalk, which, if not identical with, was very similar to crystallisation, and consisted

* From the Reports of the Royal Prussian Academy. Translated from Poggendorff's Annalen, 1839, No. 7.

in these appearing as regular elliptical granular-foliated particles. Further researches regarding organic influence on the formation of limestone have afforded him new and remarkable results. The chalk of Puskaresz, in East Prussia; of the Island of Rügen; of Schonen; of the Danish Islands; of Gravesend, Brighton, and Norwich, in England; of Ireland; of Meudon near Paris; and from Cattolica and Castrogiovanni, to the coast at Girgenti, in Sicily, exhibits two different conditions; one inorganic, which is distinguished by its extremely regular elliptical granular-foliated particles, and their fragments or beginnings; and the other organic, consisting of microscopic polythalamiæ. Every thing that has been said of microscopic calcareous animals,—creatures so minute as to appear only like very small grains,—of nautili, or polythalamiæ of the sea-sand and of the tertiary formations,—all that has been said of these, from the period of Janus Plancus, and Soldani, now a century ago, up to the most recent times, is far surpassed by the countless myriads of animals, much smaller in dimensions, and much less visible to the naked eye, which the author has observed forming whole mountains of chalk. Although D'Orbigny, Nilsson, Pusch, and other distinguished geological and zoological observers, since the year 1826, have noticed individual larger forms of polythalamic nautili in the chalk of France, Sweden, and the Bukowina; although the author himself (in 1836) proved to the Academy the existence of many calcareous polythalamiæ in the flints of the chalk which enabled us to infer the presence of prodigious multitudes of such bodies in chalk; and although, in the tabular view printed in 1837, he named these *Rotalites ornatus* (*Lenticulina*, Londsdale), and *Textularia globulosa* (*Discorbis*, Londs.), as the chief forms of the *Polythalamiæ*, and *Cypris Faba?* (*Cytharina*, Londs.), as an *Entomostracon* of the chalk; although, moreover, Mr. Londsdale, of London, lately (in 1837) reckoned, with the naked eye, 1000 white granules in a pound of English chalk; yet the numbers and masses of forms, chiefly invisible to the naked eye, which the author of the present paper has very recently observed, though anticipated by him, are very much greater. In these investigations he employed a new and peculiar mode of observation.

"As limestone and chalk, by being mixed with water, and magnified 300 times, are seen to contain, besides the granular-foliated particles, likewise coarser opaque particles, which at first seemed to be mere dark parcels of these elliptical granules, or small fragments of larger organisms, the author tried several oils and balsams that increase transparency. These had previously been employed by the author with advantage and success, in the case of infusory animals; but there they were less useful, as they increased the transparency to such an extent as to destroy all light and shade, and also the outlines. But such experiments were eminently successful with the cretaceous animalcules, more especially when turpentine was employed; and of this, the best kind is that obtained from the *Pinus balsamea,* and which is known in the shops by the name of Canada balsam. The use of this substance on finely divided dry chalk, particularly after heat had been applied, distinctly afforded to the author a result which had previously been obscure, viz. that the said chalk contains so vast a multitude of microscopic, and hitherto unknown polythalamiæ, or nautilites, as they have been termed, having a size of from 1-24th to 1-288th of a line, that frequently there must be far above a million in each cubic inch, and hence far above 10 millions in a pound of chalk. In the white or yellow chalk of the north of Europe, the particles of a somewhat crystalline nature, are equal to, if not greater in amount than, the organic remains, according to the respective volumes of the mass; but in the chalk of southern Europe, these organisms, and their visible fragments, greatly predominate; and these consist, as it would seem, exclusively of well preserved polythalamiæ. But when we spoke of a million of polythalamiæ in every cubic inch, we include only those which are well preserved, of which the fourth part of a cubic line, or every 1-12th of a grain of chalk, can be ascertained to contain 150 to 200, which would be equal to 600 or 800 in each cubic line, about 1800 to 2400 in each grain, and from 1,036,000 to 1,382,400 in every cubic inch.

"Besides the polythalamic cretaceous animalcules, siliceous infusoria have been found in chalk at Gravesend, near London.* Professor Ehrenberg has also found the cretaceous animalcules in the polishing-slate from Oran in Africa (tertiary marl, according to Rozet), and in the polishing-slate of Zante; and it has been discovered by him, that even the chalk-marl of Sicily, which there forms whole ranges of hills, and which Friedrich Hoffmann recognised as a member of the chalk series, is composed of extremely well preserved siliceous infusoria, including several of the characteristic chalk animalcules. He likewise recognised three specimens of similar chalk-marl, composed of infusory animals, or calcareous polishing-slate, among Greek minerals brought by Mr. Fiedler; and it has been ascertained that many of the siliceous infusory animals of the chalk-marl of Sicily, Oran, Zante, and Greece, are identically the same, and at the same time do not occur in other

* In the flints of that locality the author also saw distinct scales of fishes, first of all in the collection of Mr. Bowerbank of London; but he afterwards himself found similar specimens, which he carried home with him.

localities. Lastly, by an examination of the nummulite limestone of Cahira, and of the pyramids of Gyzeh, specimens of which he brought with him from Egypt, the author has discovered that they contain the microscopic animalcules of the chalk of northern and southern Europe.

"It appears that the following conclusions may be deduced in reference to the whole subject.

"1. Many, probably all the chalk rocks of Europe, are *the product* of microscopic, spiral, coralline animalcules, which, for the most part, are quite invisible to the naked eye, some provided with calcareous, and others with siliceous shells, and which are from 1-24th to 1-288th of a line in size.

"2. The chalk rocks of Southern and Northern Europe contain, among their component parts, many perfectly similar calcareous animals, of which the most remarkable are, *Textularia globulosa*, *Textularia aciculata*, and *Rotalia globulosa*. *Rotalia ornata*, *Glabigerina bulloides* (D'Orbigny), *Planulina turgida* and *sicula*, *Rosalina globularis*, *Textularia aspera*, *brevis*, *dilatata*, and *italica*, together with *Escharella scutellaris* (*Eschara scutellaris*, Soldani), are the remaining *characteristic* forms of the chalk, to which are also to be added some of the species mentioned by D'Orbigny, and Pusch, and the *Sperulina* of Lord Northampton.

"3. The cretaceous districts bordering the Mediterranean in Sicily, Barbary, and Greece, and generally regarded as tertiary deposits, are therefore, judging from their organisms, to be considered as chalk or secondary rocks; and the nummulite limestone of Egypt is to be viewed in the same light

"4. The chalk strata of southern Europe, round the basin of the Mediterranean, are distinguished from those of the north and east of Europe by their better preserved chalk animalcules, and by the smaller number of their elliptical grains; and the converse holds good.

"5. The chalk strata of the south of Europe contain few or no flints. Those of the north present many extremely regular horizontal beds, which are often only from one to six feet separated from one another. This feature was previously well known; but, what seems new and remarkable, is the observation made by the author, that in the chalk strata of northern Europe, hitherto no marls of infusory animals have been found like those which alternate with the chalk in such prodigious abundance in Sicily, Oran, and Greece. A comparison of the southern infusory-marls, and of the northern beds of flint, at once presents itself to the mind. Thus, by means of this changed relation, the formation of flint would receive its full explanation. A greater age, as deduced from the conversion of the infusory marl-beds into flint-layers, and from the greater decomposition of the calcareous animals, and their conversion into inorganic particles, might thus be assigned to the chalk strata of the north; but still, local circumstances might produce different effects at the same periods, as is, from other circumstances (from the similar chalk animalcules, &c.), more probable.

"6. The want of numerous and varied forms of siliceous infusory animals in the chalk previously noticed by the author, has now disappeared, and, in its place, great abundance has presented itself.

"In all, the author has observed seventy-one different microscopic calcareous and siliceous species of animals in the chalk; but, besides these, also numerous larger calcareous animals (1-24th of a line in size) and many included plants, Tethyæ, Sponges, Confervæ, and Fuci. The varied forms of the genera *Rotalia* and *Textularia* of the Polythalamiæ, appear to him to constitute the great mass of the chalk of all localities. He reckons altogether seven genera and twenty-two species of polythalamic microscopic calcareous animals; and, moreover, microscopic and larger nummulites, cypridæ, &c. Further, he has hitherto determined forty species of siliceous infusory animals which belong to fourteen genera, without including the eight forms previously enumerated, and which were probably soft, and merely included in flint. He has found five species of plants containing silica. In the flints of the Jura limestone of Cracow, he detected well preserved peculiar Polythalamiæ, and remains of Sponges or Tethyæ; and lately, he has found Polythalamiæ of the chalk in the flints occurring in the gault which lies under the chalk at Cambridge in England.

"A general table of these relations of the animals from the chalk and chalk-marl of the fourteen localities observed by him, and also specimens of the rocks, together with a collection of well-preserved microscopic preparations, containing nearly a perfect series of the different species of animalcules, were exhibited to the Academy.

"To this paper Professor Ehrenberg added a preliminary summary of his examination of the Spiral-corals or Polythalamiæ, considered in a zoological point of view."

The next paper on the Extinction of Human Races, by Dr. Pritchard, we shall endeavour to abridge. While other branches of Natural History are diligently cultivated, little attention is paid to Ethnography, while opportunities for pursuing that investigation are daily disappearing for ever. Perpetuity of existence, as far as our ideas of time extend, belongs alike to the smallest inorganic molecules, and the great masses which have offered themselves to the view of countless generations revolving in the heavens. But the tribes of which the organized world consists, have but a definite existence, and when changed, new organized tribes replace the old ones. It would be interesting to inquire whether such changes have any influence on the destiny of ancient races of men. A prize was offered by the Geographical Society of Paris for an essay on the ancient Negro races, stated in Chinese books to have occupied a part of Central Asia; but it turned out that Kuen-lun, the supposed region of these aboriginal tribes, was but the designation of an island in the China Sea. In the remotest part of northern and eastern Asia, tombs of magnificent construction, containing various implements, and ornaments of silver, gold, and copper, are found, which have satisfied the learned academicians of St. Petersburg that they belonged to races which became extinct before the dawn of history.

In the New World, tombs containing skeletons of a different conformation from that of existing tribes have been found on the borders of the Mississippi and Ohio. Even in the islands of Polynesia vestiges are discovered, which have been referred to a former race of inhabitants; and numerous facts tend to prove that extensive tracts of Europe were once peopled by races of different physical character from the present natives, in times which preceded the Celts and Goths. Whatever were the causes, says Dr. Pritchard, which destroyed those ancient tribes, we know to what agency we are to attribute the similar fate of many; whole races have become extinct during the few centuries which have passed since the modern system of colonization commenced. The Guanches of the Canary islands, only exist in their mummies. It would be endless to recount the names of whole nations that have been extirpated in America. Dr. Pritchard saw three individuals exhibited at Paris, the only survivors of the Charreas, the last race that has been destroyed. A similar extermination has been carried on in South Africa, the former abode of the pastoral and peaceful Hottentots, now on the eve of becoming extinct. Wherever the simple pastoral tribes come into relations with agricultural nations, the allotted time of their destruction is near, as when the first shepherd fell by the hand of the first tiller of the soil. "I cannot conclude this paper," says Dr. Pritchard, "without making an appeal to the members of the British Association in behalf of an attempt which has been lately set on foot by individuals to record the history of the perishing aboriginal tribes, and to consider whether any thing can be done to prevent their extermination.

We cannot conclude our notice of the January Number of the Edinburgh New Philosophical Journal, without regretting to see so much of its valuable pages occupied with a report on the Manufacture of Tea, and the extent and produce of Tea Plantations in Assam, by C. A. Bruce, Superintendent of Tea Culture, "*presented to the Committee appointed by Government, consisting of James Pattle, Esq., T. W. Grant, Esq., C. K. Robison, Esq., Dr. Nathaniel Wallich, Rajah Rada Kanth Deb, and Baboo Ram Comul Sen;*" because we think the report is calculated to mislead the public and occasion disappointment, instead of being likely to clear up any of those difficulties that are as yet to be overcome before the Assam Tea Company can expect to reap any return for the outlay of capital.

Mr. Bruce states, that he submits his report with diffidence, having had something more than tea to occupy his mind; nevertheless his knowledge of Tea localities is much extended since he last wrote, embracing no less than 120 different tracts, some of them very extensive both on the hills and in the plains. Mr. Bruce does not state that this number includes the patches of wild tea plants found by Mr. Griffith at Cujoodoo, Hookum, and other places, and those found by Captain Hannay at Jeypore, and we believe by Colonel White, Mr. Bigge, and Captain Jenkins at Namroop, Jeypore, Boorthath, &c. or the nurseries cultivated at Suddyah, by Capt. Charlton, as early as 1834. We shall merely endeavour to examine what information the report before us conveys regarding the existence of 120 tea tracts alluded to above.

Mr. Bruce in crossing a hill 300 feet high at Jeypore, found a tea-tract, which must be three miles in length, as he could not see the end of it; and at the foot of this hill he saw another tract, which he had not time to explore. He next found tea on Cheriedoo, a small hill close to the Dacca River; and again, after crossing the river, at a place called Hauthoweah, near the old fort of Ghergong. Neither of these *four* places Mr. Bruce had time to examine, with a view to the collection of any further personal information than that which we have above stated. Again, Mr. Bruce found tea to the south-west of Gabrew; and thus the 120 localities are reduced to *five*, in which he has himself seen the tea plant growing, even supposing his experience to be such as to render his mistaking some other plant for tea unlikely, which is by no means certain, particularly as he mentions having found on the west of the Dhunseree, a different species from what we use, but still tea.

With this amount of new information, Mr. Bruce proves by argument, as well as the reports of natives "well acquainted with the leaf, having been in the habit of drinking tea," that large tracts of the Naga mountains are covered with tea plants. On information not one whit more satisfactory than that on which Mr. B. clothed large tracts of the Naga mountains with tea plants, has he covered a large proportion of Upper Assam with them, though we have no doubt it will be found, after all, that it is confined to a few limited patches here and there, in various parts of the forests, and by no means universally diffused, and abundant, as Mr. Bruce's report would lead the public to imagine.

As a specimen of Mr. Bruce's way of showing the extent of the wild tea plants, we may quote the following: "In giving a statement of the number of tea-"tracts, when I say that Tingri, or any other tract, is so long "and so broad, it must be understood, that space to that "extent only has been cleared, being found to contain all "the plants which grew thickly together; as it was not "thought worth while, at the commencement of these ex-"periments to go to the expense of clearing any more of the "forest for the sake of a few straggling plants. If these "straggling plants were followed up, they would, *in all pro-"bability*, be found becoming more numerous, until you found "yourself in another tract as thick and as numerous as "the one you left; and if the straggling plants of this new "tract were traced, they would by degrees disappear until "not one was seen; but if you only proceeded on through "the jungle, *it is ten to one* that you would come upon a "solitary tea plant, a little further on you would meet with "another; until you gradually found yourself in another new "tract, as full of plants as the one you had left, *growing* ab-"solutely so thick as to *impede each other's growth.* Thus "I am convinced one might go on for miles from one tract "to another."

Most people in perusing this, would suppose that Assam was covered with tea plants, and that so far from Mr. Bruce exaggerating in saying you might go on for *miles*, the reader would imagine that you might travel from one end of Assam to the other through a succession of tea-tracts. For a *tract* the reader must understand a patch, several patches often occur too in the same vicinity, and it is between these that straggling plants are found. Mr. Bruce, however, calls each of these patches, *tracts*; and the common jungle, *patches.* Thus he says, "All my tea-tracts about *Tingri* and "*Kahung* are formed in this manner, with only a *patch* of "jungle between them, which is not greater than what could "be conveniently filled up by thinning those that have "too many plants. At *Kahung* I have lately knocked three

" tracts into one, and I shall probably have to continue doing " the same until one *tract* shall be made of what now con- " sists of a dozen." Mr. Bruce's substitution of the term *tract* for what is in reality a mere spot, is most unfortunate; and yet it does not appear to have been accidental, as he observes, " I have never yet seen the end of Juggudoo's tea-tract, nor yet Kujudoo's or Ningrew's." Now two at least of these localities were visited by the Assam Deputation, and their extent measured and found to be very limited, and not larger than an ordinary cottage garden. There may be other two or three similar patches in the vicinity, but it appears to us too great a stretch of the imagination to say, that the plants of these isolated little patches " run over the hills, and join or nearly join" similar little spots in distant parts of the country; and to infer, from this supposition, that the whole country is covered with tea plants, or tea forests, as they have been very improperly styled. It is easy to imagine how Mr. Bruce makes up the number of tea districts in Assam to 120, when every patch of jungle in which a few plants occur is considered by him a tract, however closely it may be connected with several other similar little clumps of plants in the same vicinity.

Any one rising from the perusal of Mr. Bruce's report, would suppose that Assam is covered with tea plants, requiring no other cultivation than the mere destruction of the surrounding forests. Mr. Bruce thinks fire is as beneficial to the tea plant, as it is destructive to all others; and that the only cultivation or care that plant requires is merely to burn it down to the roots, by setting fire to the forests in which it is so common. In the first or second year after this, Mr. Bruce is of opinion that we shall have nothing more to do than commence the manufacture of tea from an unlimited stock of plants extended over 120 tracts, which those who peruse Mr. Bruce's report, may consider equivalent in extent to as many districts, or even counties.

Instead of finding Assam one extensive tea garden, however, we suspect that the Tea Company will find that before they can manufacture, they must begin to plant; and that circumspection and skill will be required in the selection of the most suitable lands. We have so poor an opinion of the extent of the wild plant, that we think it would hardly do more than afford sufficient seed for new plantations. So far therefore from all things being ready in Assam for the extensive manufacture of tea for commercial purposes, as the public are led to imagine from the report of Mr. Bruce, we think that every thing is yet to be effected, and that some time and money have been spent in vain, and the public exposed to encounter some degree of disappointment in consequence of Mr. Bruce's report being allowed to go abroad, without a few remarks from the Tea Committee, to qualify what appears to us the extravagant views contained in it regarding the extent of the tea localities. With the Assam tea, as with other objects of popular interest, nothing is received with favour that does not flatter our expectations, however unreasonable and even absurd these may be in reality. We always find in the long run, however, that we have to pay pretty dearly for our indulgence, for while few have the moral courage to express an unpopular opinion, thousands live and flourish for a time by the dissemination of popular error, until something happens to give the question another turn. With regard to the subject before us; all we will venture to recommend is, that such flattering reports as the one we have noticed, be not allowed to impress us with the idea, that the present stock of wild tea plants in Assam is of such extent as to afford any thing like a return to the Assam Company. From what we have ourselves seen of the tea plant in the Sing-Pho jungles, in the Muttack, and in Raja Parunder Sing's territory—the only three tracts in which it occurs—the whole, root and branch, if converted into tea, would not make a single consignment such as would annually be expected from the Assam Tea Company; and after a careful examination of Mr. Bruce's report, as it appears in the Edinburgh Philosophical Journal, we regret to find that in our opinion the 120 tea-tracts with which Mr. B. has covered the map of Upper Assam, are for the most part either imaginary, or altogether dependent on native report. Mr. Bruce's adoption of the term *tract*, for each little patch of jungle in which a few tea plants are found assembled, is, as we have already stated, enough to lead to misconception. It is not however more objectionable than the term, Tea forests, we believe applied in the same way by Dr. Wallich. In our own report we employed the terms colony, and locality; the latter term we believe was adopted by Mr. Griffith, who also used the term *patch* in preference to colony, which was objectionable, in as much as it implied that the plants were introduced rather than indigenous. We think, therefore, that Mr. Bruce should, according to that respect usually paid to priority in such cases, if not to avoid the appearance of exaggeration, have employed some one of the above terms in preference to *tract*, which it might be proper to confine to an assemblage of tea patches, as the Muttack *tract*, Tingri *locality*, Sing-Pho *tract*, Ningrew *locality* or *plantation*, according as the plants may be of the wild, or cultivated stock.

The remainder of Mr. Bruce's report is chiefly made up of details regarding the manufacture of tea; but as these are derived entirely from the Chinamen employed, for whose word Mr. Bruce, as well as the public can have no security, this part of the report is to be received with some limitation. The quality of the tea produced will be the best criterion of the merit of the process or manipulation employed. The proverbial neatness and delicacy of Chinese execution we should have thought at variance with the following part of the process of making *souchong*, as given by Mr. Bruce. "The man then stands up, holding on by a post or some such thing, and works the ball of leaves under his feet, at the same time alternately pressing with all his weight, first with one foot then with the other." . . . "The tea is taken hot from the pan and packed firmly in boxes, both hands and feet being used to press it down," &c. As tea drinkers are not the least fastidious portion of the community, we would recommend Mr. Bruce to endeavour to introduce a substitute for the feet in these operations.

We think it would be a hardship to adopt Mr. Bruce's advice with regard to the prohibition of Opium in Assam. The Assamese have few luxuries, and to deprive them of such as they have, would be doing them a very questionable kind of service. We doubt if levying high duties on opium land would have the effect of preventing the cultivation of the drug; if the Assamese are fond of opium they will have it, and public measures for putting down its cultivation and preventing its introduction, would be rather difficult to enforce in an isolated province, surrounded as Assam is on all sides by countries in which opium might be cultivated without restriction. Mr. Bruce, however, states, that a native of Assam will steal, sell his property, and even his children for opium; and as Mr. Bruce himself dealt in the drug up to the period of his employment as Superintendent of Tea Cultivation, he had doubtless the very best opportunities of witnessing the immoral effects he describes.

Let us hope, however, that the cultivation of tea will in that province be carried on to an extent that will supersede opium both as a source of profit and luxury. It will be our duty to watch the progress of this new staple, and while we shall hail with satisfaction every successful step towards its introduction, we shall freely point out whatever appears to us likely to retard or endanger the final success of the scheme.

Note.—We find the report published in the Edinburgh Philosophical Journal to be the same with that which appeared in the Journal of the Asiatic Society. How it could have passed through the Tea Committee without eliciting some observation from Dr. Wallich, we cannot imagine.

Description of Animal Life in Nova Zembla. By K. E. von Baer.*

Not only the total want of trees, but also of every kind of shrub that would be large enough to attract the eye without being looked for, gives to the polar landscapes a peculiar and deeply impressive character. In the first place all power of measurement is lost to the eye. From the want of the usual objects of known dimensions, trees and buildings, distances appear much less than they are, and for the same reason also the mountains are thought lower. This observation has often been made before and was not unknown to me, yet I found the deception, for which I was prepared, much more complete than I had expected. I knew indeed that on this very account an expedition which King Frederick the Second of Denmark fitted out for Greenland failed in its object.

Mogens Heinson, who at that time was considered an able seaman, commanded the ship: he came within sight of the coast of Greenland, and steered with a favourable wind towards it; but after sailing several hours in the same direction it appeared to him that he came no nigher to the shore. An apprehension seized him that some hidden force at the bottom of the sea held him fast; he turned the ship about and went back to Denmark, with the account that he had not been able to reach the coast of Greenland, having been enchained by a magnetic rock. With this experience and with the naïve declaration of Martens concerning Spitzbergen, "The distances seem quite near, but when they are to be walked over in the country it is quite another matter, and one soon becomes very weary," I was well acquainted, and yet I found the delusion much greater than I could have supposed, and to my eye so perfect that no consideration could rid me of it. I am also convinced that it does not depend upon the want of the accustomed objects alone, but likewise on a peculiar transparency of the air, for it is never so complete on cloudy as on bright days, and not so striking in level as in mountainous regions. In days or hours which are quite clear the air appears to be almost without colour, and as the heights in sight are partly covered with snow, and constituted in part of a dark stone, which appears darker by the contrast, so the small degree of colour which the air may possess cannot be perceived. The mountains therefore apparently advance quite near to the eye, and this perhaps in a greater degree to one who has been accustomed to see hills through a different aerial perspective.

* From the Annals of Nat. Hist. Nov. 1839. Translated from Wiegmann's Archiv, part 2, 1839.

Another effect of the want of trees and even of a vigorous growth of grass is the sensation of loneliness, which seizes not only on persons of reflection but even upon the roughest sailor. It is by no means a sensation of fear, but rather a solemn and elevating one, and can only be compared with the mighty impression which a visit to alpine regions always leaves behind.

The once-conceived idea that the morning of creation was dawning for the first time, and that life was yet to follow I found it impossible to repress. Nevertheless an animal is now and then seen to stir in Nova Zembla. Sometimes a great sea gull *(Larus glaucus)* is seen to hover in the air at some distance from the coast, or a swift lemming runs along the ground. These however are not sufficient to give life to the landscape. In calm weather a want of sounds and motion is felt, if, as in our case, an expedition be made into the interior, after the departure of the numerous geese which pass their moulting season on the sea shore. Besides, even the few land birds in Nova Zembla are mute, and the insect tribe, proportionally much scantier, is also noiseless. Even the polar fox is only heard at night. This total want of sounds, which especially prevails on serene days, reminds one of the stillness of the grave; and the lemmings, which coming forth from the earth, glide along in straight lines, and then again quickly vanish into it, appear like spectres. From the little motion one sees, in spite of these signs of animal life, it seems to be wanting. In other regions the leaves of plants and trees usually make even a gentle breeze perceptible to us, but a slight wind does not ruffle these lowly plants of the high north; one might take them to be painted. A very few insects only are busy seeking to satisfy their little wants upon them. Of the numerous family of beetles only one individual has been found, a *Chrysomela,* which is perhaps a new species. On sunny days and in warm spots for instance, about the small projecting points of rock, a humble-bee is seen flying about, but it hardly hums, as is the case with us in moist weather. Flies and gnats are rather more numerous; but even these are so rare, so peaceful and languid, that in order to see them they must be sought for. I do not recollect having heard that any one of us had been bitten by a gnat, and one may truly long for the bite of a Lapland gnat, merely for the sake of perceiving life in nature. The most manifest proof of the rarity of insects in this country appears from the following circumstance, that we neither found the least trace of insect larvæ in a dead Walrus which had lain above fourteen days on the sea shore, nor in the bones of animals which had been killed in former years, even though they were not without dried flesh on some parts. The common saying in our funeral service, that man becomes a prey to worms, is not true with respect to the extreme north, and whoever dreads this lot, has only to be buried in Nova Zembla or Spitzbergen, where even the universal decomposing forces of nature will act upon him but very slowly.*

The abundance or scarcity of insects is, next to the vegetable kingdom, the surest measure for the climate of a country. Both need for their subsistence a certain quantity and a certain duration of warmth. This never fails in the torrid zone, but as we approach the north it does so in an increasing degree. Insects are however less easily transplanted than plants. That we know of no true insects from Spitzbergen may well be ascribed to this cause. M. Lehmann nevertheless observed ten species in Nova Zembla, and of these, seven which are not parasitic. Fabricius described many more species from Greenland, and amongst these even several butterflies, and Scorseby has added to them some few new species from East Greenland. But West Greenland, which in common life has been considered as the type of all northernmost countries, from its having already been known for a longer time through the Moravian missionaries, must, especially in its southern districts, be a more highly favoured country, for it has (even if we pay no attention to the old fabulous accounts) at the present time, under 61° N. latitude, birch trees from 12 to 18 feet high, and of the thickness of a man's thigh, and among these mountain ash. (Egede, Account of the Greenland Mission, p. 78.) EGEDE, found the corn, which he had sown as an experiment under the 64° of latitude, not only in ear but already with small grains on the 13th of September (*Ibid*, p. 106 and 112). Things therefore wear a very different appearance from those in Nova Zembla, and the meteorological observations show sufficiently that it is much warmer there. But even regions which enjoy a much lower mean yearly temperature than Nova Zembla are much richer in animal life, if the summer do but develope more heat. To select a less known example, I will refer to Nyshne-Kolymsk, with a mean temperature of 10° C. According to Wrangell's observations the boundary of the lofty woods is not far off, and perhaps they would extend to this place were it not for the nearness of the coast, for at Nyshne-Kolymsk there are stunted Siberian cedars and bushes in plenty. During the short summer there the gnats are an intolerable plague.

The coast of Nova Zembla is rendered far more lively than the interior of the country by the sea-birds which make their nests there. Their number and variety is indeed not so great as upon the Norwegian coast or some isles and cliffs of Iceland, but even here

* At some depth the bodies remain frozen, but even above the earth they decay remarkably slowly.

one finds the coast thickly filled with them in some spots, and they receive any one who approaches with loud cries. Above all, the Foolish Guillemot *(Uria Troile)*, which is perhaps as numerous as all the other birds put together, dwells in such colonies, sitting in thick troops and in many rows one above another upon the scarcely perceptible shelves of perpendicular rocks: they rouse themselves when any one approaches, and cause the sides of the dark rock to appear spotted with their uplifted white bellies. The Russians call such a brooding place a bazaar. Thus this Persian word has been transplanted by Russian Walrus-fishers to the rocks of the frozen ocean and applied to birds in default of human inhabitants. Upon the points of isolated cliffs, and enduring no other birds near it, lives the large grey sea gull *(Larus glaucus)*, which the Dutch whale-fishers, I know not why, whether from respect or a want of it, have named the Burgomaster. It seems to feel itself the lord of this creation, for before a whole company of fishermen it is bold enough to pick and choose from the fish that have been thrown upon the shore.

These birds are the best proofs that there is more to be had from the bottom of the sea than on land. In fact here the chief sum of animal life is sunk under the surface of the ocean. Small Crustacea are particularly numerous here, and above all the *Gammari*, which gather as thickly around a piece of flesh thrown into the water as do the gnats in Lapland about a warm-blooded animal. With a sieve one may take them up by thousands. When we threw lines in Matotschkin-Schar, the Walrus-fishers, who never took this trouble assured us that it would be quite in vain, for in the first place there were hardly any fish there, and moreover the *Kapschaki* (thus they call the *Gammari*) completely consume within a few hours sometimes the bait and sometimes the fish as soon as it is dead. In fact we seldom drew up anything but our empty lines.

Scanty as is the vegetation, it yet feeds a quantity of lemmings. Gentle declivities are frequently burrowed through in every direction by them. But the number of animals is not near so great as might be supposed from the quantity of burrows; for by far the greater part are empty, which one may soon be convinced of by tracking them with dogs, but nevertheless their number is so considerable as to force us to ask how so many lemmings can find support upon such a vegetation. But it is also not impossible that the vegetation appears so small to the observer because the lemmings make a considerable portion of it invisible. If they devoured the roots not much of the vegetable kingdom of Nova Zembla could long remain, and the lemmings themselves would soon perish from want of nourishment. But those captured by us could in no way be brought to eat the smallest root. Since, therefore, when they are at large they certainly devour the flowers only and green parts, and since the plants of this country are all perennial, in the following year they again put forth a stem. I was still more surprised that when suffering the greatest hunger they would touch no Cryptogamia. It is a pity that the small number of ferns which have been found did not allow us to make trial whether these practical vegetable physiologists direct themselves according to the presence of spiral vessels, or follow the divisions of the Linnæan system. There are two kinds of them; one seems to be *Mus grœnlandicus*, Traill, or *Mus hudsonius*, Auct. They quite agree with the description which Richardson gives in the 'Fauna Boreali-Americana;' less with that of Pallas. The other species likewise appears to me distinct from the Scandinavian lemming; in the colour the difference is truly striking. Pallas, who however seems only to have seen young animals, has enumerated it as a Russian variety of the Scandinavian lemming. The first is particularly distinguished by its tameness, for, four-and-twenty hours after it had been caught, it hardly made any attempt to escape when held free upon the hand, and one never sees two individuals of this species quarrelling together. The second, yellowish-brown species is much more ready to fight.

Next to the lemmings the polar foxes are also tolerably numerous. They find in the lemmings, in young birds, and in the sea-animals which are thrown up on the shore, a plentiful sustenance.

On the contrary, polar bears are seldom seen in summer, either because they avoid the places where they scent men, or because they only collect together on those parts of the coast where there is ice. The rein-deer also appear to have become rare, on the western coast at least, from the numerous winterings of late years of the seal-fishers. Not only were very few killed during our residence, but one of the companies which had passed the winter before in Nova Zembla, and had been advised to procure a provision of flesh by hunting the rein-deer, had not been able to obtain any. Wolves and common foxes, which, at least in the southern part of Nova Zembla, also sometimes occur, appear never to have been numerous even there. With this enumeration the list of land Mammalia would be complete, if MM. Pachtussow and Ziwolka had not, during their winter stay, seen a little white animal within their hut, which they in their journal call a mouse. As the animal seen, according to M. Ziwolka's testimony, must have been larger than a common domestic mouse, and therefore could not be an individual of the white variety of this animal brought by chance in some ship, I am doubtful as to what it can be. On one hand it is stated that the North American lemmings become white in winter, but yet not so completely white as the animals of the weazel genus; on the other hand it might also be possible that the little animal noticed was a weazel. In Spitzbergen also a little white mammal has been observed, whose systematic determination is uncertain.

The sea Mammalia are of more importance, and expensive expeditions are yearly fitted out for the purpose of catching them by the inhabitants of the coast of the White Sea; but unhappily the booty is so uncertain that they may be compared to a game at hazard. If the sea is unusually free from ice the losses are very great. One day however may repay the loss of a whole year. For this reason these undertakings have always been renewed for centuries even though they sometimes entirely fail. The result of a fortunate year is usually this, that in the following one too many ships go to Nova Zembla, and either destroy to too great an extent these mostly gregarious animals, or at least scare them away. Thus in the year 1834 some expeditions were very fortunate, after a previous cessation; in the year 1835 about 80 ships went to Nova Zembla, for which may be reckoned at least 1000 men. In the year 1836 the number of the ships diminished to one half. In the current year there were hardly more than 20 ships; but only one, which entered the sea of Kara, made a great profit: one or two captured nearly enough to pay the cost of their fitting out, and of the rest the greater part lost far more than a half.

The most important animal for this chase is the Walrus, and after the Walrus the Dolphin *(Delphinus Leucas)*, known under the name of the white whale, but which is here called Bjelucha or Bjeluga. Among the seals the sea-hare (Morskoi sajaz), *Phoca leporina*, Lep, *Ph. albigena*, Pall., but probably not distinct from the *Phoca barbata* of Fabricius, gives the richest produce, both as regards its size and quantity of fat, as well as its thick skin. *Phoca grœnlandica* bears among the Russians very different names, according to age and sex: the old full-coloured male is called Luisan or Luisun; the female, Utjälga; the not yet full-coloured animals, of a year old, they call Sjärunok and Sjärka, and the young ones, according to their different colours, Pljächanko, Chochlutschka, Bjăka. But they are not quite accurate in the application of these names to the young animals, for they also apply them to the young of a third species of seal which occurs here, and which when full-grown is called Nerpa. This seal, occurring everywhere singly on the coast, is probably Fabricius's *Phoca hispida.*

A fourth species of seal which belongs to these seas, though not to the coast of Nova Zembla itself, but to the Timanic coast and to the entrance of the White Sea, and even there is not frequently seen, the Tewjak, is said to cover its face with a cap: it is therefore probably the Klappmüts of the Dutch, or *Phoca cristata*, Erxl., *Cystophora borealis*, Nilsson.

Of Cetacea this sea contains in the first place a species of whale of the sub-division of fin-fish *(Balænoptera)*, with very short whiskers, which I saw in Archangel. They rarely appear in the vicinity of Nova Zembla, and one never hears of their being stranded on this coast. Nearer to the north coast of Lapland, where they are almost yearly thrown on shore in the Motowsker bay, they are so frequent that I much wonder why the earlier attempts for the regular pursuit of this animal, difficult it is true to slay, have not been renewed and perseveringly carried on. It is worthy of remark that the Greenland whale never appears to stray into the district of Nova Zembla. For this reason we must believe that the whale-fishery which the Northmen carried on, according to Ohthere's testimony*, in the ninth century, in the neighbourhood of the North Cape, was for this very fin-fish. Far more rare is the Narwal *(Monodon Monoceros)*: and only in the neighbourhood of ice. Of Dolphins, this sea contains, besides *Delphinus Leucas*, *Delphinus Orca* (Kossatka), and a small species which the Russians call Morskaja Swinja; but I have not been able to learn whether this is *Delphinus Delphis*, or *Delph. Phocæna*.

The sea Mammalia in Nova Zembla would therefore be exactly the same as those known in the Spitzbergen-Greenland sea, if the Greenland whale reached as far.

On the other hand, Spitzbergen and Nova Zembla are strikingly different in their winged inhabitants. The latter country indicates by its birds the vicinity of the continent. It is richer in species, but less interesting to the naturalist; for many of these species are none other than those which yearly pass through our country, and indeed in part remain with us; whilst another part of them go as far as Nova Zembla, in order to devote themselves to the business of brooding where they may be undisturbed. Of land birds we found the Snowy Owl *(Stryx Nyctia)*, which indeed passes the winter there; the Snow Bunting *(Plectrophanes nivalis)*, *Strepsilas collaris*, *Tringa maritima*, and a Falcon, which was not very rare in Kostin-Schar, but which could not be shot and more closely examined. Earlier accounts also make mention of an Eagle, but the Walrus-catchers whom I questioned said they knew nothing of it. Perhaps however it is the same as the Falcon.

* See King Alfred's Translation of Orosius, ed. Barrington, p. 241, Forster's note at the end.

Among the web-footed birds which pass the season here the Saatgans are so common, at least in the southern island, that the collecting their fallen wing-feathers is an object of profit; the Ice-duck (*Anas glacialis*) is frequent, and the Singing Swan (*Cygnus musicus*) not rare.

According to the assertions of the Walrus-catchers, only one species of goose comes to Nova Zembla, and we in fact got sight of no other than the Saatgans and the Brent Bernicle (*Anser torquatus*), which latter however does not pass for a goose among the Russians. The Eider duck or Eider goose is also not rare. The web-footed herbivorous birds however collect in much greater numbers upon the island of Kolgujew, which is described as covered with swans and geese, than in Nova Zembla, where the vegetation is too scanty. On this account expeditions are sometimes sent hither to kill and salt these birds. A merchant of Archangel told me that once 15,000 geese were killed here in two hunts.

To the web-footed birds of Nova Zembla belong moreover *Uria Troile* (in unspeakable numbers), *Uria Grylle, Colymbus septentrionalis, Sterna Hirundo, Larus glaucus, Larus canus, Larus tridactylus, Lestris catarractes,* a *Procellaria,* which we however could not procure. *Somateria spectabilis* and *Larus eburneus* are stated to occur only on the northern coast. There also, according to the descriptions we heard, is probably found *Mormon Fratercula* and *Mergulus Alle.* It appeared very singular to me that no one had seen, south of Kostin-Schar, a bird of the family of *Alcadæ,* as *Alca Pica* does not belong to the most northern birds, and even *Mormon Fratercula* occurs on the Norwegian coast.

There is no trace of the whole class of Amphibia in Nova Zembla. The Batrachia and Sauria evidently cannot exist for want of insects. Of fish, the extreme north, even where very rich in individuals, contains generally but very few species, and partly for this reason, because the fresh water does not possess its peculiar forms so numerous in warmer regions, but only the fish that ascend from the sea at certain periods. Thus Scoresby says of Spitzbergen and of the neighbouring sea, that it has but four kinds of fish. My catalogue of the fish of Nova Zembla contains ten, all of which, with the exception of the Omul (*Salmo Omal,* Pall.), which is said to occur on the east coast, we have ourselves seen. Among these the most important is the Alpine trout (Golez— *Salmo alpinus,* Fabr.), which ascends in autumn into the mountain lakes, and in many years is caught in immense quantities and exported to distant countries. All the other fish are inconsiderable or of no value for commerce, and even in the œconomy of nature only *Gadus Saida,* Sep., and *Cyclopterus Liparis* are of any importance.

Proceedings of the Linnæan Society.

Nov. 5, 1839.—Edward Forster, Esq., V.P., in the Chair.

The Rev. William Wood, B.D., F.L.S., exhibited specimens of a variety of *Typha angustifolia*, remarkable for its small size, and the shortness of its female catkins, collected by himself in the extensive marshes situate between Sandwich and Deal.

Read, "Descriptions of some new Insects collected in Assam, by William Griffith, Esq., Assistant Surgeon in the Madras Medical Service." By the Rev. F. W. Hope, M.A., F.R.S., & L.S.

The insects described in this paper, some of which are remarkable for their size and splendid colours, were mostly collected in Assam by Mr. Griffith, during the stay of the late Scientific Mission from Calcutta, to which he was attached. They chiefly belong to the longicorn beetles, and to the family of *Lamiadæ*. The following are the characters of the new genera and species:

LAMIA.

1. *L. Horsfieldii.*

Long. lin. 26; lat. lin. 8½.

Corpus cinereum; antennis corpore longioribus, elytrisque flavo-cretaceis maculisque ornatis, antennæ articulis tribus primis subscabris.

This species, which has been named in compliment to Dr. Horsfield, is the largest of the family, and is nearly related to *L. catenata* of De Haan from Japan.

G. N. EUOPLIA.

Corpus subdepressum. *Antennæ* lamiæformes, ferè ut in Omacantha. *Thorax* utrinque spinosus, dorso punctulatus. *Elytra* depressa, apicibus 2-spinosis spinâ suturali minore, lateralibus majoribus. In reliquis Lamia convenit.

1. *C. polyspila*

Besides the one enumerated, the author possesses five other species, all natives of India, and which still are undescribed.

G. N. OPLOPHORA.

Caput ferè quadratum. *Mandibulæ* falciformes. *Antennæ* corpore paullò longiores, articulis basi pallidis. Thorax utrinque armatus, dorso fortiter rugoso, tuberculo in medio disci posito. *Elytra* thorace 4-plò longiora, basi sinuata subscabra, gradatim e humeris ad apicem magnis tudine decrescentia, apicibus rotundatis. *Corpus* infrâ annulis abdominis ad apicem sensim attenuatis. *Pectus* valde convexum, mucrone armatum. *Pedes* difformes et robusti.

1. *O. Sollii.*

This splendid species is dedicated to Richard Horsman Solly, Esq., F.R.S. & L.S., in whose cabinet the chief part of the insects described in this paper is contained. To the same genus belong *Lamia punctata* of Fabricius, and two undescribed Indian species.

G. N. ANOPLOPHORA.

Caput quadratum. *Antennæ* corpore duplò longiores, ultimo articulo valdè elongato. *Thorax* utrinque spinosus, medio depressus. *Elytra* anticè et posticè ferè æqualia, apicibus rotundatis. *Corpus* infrà squamosum, pectore inermi. *Pedes* difformes et robusti.

1. *A. Stanleyana.*

This insect, distinguished for its brilliant colours, which rival those of some of the more splendid Lepidoptera, has been named in honour of the Lord Bishop of Norwich, President of the Linnean Society.

CALLICHROMA, *Latr.*

1. *C. Cantori.*

Long. lin. 21 ; lat. lin. 5.

Viride, nitidum; antennis violaceis, femoribus tibiisque lætè cyaneis tarsisque aureo-ornatis.

This species is named in compliment to Dr. Cantor, a distinguished zoologist in the service of the East India Company, and whose valuable collection of Indian Reptilia and drawings are deposited in the Radcliffe Library at Oxford.

2. *C. Griffithii.*

Long. lin. $20\frac{1}{2}$; lat. lin. 8.

Obscurè atrum; antennis tarsisque luteis, elytris nigris et flavo-fasciatis.

This species is dedicated to its discoverer, an acute and enterprising botanist, and author of two valuable memoirs on the development of the ovulum of Santalum and Loranthus, printed in the 18th volume of the Society's Transactions.

MONOCHAMUS, *Megerle.*

1. *M. ruber.*

Long. lin. 11 ; lat. lin. $4\frac{1}{2}$.

Ruber ; antennis corpore duplò longioribus, thorace elytrisque nigro-maculatis, pedibus concoloribus.

Read also, "On *Cuscuta epilinum* and *halophyta.*" By Charles C. Babington, Esq., M.A., F.L.S.

The first of these species has been recently added to the British Flora by J. E. Bowman, Esq., F.L.S., having been found by him growing abundantly on flax, near Trelydan Hall, Montgomeryshire, in August last. The other species, which occurs on the coast of Norway, growing upon *Chenopodeæ*, has not been hitherto observed in this country. The author gives the following characters of the two plants :

1. *C. epilinum* (Weihe), florum glomerulis bracteatis sessilibus, squamis palmati-subsexfidis tubo corollæ semper ventricoso adpressis, sepalis carnosis basi deltoideis corollâ vix brevioribus.
2. *halophyta* (Fries), "florum glomerulis subbracteatis" sessilibus, squamis bifidis tubo corollæ ventricoso adpressis : segmentis bifidis, calyce corollâ multò breviori.

Nov. 19.---Edward Forster, Esq., V. P., in the Chair.

Read, "A Monograph of the genus *Disporum.*" By D. Don, Esq., Libr. L.S., Prof. Bot. King's College.

This genus was first suggested by Mr. Brown, in his 'Prodromus Floræ Novæ Hollandiæ'; and the name of *Disporum* was subsequently given to it by Salisbury in the first volume of the Transactions of the Horticultural Society of London. It remained, however, undescribed, and almost unnoticed, until the publication of the author's work on the plants of Nepal, in which a detailed description of the genus, and the characters of two additional species were given. The characters of the genus consist in its campanulate perianthium, with the sepals produced into a pouch or spur at the base, in the cells of its ovarium bearing two ovula, in its baccate pericarpium, and in its umbellate inflorescence. These distinctions will be found to be common to all the Asiatic species hitherto referred by most botanists to *Uvularia*. We subjoin the characters of the species described in this paper.

1. *D. calcaratum*, umbellis pedunculatis sub-5-floris, sepalis lanceolatis acutiusculis basi longè calcaratis, antheris, filamentis stigmatibusque stylo triplò longioribus, foliis ovato-lanceolatis sessilibus.

Uvularia calcarata. *Wall. Cat. n.* 5087.

2. *D. Wallichii*, umbellis subsessilibus sub-5-floris, sepalis lanceolatis acuminatis, calcaribus rectis abbreviatis, antheris filamentis 4-plò brevioribus, stylo stigmatibus longiore, foliis ovato-lanceolatis subpetiolatis.

Uvularia Hamiltoniana, B. et. C. *Wall. Cat.* n. 5088.

3. *D. Hamiltonianum*, umbellis pedunculatis sub-5-floris, sepalis lanceolatis acutis, calcaribus abbreviatis recurvis, antheris filamentorum longitudine, stylo stigmatibus subæquali, foliis ovato-lanceolatis subpetiolatis.

Uvularia Hamiltoniana, A. *Wall. Cat.* n. 5088.
U. Betua. *Ham. MSS.*

4. *D. Horsfieldii,* umbellis pedunculatis sub-5-floris, sepalis spathulatis mucronatis puberulis, antheris filamentis duplò brevioribus, stylo stigmatibus duplò longiore, foliis ovato-lanceolatis subpetiolatis.

Uvularia Hamiltoniana, δ. *Wall. Cat.* n. 5088.

5. *D. Leschenaultianum,* umbellis sessilibus 3---5-floris, sepalis ovato-lanceolatis acutis basi gibbosis, antheris filamentis vix duplò brevioribus, stylo stigmatibus ter longiore, foliis ovatis subpetiolatis.

Uvularia Leschenaultiana. *Wall. Cat.* n. 5089.

6. *D. Pitsutum* (Don, Prodr. p. 50.), umbellis pedunculatis 7---9-floris sepalis cuneato-lanceolatis obtusiusculis basi gibbosis, antheris filamentis ter brevioribus, stylo stigmatibus duplò longiore, foliis lanceolatis subpetiolatis.

7. *D. parviflorum* (Don, Prodr. p. 50.), umbellis subsessilibus 2---7-floris, sepalis lanceolatis acuminatis basi gibbosis, antheris filamentis duplò brevioribus, stigmatibus stylo ter brevioribus, foliis lanceolatis subpetiolatis.

8. *D. fulvum* (Salisb. in Hort. Trans. i. p. 330.), umbellis sessilibus sub 4-floris, sepalis lanceolatis acutis basi breviter calcaratis, antheris filamentis vix brevioribus, stigmatibus styli longitudine, foliis lanceolatis subpetiolatis.

The author concludes his paper with the description of a new and nearly-related genus, founded upon a plant which was introduced from New South Wales into the Royal Botanic Garden at Kew, in 1823, and which is remarkable for its unenclosed embryo, and for the singular appendages, similar to those of *Parnassia,* which are seated at the inner base of the sepals. The following is the description of this interesting genus :—

TRIPLADENIA.

Perianthium 6-phyllum, petaloideum, patens, æquale, deciduum : *foliolis* æstivatione involutis, basi biappendiculatis ! sessilibus. *Stamina* 6, toro, nec basi sepalorum inserta. *Antheræ* erectæ, extrorsæ, biloculares, duplici rimâ longitudinali dehiscentes. *Ovarium* liberum, triloculare : *loculis* biovulatis : *ovulis* campylotropis, collateralibus, erectis. *Stigmata* 3, recurvata. *Pericarpium* sub baccatum, 3-loculare, 3-valve, loculicido-dehiscens : *loculis* 1---2 spermis. *Semina* sub-orbiculata, hinc convexa, inde angulata, v. concaviuscula, glabra, nitida, colore succinea, hilo maximè fungoso-strophiolato, chalazâ orbiculatâ concavâ fusca, raphide dimidio seminis vix breviori, elevatâ: *testâ* tenui, membranaceâ: *albumen* copiosum, corneum, album. *Embryo* oblongus. albus, hinc convexus, inde planiusculus, more Graminum extra albumen locatus eodemque facie planâ applicatus, funiculo maximè strophiolato solummodò obtectus ! extremitate radiculari (cauliculari) paullò latiori.

Herba (Novæ Hollandiæ) *perennis, rhizomate multicepite, caulibus subsimplicibus multangulis, foliis amplexicaulibus ovato-lanceolatis, pedunculis axillaribus solatariis unifloris infra medium articulatis involucelloque 3-phyllo munitis.*

1. *T. Cuninghamii.*

On the Remarkable Diffusion of Coralline Animalcules from the use of Chalk in the Arts of Life, as observed by Ehrenberg.

An examination of the finest powdered sorts of chalk which are used in trade has afforded Professor Ehrenberg the following result, that even in this finest condition not merely the inorganic part of the chalk is become separated, but that it remains mixed with a great number of well-preserved forms of the minute shells of Coral Animalcules. As powdered chalk is used for paper-hangings, Professor Ehrenberg also examined these as well as the walls of his chambers which were simply washed with lime, and even a kind of glazed vellum paper called visiting cards, and obtained the very visible result,—demonstrating the minuteness of division of independent organic life,—that those walls and paper-hangings, and so doubtless all similar walls of rooms, houses, and churches, and even glazed visiting cards prepared in the above-mentioned manner (of which cards, many however, are made with pure white lead, without any addition of chalk) present, when magnified 300 diameters, and penetrated with Canada balsam, a delicate mosaic of elegant coralline animalcules, invisible to the naked eye, but, if sufficiently magnified, more beautiful than any painting that covers them.—*Pogg. Ann.* 1839. No. 9.

On the Occurrence of Squalus spinosus, Linn., on the Coast of Yorkshire. By ARTHUR STRICKLAND, Esq.

On the 11th of August 1838, a large fish was brought on shore at Burlington Quay, differing from any I had seen before, which had been caught that morning in a trawl net; its characters evidently bespoke it to belong to the shark tribe, but differing in many respects from any of those usually met with. Its whole length was $7\frac{1}{2}$ feet; its girth in the largest part (just behind the pectoral fin) was 3 feet 8 inches; its whole surface was covered with a skin strikingly different from the rough file-like surface of most of the shark tribe, being very smooth and slimy; but the upper part of the back was studded over with sharp white spines hooking backwards, the largest not above $\frac{1}{4}$ of an inch long, but varying greatly in size. Each spine was set upon a thin hard circular base about the size of a fourpenny piece. In some instances two, and in a few, three spines were clustered together, but were usually separate about one inch asunder. I could not perceive that they were placed in any order or pattern. These spines continued less abundantly down the sides, and seemed to cease altogether as they approached the belly, but were abundant upon all the fins. A distinct lateral line commenced above the insertion of the pectoral fin where it was slightly bent, and from thence ran in a straight line to the tail, where it bent upwards, and followed its course nearly to the extremity. The top of the head was quite flat, ending in a blunt round snout, the space between the eyes being somewhat more than that between the eye and the end of the nose; the eyes were large, and placed in the projecting edge that overhung the mouth: nearly half-way between the eye and the end of the nose were placed the nostrils, about $1\frac{1}{2}$ in extent the longest way; they were partially divided in the middle by two valves, the posterior one short and blunt, the anterior longer and pointed. The distance from the end of the nose to the mouth was 6 inches; the whole of this space between the nose and mouth was covered with numerous small open pores, probably the glands for the secretion of the mucus that covered the whole surface of the body. The mouth was furnished with three rows of teeth, with the commencement of a fourth row imperfectly formed. The outer or larger row was set upon an edge, but evidently movable, as some of these were doubled backwards; the rest were set behind these in lines, each tooth diminishing in size to the last. The teeth were thin and sharp, about half an inch broad, and a quarter of an inch high: the posterior edge was formed into two longish points, the upper one pointing partly upwards;

the anterior side was formed into two much smaller points, pointing in different directions. There was no tongue, nor any appearance of one, the bottom of the mouth being smooth and hard. Seven inches from the mouth commenced the brachial openings, which were five in number, all placed in front of the pectoral fin; the first was 3 inches long, each increasing in size to the last, which was 6 inches. Immediately behind the centre of these commenced the pectoral fin, which was 11 inches in length, very thick and fleshy in substance, particularly at the base, the posterior edge thin and flexible; but as in all the fins except the tail, there were no perceptible fin rays or membrane, all being smooth and fleshy. This fin opened perfectly horizontally, or at right angles to the sides of the fish. Eighteen inches behind these commenced the ventral fins, which were equally thick and fleshy, 14 inches long and 11 inches broad, cut nearly square; between the posterior base of these fins was placed the vent. The space from that to the lower end of the tail was only 17 inches; from this point to the upper extremity of the tail was 23 inches, in one unbroken line, there being no distinct lobes of the tail as in most of the shark tribe. The edge of the tail was composed of indistinct fleshy rays covered with smooth membrane. A little behind a perpendicular line above the anterior base of the ventral fin was placed the first dorsal fin, which was 6 inches long, upon a base of the same length; 4 inches behind this was placed a second fin, similar in all respects, except perhaps being cut a little more square at the end. From the front of the first of these fins to the end of the nose was a space of about 5 feet, without any other fin or projection except the small spines before mentioned. The colour of the fish was when I saw it, a few hours after it was caught, a nearly uniform reddish slate-colour, somewhat lighter on the lower parts; but it was described by the fisherman who caught it as having been more of a red cast, with blotches of a lighter colour, before it died.

The peculiar characters of this fish consist in the smooth slimy spinous skin (resembling in this respect some of the Ray tribe), the thick fleshy fins with the five brachial openings all placed in front of the pectoral fins, in having no central dorsal fin, no temporal orifices, no anal fins. In these respects it differs from any fish hitherto described as a British species. Nor does it agree with any I have been able to discover in any work I have yet had an opportunity of referring to. ARTHUR STRICKLAND.

Burlington Quay.

This species is the *Echinorhinus obesus* of Smith, who says in reference to it, "This shark is comparatively rare at the Cape of Good Hope.

It is described by the fishermen as sluggish and unwieldy in its movements, and but seldom to be observed towards the surface of the water. When they obtain specimens it is generally at a time when they are fishing in deep water, and when the bait with which the hooks are armed is near to the bottom. In this respect it resembles the Scyllus, or Ground Shark. If we were to regard only its internal organization we should be disposed to consider it as closely allied to that genus."---*Illustrations of the Zoology of South Africa*, by Andrew Smith, M.D., Part I. Pisces, pl. 1.

After an attentive examination of the particulars on this subject published in the Supplement to Mr. Yarrell's History of our British Fishes, part ii. p. 54, I have no doubt that all the specimens, and the various synonyms employed, refer but to one and the same species at different periods of its existence.---A. S.

Note.---Since the receipt of Mr. Arthur Strickland's communication, the second portion of a systematic arrangement and description of sharks by Drs. Müller and Henle, published at Berlin, has been received in this country, a reference to which appears to confirm the opinion given by our friend that the various published accounts of a spiny shark refer but to one species. The following are extracts from this valuable German work, p. 91 :---

Second Family. Scymni.

Second Genus. *Echinorhinus,* Blainv.---*Goniodus,* Agassiz.

Species 1. Echinorhinus spinosus, *Bonap.*

Le Boucle, *Brouss,* p. 672. 21.

Sq. spinosus, *Linn. Gm.* 1500. 27.

Squale bouclé, *Lacep.* i. p. 30. tab. 3. f. 2. *Cop Encyc.* p. 11. n. 22.

Sq. spinosus, *Bl. Schn.* 136.

Squale bouclé, *Risso. Ichth.* 42.

Scymnus spinosus, *Risso. Hist.* 136. *Cuv.* 393.

Leich bouclé, *Dict. des Sc. Nat.* pl. 28. f. 2.

Echinorhinus spinosus, *Bonap.* 13.

Sq. (Echinorhinus) spinosus, *Blainv. Faun. Franc.* p. 66.

Goniodus, *Agassiz.* vol. iii. tab. E. f. 13. (Teeth).

Hab. Mediterranean sea and the ocean.

Examples stated to have been seen by the authors of the work :--- One in the Museum at Leyden; one from the Cape by Dr. Smith.

The coloured figure of this shark sent us by Mr. Strickland, so closely resembles Dr. Smith's figure, as to make a second illustration unnecessary.---Ed.

BIBLIOGRAPHICAL NOTICES.

Histoire Naturelle des Poissons d'eau douce de l'Europe Centrale. Par Ls. Agassiz. 1er Livraison, contenant les Salmones. Oblong folio. Neuchatel, 1839.

Natural History and Illustrations of the British Salmonidæ. By Sir William Jardine, Bart. Part First. Elephant Folio. Edinburgh, 1839.

On the Growth of the Salmon in Freshwater. By William Yarrell, F.L.S., V.P.Z.S., with Six coloured Illustrations of the Fish of the Natural Size. Oblong Folio. Van Voorst. London, 1839.

The titles of the works which we have placed at the head of this notice will show that the interest which the Natural History of the Salmonidæ has of late excited, has in no way decreased either in this country or on the Continent, and we sincerely trust that the individuals who are now devoting their talents to the elucidation of the habits and structure of this family of fishes, of much importance commercially and possessing great scientific interest, may be enabled to carry on their investigations until the complete history of the subject is attained.

At the commencement of the present century, the history of the British fishes composing this family had for a considerable period remained stationary. But then, various experiments began to be tried, with the view of ascertaining the time required by the fry or smelts to attain a certain weight after leaving the rivers, which was very satisfactorily established, showing a remarkably rapid increase in weight and size. This fact, previously surmised, had given rise to the conclusion, that the young on hatching from the ova increased with equal rapidity, while the history of a little fish provincially known in Scotland as the *Parr*, created much discussion, and no little difference of opinion, whether it was a young state of the Salmon, or a full-grown and perfect fish. The immense decrease of the Salmon fisheries also called for investigation; and although the habits of the species which composed the chief staple of the fisheries were practically known to the Taxmen, the proprietors or their factors were not sufficiently conversant with their growth, migration, or breeding, either to impose salutary restrictions in the leases, or to check the indiscriminate and over-killing of the fish, which was almost the sole cause of the decrease; the latter caused the appointment of various Parliamentary Committees, which published reports containing an immense but undigested mass of information, and which might have elicited much more had the members of them given some attention to the obscure points in the history of the family before examining the witnesses. The difficulty of investigating the subject is we acknowledge great, and when we know that it has been undergoing strict research by persons well qualified for the task for several years without complete information being obtained, we feel even more anxious to understand the mystery which involves the "lives and loves" of these very valuable inhabitants of our rivers and oceans. Mr. Yarrell, Sir W. Jardine, Dr. Parnell, and Mr. Shaw of Drumlanrig are all either now, or have been very lately working on this subject, and the fruits of their researches will eventually leave little to be accomplished. Sir Francis Mackenzie of Garloch is about to form extensive stews for the breeding of salmon, and to re-perform some of Mr. Shaw's experiments. The experiments of the latter observer detailed to the Royal Society of Edinburgh, and published in Professor Jameson's Journal, are of the greatest importance; they have been conducted with great care, and so far as they have been prosecuted have been accompanied by results as satisfactory perhaps as we could expect from the whole difficulty of the subject. The sum of our knowledge at the present time, so far as regards the common Salmon, is, that we have hitherto been in error in considering its growth to be rapid during the first stages of its existence, and that it does not migrate until at least one year's residence in the fresh waters. On reaching the sea however the increase in size becomes very great, exceeding one pound in weight monthly. It has been further proved incontestably we think by Mr. Shaw, that the great proportion of the small fish called *Parrs*, or in the English rivers *Pinks**, are the first state of the young Salmon previous to its assuming the migratory dress; but the additional proposition that the *Parr* does not exist at all as a distinct fish, is extremely questionable, and still requires investigation. At present the opinions of all our best ichthyologists are in favour of its distinctness, and the minute and careful differences detailed by Dr. Parnell in his "Fishes of the Frith of Forth," go very far to prove every thing that is wanting. The history of the other migratory fish remains nearly in the same state in which it has been for the last thirty years, though the works before us have commenced their elucidation, and some experiments are now in progress. The geographical distribution of the species has not been at all attempted, and the facts which relate or bear upon it are few in number.

The publication of the History of the Freshwater Fishes of Central Europe by M. Agassiz has been looked forward to with interest by British ichthyologists. Some of the plates for it were engraved so

* See Mr. Yarrell's figures in the work we have placed at the head of this notice.

far back as 1832, and the long time which it has been known to be in preparation, with the high scientific character of its author, raised the expectations of those who were studying the same subject. The first livraison of plates has now reached this country, accompanied only with simple explanations, so that we do not yet receive the views of M. Agassiz upon many of the obscure points, but can only guess at what may be his probable conclusions. The mode of publication is however otherwise excellent, each livraison being intended to contain complete illustrations of a family or group, so that the whole is brought under review at once, and is not scattered about as so commonly occurs in works which appear in numbers. The descriptive letter-press to this part is promised with the plates of the second, which are to illustrate the *Coregoni.*

The plates are lithographic, are minutely executed, and those devoted to the details of the fins, scaling, and magnified figures are very useful. A plate of details is given with each species. The others represent the fish in its various states incident to age and season. The first series show the Salmon, M. and F., in its breeding dress, and a female in the state of summer or high condition after having newly entered a river. These figures lead us to believe, what we have long suspected, that the Salmon of many of the continental rivers differed or was not identical with the common British fish. They are reduced from specimens upwards of three feet in length; at this age and size the tail in both sexes of the latter would be completely square, and the scale represented fig. 3. tab. 1 *a.* is fully two-thirds less. The markings in tab. 2. also differ much. Six plates are devoted to the illustration of *S. fario.* Some of the figures are of importance as showing what is to be understood by the *S. marmoratus,* Cuv., and the *S. sylvaticus* of Shrank: but with the English synonyms we cannot agree, they are given, "the Trout, the common Trout, the river Trout, the *Gillaroo,* the *Parr (a young Trout).*" Now the *Gillaroo* of Ireland still requires investigation, and we have reason to believe that it will form a distinct species. The *Parr* of Scotland has no connexion with *S. fario,** and the figure given as the supposed "*Parr* or young Trout" has been undoubtedly designed from a young specimen of true *S. fario.* We may also remark that all the examples figured are from specimens agreeing with a very marked but not uncommon variety of the Scottish *S. fario* found in

* For distinctive characters between the Scotch *Parr* and common *S. fario,* see Sir W. Jardine in Proceedings of Berwickshire Club. For characters separating it from the young of the Salmon and migratory Trout, see Mr. Yarrell's British Fishes; and Dr. Parnell, Fishes of the Frith of Forth.

the smaller alpine streams. On tab. III *b.* are given representations of the head of a deformed Trout, similar to that represented by Mr. Yarrell, and which we know to occur in several lochs in Wales and in Scotland, and to be not uncommon in the localities where it is found. The malformation is extremely uniform or similar in all the specimens or representations of it which we have seen, but the cause has not yet been noticed, nor has it been attempted to be accounted for. Is the race continued by breeding?

Seven plates illustrate two species of migratory Trout which are given under the names of *S. trutta* and *lacustris* Linn.*. In these we think we recognise the two British fishes which have been confounded under the provincial name of "Sea Trout." They are very distinct in some of their states, and the form of the tail distinguishes them, together with the colours during the breeding season, but we should have preferred to have seen figures of these species when in high condition; residence in a lake may in various ways influence the form. The young of these fish constitutes the *S. albus* of Fleming. Should the *S. trutta* of this work not stand as *S. eriox* of Willughb.?

The Char are all placed under *S. umbla,* Linn., and the "Welsh Char" is given as an English synonym. Although we know the Char to vary very considerably, we are inclined to refer the British fish to two species, chiefly distinguished by the great difference in the scaling. Those figured by M. Agassiz seem all referable to the "Northern Char" of modern British writers.

S. hucho of the Danube, unknown in the British waters, is represented in the young and adult states, and the last plates delineate the *Thymallus vexillifer,* Agass., or Common Grayling, found only by the British ichthyologist in certain districts in England.

In looking at the list of the Salmon of Britain and Central Europe comparatively, we are prepared for a close resemblance of species; but from the work before us we perceive one species, *S. hucho* of the Danube, which does not occur in Britain or Ireland, while we find omitted the *Bull Trout* of the river Tweed, (the *S. eriox* of some authors, but not of Willughby,) and the great Trout of the Scotch, Irish, and North of England lakes. These we have no doubt in being distinct species, and it appears to us remarkable that the latter should be wanting to the Swiss lakes. Among the common Trout, *S. fario,* we feel inclined to adopt more species than those of the Swiss ichthyologist, but as the specimens now figured are chiefly river varieties, and certainly all one species, we are not so able to judge how the varieties in the lakes

* We are presuming that the *S. lacustris* here given is a migratory species, and if so we think the name objectionable.

of Central Europe agree with those from the lochs of Scotland and Ireland, or how the characters which we think entitle them to separation are kept up in other localities. We shall look anxiously for the appearance of the Second Livraison and the letter-press, when we shall endeavour to enter more fully upon this curious subject; in the mean time we would wish that encouragement to the work in this country which is due to the persevering zeal of its author.

The History of the British Salmonidæ, by Sir W. Jardine, which stands next upon our list, is a work which has also been some time in preparation, and of which the first Fasciculus of six plates is now published.* The figures are here drawn as near the size of life, as that of the paper will admit of, and are engraved with the view of giving the effect of the newly taken fish; all the details of anatomy, scaling, and outward structure, which require most minute execution, being reserved for the volume which will contain the descriptive letter-press, and which will appear with the last fasciculus of the plates. The sketches for the colouring we know to have been nearly all made at the water's edge from the fish when newly caught; thus endeavouring to preserve an imitation of the rich tints which so quickly fade, and are lost in preserved specimens; and the department itself has been entrusted to, and performed with much credit by Mr. Bayfield of London. It is expected that the whole species found in the waters of Britain and Ireland will be illustrated in six fasciculi, or upon from thirty-six to forty plates.

On the two first plates before us are figured the Gilse or state of *S. salar* before having spawned, the second being named with a? and considered to represent the same state of the second species of British Salmon, whose history has scarcely yet been noticed by our ichthyologists. Plate 3. represents *S. albus* of Fleming, given under that name to identify without doubt the fish alluded to in the "British Animals," and so often referred to by our modern writers. This is now known to be the young of our migratory species confused together, and in this state extremely difficult to separate. 4. is a variety of the large *S. ferox*, which we noticed M. Agassiz does not include in his list of the fishes of Central Europe; the specimen is remarkable for the close and numerous spottings over the whole body. 5. are two beautiful lacustrine varieties of *S. fario*, and 6. exhibits figures of the Lochmaben *Coregonus C. Willughbeii*, Jard. The second fasciculus, which is in preparation, will contain, 1. *S. salar*, adult male in the dress of the spawning season; 2. *S. salar* in a very young state; 3. *S. trutta*, adult

* See Prospectus published in Annals of Nat. History, vol. ii. p. 138.

4. *S. trutta* in the dress of spawning season; 5. *S. fario*, river varieties; and 6. *S. fario* in the spawning dress.

The work of Mr. Yarrell forms another interesting addition to our knowledge of the Natural History of the Salmon. The young of the Salmon (in the district where the experiments were made called Pinks) were put into an artificial lake on the property of Thomas Upton, Esq. of Ingmire Hall, having no outlet or feeder by which other fish could gain admittance. These were afterwards taken at intervals of from eleven to twenty-seven months, and Mr. Yarrell's description and plates detail and exhibit the changes and appearance of the fish when taken from the lake. The experiments of Mr. Upton and Mr. Parker corroborate in general what Mr. Shaw has so successfully proved in Scotland, and are interesting as showing the change in colouring undergone by the Pinks at the period when the clear and silvery scaling is assumed; but beyond the time when the migratory change takes place we cannot depend upon the increase of weight or size. Any one accustomed to see many Salmon in different states fresh from their native rivers, and to compare them with fish kept artificially, could at once say that Nos. 4, 5, and 6, had been kept in fresh water; this is particularly evident in the form of Nos. 4 and 5, and we would account for the comparatively fine condition of No. 6 by the lake being newly completed, and unstocked (we presume) with other fish. It is well known how much common Trout are influenced in their condition by being placed in a newly formed pond or lake. The drawings by Mr. C. Curtis illustrating Mr. Yarrell's paper were exhibited to the British Association at Newcastle, and were then much admired. The coloured engravings from these now published, are executed with great minuteness and delicacy.

Narrative of an expedition into Southern Africa during the years 1836 *and* 1837, *from the Cape of Good Hope through the Territories of the Chief Moselekatse to the tropic of Capricorn.* By Captain W. C. Harris. 8vo. Bombay, 1838. Murray, London. (Reprinted) 1839.

This volume may perhaps be thought by some scarcely to come under the range of works which should be noticed in the 'Annals,' but as the author tells us that "both from education and taste," he "possessed an ardent desire to contribute his mite to the geography and natural history of the countries" he "was about to explore;" and that there are interspersed through the work anecdotes of several rare animals, which though not written for the naturalist are extremely interesting to him; we have thought it worth while to bring it under the notice of our readers. Capt. Harris seems to have been born a sportsman, possessing the bump of destructiveness in its fullest development. At a very early age (16) he received a commission in the army in India, where he was "entered" at the Lion and Tiger of the East: but not satisfied with the gorgeous scenery and abundant game which this continent produced; hankering after the tales of travellers in the plains of Southern Africa, and considering that country as the "fairy land of sport," the "hunter's paradise," he took advantage of a banishment to the Cape of Good Hope by the Medical Board, to project a realization of his young dreams of the interior; and, having found a brother sportsman, they set out upon their expedition with a retinue of horses, oxen, wagons, and Hottentots for Graham's Town, travel by Kuruman or New Litakoo to the residence of Moselekatse the Matabili chief, penetrate still northward to the river Limpopo, and return again to the colony by the route of the Vaal river. The volume is pleasantly written, and carries on both the sportsman and naturalist. Some of the descriptions of scenery are beautifully sketched; and if some of the hunting scenes seem as if coloured with a sportsman's licence, and the rifle is used with Kentucky precision, we can excuse the enthusiasm which prompted the tale, and knowing the feelings which excite the comparatively puny European sportsman, who has hooked and mastered his first twenty-five or thirty pound Salmon, or sees his first red Deer fall in the glens of Athol or the wild forests of Ross, we can join with the "tingling excitement" experienced when galloping side by side with the "Swan-necked Giraffe," and the "bursting exultation" when looking down on the first noble prize he had won.

To the naturalist the volume is interesting as detailing different traits in the habits of several of the rare Antelopes. It confirms the remarkable manner in which many of the species are restricted, as it were almost by a line, within certain boundaries, and the incredible troops in which they migrate and are spread over the interior, where the arrows and pitfalls or traps of the natives, and the ravages of the larger *Felinæ* are as nothing compared with the increase. All these animals are said by Capt. Harris to be easily overtaken by a good and well-conditioned horse, their very speed being their destruction, frantic terror at such novel enemies causing them to spend their strength in the exertions of a few miles. The speed of the Camelopard is extraordinary, but "our best horses were able to close with him in about two miles."

The great fault of Capt. Harris's book is a constant attempt to assume a scientific character, which every page contradicts. There is no precise information on the subject either of zoology or geography, the two branches which the author particularly boasts of his desire to investigate; he does not appear to have made a single observation to ascertain either the latitude, longitude, or elevation of the places he visited, nor to have carried any instruments for that purpose; and this is the more to be regretted, as he visited a part of the country very seldom penetrated by Europeans. The positions on his map are consequently laid down at least 20° wrong in latitude, and their longitude of course must have been taken at random. Though not a practised zoologist, Capt. Harris's hints on habits and localities are often valuable, and they are given but as incidental to the great thread of his discourse, which is a lively narrative of a shooting excursion and nothing more; but this very character deprives them of suspicion. To the end of the volume is added a descriptive Catalogue of the Mammalia of Southern Africa, but which contains little that was not previously known: it is in fact chiefly copied (though without acknowledgment) from Dr. Andrew Smith's "African Zoology," a small work printed at Cape Town about eight or ten years since, and we believe never published, though freely circulated among the friends of the amiable and talented author.

We have thus attempted to give a fair and impartial account of Capt. Harris's volume. It is written in the lively dashing spirit of a soldier and a sportsman: no one can read it without amusement, and few without some instruction; and if truth has obliged us to mingle some slight censure with our general praise of the performance, it is because the pretensions which the author makes to scientific knowledge create expectations which are disappointed in the perusal.

Proceedings of the Zoological Society.

March 12, 1839.---William Yarrell, Esq., in the Chair.

Mr. Ogilby communicated a portion of a letter which he had received from M. Temminck. It related to two species of Monkeys, *Colobus fuliginosus* and *Papio speciosus;* the former M. Temminck considers identical with the Bay-Monkey of Pennant, and he states that this opinion is founded upon its agreement with a coloured drawing now in his possession; this drawing having been taken by Sydenham Edwards from the specimen of the Bay-Monkey formerly in the Leverian Museum, and which is the original of Pennant's description.

The *Macacus speciosus* of M. F. Cuvier is stated by M. Temminck to be founded upon an immature specimen of a species of *Macacus* which inhabits Japan; the habitat of Molucca Islands given by M. F. Cuvier being founded upon error. The specimen was originally taken from Japan to Java, where it died; the skin was preserved, and M. Diard having obtained possession of it, sent it to the Paris Museum; and as there was no label attached, M. F. Cuvier imagined it to be a native of the place whence M. Diard had sent it.

Mr. Fox exhibited several birds, which he stated had formed part of an extensive collection made in Iceland by the Curator of the Durham Museum.

May 14, 1839.---Sir John P. Boileau, Bart., in the Chair.

The Rev. F. W. Hope exhibited a portion of his collection of insects, in order to illustrate a paper entitled "A Monograph on Mr. William Sharp MacLeay's Coleopterous Genus *Euchlora.*"

Genus Euchlora, MacLeay.

Melolontha, Linn., Fab. and Olivier.

A*ntennæ* articulis novem, basilari conico elongato, 2do, 3tio, 4to, 5to et 6to brevibus subglobosis; capitulo ovato, triphyllo, elongato, antennarum longitudinis totius haud dimidium æquante.

Labrum prominulum, clypeo fere absconditum, margine antico lineari, ciliato, emarginato, lateribus rotundatis.

Mandibulæ latitantes, subtrigonæ suprá planæ, latere externo rotundato, interno ciliato, ad apicem 3-dentato.

Maxillæ caule subtrigono-triquetro, ad apicem inflexæ 6-dentatæ.

Palpi maxillares articulo terminali cylindrico ovato.

Labiales articulis 2do et ultimo longitudine æqualibus hoc subulato.

Mentum subquadratum, margine antico emarginato angulis truncatis rotundatis ac lateribus sinuatis, posticè valdè convexis.

Caput subquadratum clypeo lateribus rotundatis margine reflexo.

Corpus ovatum convexum posticè elytris haud opertum. *Thorax* subquadratus ad basin duplò longior quam latior, latere postico sinuato vix lobato.

Scutellum parvum cordato-truncatum. *Sternum* haud productum.

Pedes validiusculi tibiis anticis 3-dentatis. *Tarsorum* ungues posticorum indivisi reliquorum ex unguibus unus bifidus, alter indivisus.

"It is in the warm and tropical regions of the world that we find vastness one of the leading characteristics of animal life. It is in the same regions also, amongst the class of insects, that we find a corresponding magnitude attended with a wonderful increase of species, many examples of which might here be mentioned. It is sufficient for our purpose at present to note only a few of them, such as the *Sternocera*, among the *Buprestidæ; Lamia,* belonging to the

Longicorn beetles, and *Melolontha* and *Euchlora*, well-known genera pertaining to the Lamellicorns. With regard to vegetation, there will also be found an equal magnitude of stature and a luxuriance of foliage quite in proportion to what occurs even in the animal world. If we look to the tropical regions of Asia, Africa, and America, we shall find a similarity of character generally predominating: but it is in the tropical jungle chiefly, and on the banks and estuaries of mighty rivers, that insects will be found, not only formidable by their size, but remarkably numerous in species and individuals. The genus *Euchlora* of Mr. MacLeay, to which at present I wish to draw your attention, is not very distinguished for its size, although larger than all the allied genera belonging to the family. The predominating colour is green, and the abundance of individuals belonging to some of the species is incalculable. I may mention, *en passant*, that the thousands which have annually been imported into Europe, appear from inquiry not in the least to have thinned their numbers. On one occasion I received forty Chinese boxes, and in each of them (I speak greatly within bounds) there were at least twenty specimens of *Euchlora viridis*. These boxes are imported into England, and other parts of Europe, in great quantities, and there is scarcely a museum at home or abroad, however insignificant it may be, but exhibits its Atlas Moths, its purple-coloured Sagra, and less attractive Euchlora, in tolerable profusion. I have stated above that the prevailing colour of the species is green, but there are some exceptions. The under side of some of them is usually a bronze, or a rose-coloured copper; some of them green above and beneath; others green above and yellow beneath; while some again are blue on the same side, with the play of light appearing of a violet colour. With regard to the colour of insects, greens as far as my observations go, naturally on one side merge into blues and violets, and on the other into orange and yellows. Instead of occupying the time of the meeting with a question at present (as far as regards insects) comparatively little studied or understood, I proceed to remark on the geographical distribution of the family *Euchloridæ*. Had some of the Continental entomologists been better acquainted with Mr. MacLeay's Horæ Entomologicæ, they certainly never would have considered *Euchlora* as an European genus. In a late work, published in Paris, the "Histoire Naturelle des Animaux Articulées" (at page 135), we find under the generic name *Euchlora*, not only *Mimela* and *Aprosterna* included, but also *Anomala*, &c. It is singular that the same appellation is given to twenty-two species therein specified, a short analysis of which I now place before you, and shall then allude more particularly to the genera composing the family, the range over which it extends, and mention the countries and localities in which they severally occur.

"Of the above twenty-two species, five of them appear to be true *Euchloræ*, two others belong to *Mimela*, Kirby, another to *Rhombonyx*, Kirby, and the remaining fourteen to *Anomala* of Megerle, as it now stands. Before I conclude these remarks on the species of the genus before us, it is necessary to state that I have elevated *Euchlora* to the rank of a family, the following genera properly belonging to it.

EUCHLORIDÆ, Hope.

Genera.		Country.	Species known.
1. Euchlora,	*MacLeay* . .	Asia	30
2. Aprosterna,	*Hope* . . .	Asia and Africa. . .	5
3. Mimela,	*Kirby* . . .	Asia	22
4. Rhombonyx,	*Kirby* . . .	Siberia and China . .	2
5. Anomala,	*Megerle* . .	Old and New World .	120
			179

Genus 1. EUCHLORA.

"The family of *Euchloridæ*, from the above table, consists of five genera, and nearly two hundred species, which have fallen under my notice. True *Euchlora*, I state, belongs exclusively to Asia and its isles. It occurs as far south as Manilla, appears at Singapore, and runs from thence through the continent of India up to the Himalaya; the extreme eastern point appears to be Japan, while its western range does not reach Bombay, probably from the intervention of some physical barrier. Captain Ezra Downes has taken it at Neemuch. The Entimology of that district essentially agrees in character with that of Calcutta and Madras, at the latter of which places *Euchlora* is taken.

Genus 2. APROSTERNA.

"This genus is not peculiar to Asia, as some of the species are found in New Guinea.

Genus 3. MIMELA.

"This elegant genus, rivalling in colour and splendour the *Buprestidæ*, is confined to Asia; it ranges wherever *Euchlora* is found.

Genus 4. RHOMBONYX.

"This genus is probably peculiar to Asia. One species is found in China, and the other, I have reason to think, is only found in Asiatic Siberia.

Genus 5. Anomala.

"Anomala is common to the four quarters of the globe, and may properly be divided into three if not four sub-genera, which task I willingly leave to other entomologists.

"In concluding these observations on *Euchlora*, I have only to add, that it may excite some surprise that this genus extends far into the Himalayan regions; it may be explained however, satisfactorily, by the influence of local causes. It is an ascertained fact that tropical vegetation often extends into high latitudes, and why then may we not expect to find insects which feed upon it, and are intended probably to keep it within due bounds?

"From information given to me by my friend Professor Royle, I state that the tropic-girt base of the Himalayas is characterized by a vigorous and luxurious vegetation.

"In the same regions there is also an uniformity or great equality of temperature, well adapted for animal as well as vegetable life. The exuberance of the latter adds to the humidity of the atmosphere, as well by the exhalation of the foliage as by preventing free evaporation from the soil. In the boundless forest and interminable jungle there will generally be found a great equality of temperature, brought about in consequence of the umbrageous shelter impeding the absorption of heat by day, as it checks the free radiation of it at night. It is then, owing to the presence of tropical vegetation, united with moisture, that there arises considerable uniformity of temperature; in a word, it is from local causes that we are enabled to explain the reasons why we meet with the representatives of tropical genera of plants and insects extending into higher latitudes than at first might naturally be expected."

Remarks on an East Indian Turnip-fly (Haltica Nigro-fusca). By J. T. Pearson, *Assistant Surgeon.*

[From the Transactions of the Agricultural Society of India.]

Desc. Cl. Insecta.---*Auctorum.*
Ord. Coleoptera.---*Auct.*
Sec. Tetramera.---*Latreille.*
Fam. Chrysomelidæ.---*Leach.*
Gen. Haltica.---*Auct.*
Sp. H. Nigro-fusca.---*Mihi.*

Black Haltica, with brown legs and antennæ.

Colour, shining black, with a shade of blue. *Form*, oval. *Head* and *thorax,* thickly and minutely punctated. *Elytra* minutely punctated in lines; but appearing, as well as the *head* and *thorax,* smooth to the naked eye. *Antennæ, tibiæ,* and *tarsi* brown; the *antennæ* hirsute; *tibiæ* and *tarsi* clothed with short stiff hairs. *Thighs* black; minutely punctated; clothed with coarse distinct hairs. *Under surface,* black, slightly iridescent.

Sexes alike.

Length 0.10 inches; breadth of elytra 0.05 inches.

Inhabits Darjeeling in the Himalayah mountains. Found in gardens on the young plants of the cabbage, cauliflower, turnip, radish, and others of that order.

Obs. This destructive little insect differs from any species of the genus *Haltica,* of which I have met with a description. Its ravages are but little, if any, inferior to those of the celebrated "Turnip-fly," or flies, the *Haltica nemorum* and *concinna* of entomological authors; complete rows of the young plants being sometimes destroyed by it soon after they appear from the ground: its attacks are particularly destructive to the two first, or seed leaves; but it preys also upon the succeeding ones, though not to the same extent, eating a few holes in them only, and not destroying the plant.

Mr. C. D. Russell informs me that last year *(and never before)* this, or a similar insect, committed great ravages on the Indigo throughout the whole district of Rungpoor; first attacking the young plant, and after the rains, the crops for seed. He has promised to try to furnish me with the specimens; and should he be able to do so, I shall have the pleasure of laying a description of the insect, together with such information as I may collect, before the Society. Perhaps other gentlemen in the district will favour me with communications on the subject.

Among the expedients to get rid of the plague of "*the fly*" the chief have been dressing the land with lime, with wood ashes, and even with sulphur; but all without the least success. Mr. Le Keux, in an excellent paper in the Transactions of the Entomological Society, says, that in one instance he tried watering the ground on the fourth day after sowing it with turnips, with a mixture of one ounce of tar, one ounce of olive oil, and two ounces of strong caustic potash, shaken up with a quantity of water (how much is not very clear) with apparent success. Carbonate of Ammonia succeeded in killing the insect, but it destroyed the plant also. Steeping the seed, as is done against the vegetable parasitical destroyer, "*the smut*" in corn, would probably do no good here; but it might be tried. In short, of all the expedients hitherto resorted to, none have succeeded in keeping off "the fly," unless we may except the above quoted single experiment.

Perhaps a remedy may be found in pitting one insect against another, the insectivorous against the herbivorous tribes; and by encouraging, rather than scaring away, the insectivorous birds. In this way the larvæ of the lady-bird *(Coccinella)* devour the "Hop-fly," (a species of *Aphis*, and not a beetle) and save the plant: the parasitic larvæ of the *Hymenopteræ* attack the insects they feed upon in all their states; and those of the *Dipteræ* the *Hymenopterous herbivoræ.* Of this last Mr. Yarrell gives an account in the *Trans. Zool. Soc.* in his paper on the "*Yellow fly,*" *(Athalia centifolia)* where a *Dipterous* parasite is described as inhabiting, and having devoured the larva of that destructive insect.

Mr. Le Keux is of opinion that the antidote against these insects will be found "in some effluvia, or odour, which may be either offensive to the insect when near, or so overpower the scent of the turnip, as to prevent the fly from distinguishing, and being attracted by it." He further remarks, that so long as the plants are kept wet the insect disappears; which agrees with my own observations on the Darjeeling insect.

The attacks of the "Turnip-fly" are said to be diverted from a plant by more attractive food. Thus Mr. Le Keux has "*invariably*" found that the *white stone turnip*, mixed with the *Swedish turnip*, protects the latter; the insects preferring the former, so that the *Swedish* has time to grow up beyond their power of destroying it, while they are engaged in devouring the other sort. This appears to be the easiest of all methods of defending a crop whenever it can be done; and well worth making experiments upon. Should there be found a plant which the Rungpoor insect prefers to the more precious Indigo, the advantage of employing this expedient need not be dwelt upon.

As the subject of insects hurtful to Agricultural productions is at present exciting much interest in Europe, I have thought it well to present the foregoing observations to the Society: for, it is of the greatest consequence that attention should be every where awakened to it, in the hope of discovering some remedy against their ravages. It cannot be thought a trifling matter, when it is considered, that an irruption of "*the fly*," will be as fatal to the prosperity of the planter as an inundation of the Ganges.

Journal of the Asiatic Society of Bengal for December, 1839.

In the notice prefixed to the December number of the Journal of the Asiatic Society, (which by the way appeared five months after its time), we are told that the late severe *Epidemic* interfered so seriously with the arrangements, as to render typographical mistakes unavoidable.

We doubt if contributors will be satisfied with this explanation for the introduction of errors into their papers, which destroy their sense and meaning; thus in one paper, the Himmaleh are made to run in a north-east and south-west direction, instead of north-west and south-east; and *Avicula socialis*, and *Ammonites nodosus*, are converted into four genera instead of two, as follows; *Avicula*, *Socialis*, *Ammonites*, *Nodasus*. We have also two other *new genera* unexplained, viz. *Encrinilis* and *Monitiformis*. The curious thing is, that the *Epidemic* should have confined its ravages to the typography of those sentences which required some degree of intelligence in scientific nomenclature to perceive; while the printer's part is executed with the usual care, accuracy and good taste for which the press from which the Journal issues is remarkable. We do not think it below the dignity of scientific persons when a thing comes before them, be it what it may, to confess freely and unaffectedly that they do not understand it, should that really happen to be the case. On the contrary, such candour is absolutely necessary on the part of every scientific inquirer; so much so, that, whoever is without it, is unworthy of credit as a scientific observer, because we cannot be answerable for the lengths to which our moral weakness may carry us, either in suppressing the truth, or in the statement of facts that may be in any way opposed to our own views.

Indian Hand Book of Gardening, containing directions for the management of the Kitchen and Flower Garden in India. By G. T. FREDERIC SPEEDE. Bishop's College Press. Ostell & Co., Calcutta. June, 1840. pp. 284.

Any attempt to render the improved practice of useful arts better understood in India, deserves commendation; and although the Kitchen and Flower Garden are luxuries of far less interest in the East than elsewhere, still their improved culture might lead to more important improvements.

We require however to be much better acquainted than we are at present with peculiarities of soil and climate, as well as the nature of cultivated plants, together with such as might be cultivated with advantage in various parts of India, before we can hope for much good from any general rules for Gardening. Mr. Speede's little book is dedicated to the Superintendent of the H. C. Botanic Garden for that zeal "which, while effectively employed in the higher walks of Botanic "Science, could condescend to consult the good of society by afford-

"ing his able assistance in promoting the Horticulture of India." This is the most ironical dedication we ever saw; but if those whose duties might be supposed to qualify them for the special improvement of Agriculture and Gardening neglect their posts, they must put up with ironical dedications, just as the Public must be content with such books as are offered by more zealous individuals. Mr. Speede's little book treats chiefly of the cultivation of European vegetables, fruits, flowers, and ornamental shrubs, and as the only work that has been hitherto devoted to such subjects, we recommend it to all those who have gardens.

News of Naturalists.

We alluded in our paper on "Indian Cyprinidæ," Asiatic Res. vol. xix. part. 2, p. 258, to the intended visit of Mr. W. S. Macleay to New Holland. We have recently been favoured with letters from Sydney, dated the 12th of February last, by which we were happy to hear of his arrival. As might be expected, the time spent on the long voyage from England to Sydney was not lost; the ocean indeed is a rich domain to the philosopher. Mr. Macleay mentions having fallen in with the American Scientific Expedition, which left the United States about eighteen months ago, in two corvettes and four schooners. They had visited, when Mr. Macleay met them, the Cape de Verds, Brazil, Patagonia, Terra del Fuego, Chilli, Peru, and the South Sea Islands, and had made extensive collections in all departments of natural history. The following are the scientific men which compose the expedition, and their duties. Titian Peale for mammalia and birds; Dr. Pickering for insects, reptiles, and fishes; Mr. Coulter for mollusca, and Mr. Dana for crustacea, pelagic animals, and geology; Mr. Rich for botany; two gardeners, and two artists complete the scientific corps. The expedition is creditable to the United States, and we trust will prove highly important to the advancement of science. Extensive collections were making in every department of nature, which were forwarded to Philadelphia as opportunities offered. With regard to Mr. Macleay himself, it is his intention to remain four or five years in New South Wales, where he thinks he will have occasion to publish some of the results of his investigations without waiting for the remote prospect of his return to England. He had made one journey to the Hunter river; there are bones, he observes, in limestone caves of Wellington valley, which prove to be those of gigantic marsupials, now extinct; but with the exception of these, few fossils have been found in New South Wales. The impressions of a fern and of a fish, some corallines, molluscous shells, and a few radiata, are all that he has yet seen or heard of. No crustacea or annulosa or cirrepedous shells have yet been found, nor reptiles or birds. Indeed, he observes, this *new* country is in reality a very old one, if we may judge from the low organization of its fossil remains.

Mr. Macleay asks many questions regarding India, which perhaps we will do better by publishing, than by attempting to answer ourselves. He is particularly interested in those fossil remains which, as he himself expresses it, "fill up gaps in the chain of living nature," and asks if we have any Trilobites. They occur, he says, at the Cape of Good Hope, and might be expected in silurian rocks. He is desirous of being informed if leeches abound in the dark damp forests of India, and also if there be any insects parasitical in ants' nests, and whether bees and wasps are infested with parasites in India. He is desirous of having some of the Hymenopterous and Dipterous insects of India, with all the parasitical kinds, and the names of the animals they infest. We had sent a small collection of the commoner insects collected in the cold season, but Mr. Macleay is now desirous of having some of those which are found on plants of various kinds during the rains; and in making collections during winter, he recommends stones to be turned, and the bark of trees to be removed in search of the rarer sorts. Calcutta is not the most favourable place for making collections of any kind, but we shall procure what we can; we shall also be very happy to forward to Mr. Macleay any collections that may be intrusted to us for the purpose by friends in the *Mofussil.* Mr. Gould, the ornithologist, is also in New South Wales, and Mr. Swainson is said to be on his way to New Zealand.

The Curator Question.

The Report to which so many high official signatures were obtained,* is stated by the late Secretaries of the Asiatic Society to be based on certain resolutions of the Society, which in reality is far from being the case. The only resolution of the Society delegating any authority whatever to the Committee of Papers on the subject of the Curatorship, is the following (Journal Asiatic Society 1839, p. 1060): "It "was further decided, that the Committee of Papers should "report to the next Meeting, on the nature and extent of the "duties the Curator is expected to undertake, with reference to "the office as held in other Museums." The Committee by this, were not authorised to go into any of the various questions mixed up in the Report to which so many of the members lent their signatures; they were required merely to report on the nature of those duties performed by the Curators of other Museums, regarding which, there is not one syllable from beginning to end of the Report in question; nor were the Committee authorised to discuss the question of who should, or should not, be Curator. The question proposed to the Committee, was also one with which individual interests had nothing whatever to do; it was a question therefore which did not render it expedient that any member of the Committee should have been excluded during its consideration. Lastly, the Committee were not authorised to submit the Report to any one with a view to induce him to decide as

* See Journal As. Soc. of Beng. 1839, p. 1062.

to his accepting or declining the office of Curator. On the contrary, it is expressly stated in the resolution of the Society, that the Report should be brought up at the next Meeting, without any thing whatever to justify the Secretaries in making any other use of the Report in the mean time. The use they did make of it—namely, that of calling upon us to acknowledge its authority, or resign the place to which we had been invited a few months before by the same parties, under other circumstances—left us no alternative but to point out the very objectionable course that had been pursued.

Papers Received.

1. Plants characteristic of different nations, by Professor Schouw; translated from the original Danish, by Dr. Cantor.

2. Professor Schouw's Physical Sketch of Europe; from the Danish, by Dr. Cantor, Assistant Surgeon, doing duty with H. M. 26th Foot.

3. On the affinities of the *Falconidæ*, being an attempt at a natural arrangement of this family. Part 1, by W. Jameson, Esq. Bengal Medical Service.

THE

CALCUTTA JOURNAL

OF

NATURAL HISTORY.

On the Affinities of the Falconidæ; being an attempt at a Natural Arrangement of this Family. *By* WM. JAMESON, ESQ. *Bengal Medical Service.*

The number of species, and the numerous and various modifications which they present, have rendered the *Falconidæ* the most interesting and complicated group for illustration in the whole ornithological kingdom. The various arrangements which have as yet been proposed, are more or less unsatisfactory, probably from authors not taking properly into consideration the affinities which the different genera bear to each other, which may be owing (at least in several cases) to the extent of the collections examined; for in order to render such an arrangement satisfactory, a vast series of specimens must be examined to shew the general connexion which each minor group presents.

The views of a circular arrangement of the objects of Nature, first pointed out by Werner to exist in the inanimate world, has been ably taken up, and extended to the animal kingdom by several authors, but first applied to insects by MacLeay in his "Horæ Entomologicæ," a work which has produced a new era in zoology. Advocating a similar arrangement in ornithology, the names of Swainson and Vigors stand prominently forward; nor is the botanical kingdom without its advocates. In this department we have Fries, Lindley, Agardh, Decandolle, &c. attempting to prove the same as applicable.

It is foreign to our purpose at present to enter into any discussion upon the merits or demerits of the ternary or quinary systems. But we cannot thus quietly pass over the name of the illustrious Werner, who in the long and animated discussion as to the authorship of the circular arrangement, has been entirely kept in the back ground; and where, let me ask, can a more beautiful illustration be seen of the principles now advocated, than in his system of colours. Moreover, in his mineralogical system we see the same plan adopted, though from the imperfect state of mineralogical science, not carried out to its full extent.*

The Rapacious Birds form in themselves a great group, which has been divided into two grand divisions, viz. the Diurnal and the Nocturnal Birds of Prey, the former comprehending the Vultures and Hawks, the latter—the Owls; and these again have been divided into many minor groups and genera; and some authors have even carried the subdivision further into sub-genera; but it is much and deeply to be regretted that such a term ever was adopted, seeing that it has led to so much confusion, the characters fit to constitute a genus being of such an indefinite and arbitrary nature, how much more so must be those which constitute a *sub-genus.*

Although the division of Vultures, Hawks, and Owls into minor groups serves generally the ends of classification, in nature they do not exist, for it is impossible to say correctly where one minor group begins and ends. No doubt we can, if a typical species is presented, determine to which group it belongs; but when we examine all the species belonging to any group, some will be found to blend so imperceptibly into the next adjoining one, as to render it impossible to decide

* For an account of Werner's Mineralogical System, see Jameson's System of Mineralogy, vol. II. p. 475.

whether they ought to be retained in the group under consideration, or be placed under the next adjoining. Such is the case with all the works of Nature, presenting to the eye of the observer one harmonious whole, leading the mind gradually from the contemplation of Nature to Nature's God.

That the ancients were aware of these subdivisions, we learn from the writings of Aristotle, who, in his elaborate work, divides the Hawks into three groups, viz. *αετοι*, ἱερα-χες, and *ιχτινοι*, and these again into minor groups. Thus under the ἱεραχες are included all the Falconidæ belonging to the families Hawks, Falcons, and Buzzards, properly so called.* In fact, upon this arrangement all the great improvements which have within these few years been proposed, are founded. Nor is it alone in ornithology that the ancients excelled; for we find that in regard to many quadrupeds they had much more accurate information than either Buffon or Linnæus. Thus what Aristotle has written in regard to the organization, history, and manners of the Elephant is much superior and more accurate than the account given by Buffon. Neither Buffon nor Linnæus were acquainted with more than one species of Elephant, though both the Asiatic and African species seem to have been not only well known to the ancient naturalists, but also to the statuarists, for we find them both not only well described, but also accurately represented on monuments, models, &c.† Moreover there are many animals described well by the ancients, which till lately were considered fabulous. Thus, for example, we may mention the prickly mouse, stated by Aristotle and Ælian as occurring in Egypt and Lybia, which animal was actually found to exist there by the French Scientific Mission which accompanied Bona-

* Vigors on the Falconidæ, *Zool. Journ.*

† Marcel de Serres, *Edin. New Phil. Journ.* vol. XVII. p. 274.

parte, a figure of which has been given by Geof. St. Hilaire and Savigny.*

Brisson, in his elaborate work, divides the Diurnal Birds of Prey into three grand groups, or genera; viz., 1st genus Accipitrinum; 2d. genus, Aquilinum; and 3d. genus Vulture. In the first of these divisions he includes the Sparrow-Hawks, Goshawks, Falcons, Buzzards, and Harriers; in the second, the Eagles properly so called, Sea-Eagles, Caracaras, and Harpies; and in the third, all those species which are popularly known under the name of Vulture, or rather those Rapacious Birds whose necks are more or less denuded of feathers, and including also, though an exception to this rule, the Læmmergeyer, or Gypaëtos barbatus, Cuv.

This admirable arrangement for the time was almost entirely neglected by contemporary naturalists, its place being supplied by one, which, though far inferior in merit, yet it was much more simple, and well adapted for the state of science at the time I allude to than that of Linnæus. In fact most of the divisions of Brisson, borrowed in part from the ancients, have been found to be based upon characters which authors now have, and are adopting; and if ornithologists had followed his system in many places, instead of clinging reverentially to that of the illustrious Swede, the student would not now have been perplexed with the innumerable list of synonyms presented by many groups. For many years the system of Linnæus was considered the standard work, and adhered to with almost religious veneration, and owing to the vast inroad of new species, we had arranged under one and the same genus, species that had scarcely

* Descrip. d' Egypt ou Recueil des Observ. et des Recherches qui ont èté faites in Egypte pend, l' exped. de l' arm. Franç. Zool. par Geof. St. Hilaire and Savigny. A copy of this magnificent work is in the Library of the Asiatic Society of Calcutta.

any one generic character in common with each other, authors being unwilling to make new genera. It was then that ornithology appeared a mass of ill digested, and ill arranged matter, and in many cases before it could be determined whether a bird was a new species, it was necessary to examine upwards of two hundred, and in no group was the task more difficult than among the Hawks. Labouring under such disadvantages, ornithologists hailed with much pleasure and satisfaction the admirable system contained in the Regné Animal of the Baron Cuvier, who with that wonderful sagacity, which is so conspicuous in all his works, remodelled the whole of the Linnæan system, and produced one, which for simplicity and elegance, stands, as a whole, unrivalled, and probably, under certain modifications, will long remain so.

In the Linnæan system we find the Diurnal Rapacious Birds divided into two grand divisions—viz., Falcons and Vultures. The former of which is thus characterized:—Rostrum aduncum, basi cera instructum, caput pennis arcti tectum. Lingua bifida,—terms which however are not at all applicable, and the latter statement is quite inaccurate if applied to the whole group. The group of Falcons he does not again subdivide, if we except that division where he arranges them into those with the waxen-coloured and those with the dusky coloured cere, a character which is only a mark of age, not a real generic distinction.

The above simple arrangement, as already mentioned, answered all the purposes required in order to point out clearly the species then known, the number being only twenty-four, three of which, however, are not species, but young birds, or females of others previously described.

By the Baron Cuvier the Diurnal Birds of Prey are divided into two grand groups—viz., the Vultures and Hawks; the former being again subdivided into five genera, viz., Vulture properly so called, Cathartes, Sarcoramphus, Percnopterus, and Gypaëtos; and the latter into other two minor groups, viz., the *Noble* and *Ignoble Birds of Prey.* Under the Noble Birds of Prey, are comprehended the genera Falco and Hierofalco; and in the Ignoble, the genera Aquila, Haliaëtus, Pandion, Circaëtus, Harpyia, Morphnus, Astur, Nisus, Milvus, Pernis, Buteo, and Circus. But the genera will be found, when properly examined, to be arranged in groups which in many instances are not at all connected to each other. Thus he has the genus Hierofalco (a genus which has as its type the Falco islandicus, and which we have retained as a connecting link between the genus Falco and Cerchnis, it presenting all the characters, with the exception of the rather shorter tarsus and wings, common to the typical species of the genus Falco properly so called,) following that of Aquila, the genus Nisus following that of Milvus, whose affinity to each other is distant, or, in other words, there are many genera which come between in order to connect them. In other parts of his arrangement he follows out, to a certain extent, the principles so well advocated and beautifully illustrated by MacLeay and others in Britain.

In this rapid sketch we must notice a few of Cuvier's contemporaries who have written upon this interesting department; and there is no one who deserves more than the celebrated Temminck, who by his profound views, acute reasoning, and excellent generalizations, has done so much for the advancement of ornithological science, but who by his inveterate enmity to new genera, especially in the Falconidæ, shews that in many cases he is as much guided by theory as by practice.

Temminck, in his excellent manual, divides the Diurnal Birds of Prey into four groups—viz., Vulture, Cathartes, Gypaëtos, and Falco, the last of which he again subdivides into six divisions. In the first of these he includes all the Falcons properly so called; in the second, the Eagles; in the third, the Goshawks; in the fourth, the Kites; in the fifth, the Buzzards; and in the sixth, or last, the Harriers. But as he in this arrangement only comprehends the birds of Europe, we cannot with justice attempt to analyse it, all we can state is, that it has the same objections as that of the Baron Cuvier. In fact, it is just a mere modification of it, the former adopting the plan of the ancients, viz. sections instead of genera.

Mr. Vigors in his admirable paper on the Falconidæ, published in the Zoological Journal, has divided the Rapacious Birds into a series of groups, which he has denominated the typical and aberrant. In the former he arranges the Hawks and Falcons, and in the latter, Buzzards, Kites, and Eagles. As a general character for the typical species, he has, Rostra brevia, precipue dentata, præda aëria, terms which though particularly applicable, will apply also to many species among his aberrant group; for in many we find the bill very short and toothed, and at the same time in their habits truly aerial. Moreover to his so-called Stirps accipitrinum, we have only a festoon ascribed, which however is entirely wanting in many species belonging to the genus Accipiter. Again, in a bird in the Edinburgh Royal Museum, sent by Major Clunie from Moreton Bay, New South Wales, having almost every character in common with the genus Pernis or Honey Buzzard, (the particular arrangement of small feathers in the loral region excepted) there is a double tooth. In another species also in the same collection, more nearly allied to the genus Buteo than to any other, there is a powerful tooth.

In his aberrant group we have as the characteristic marks, Rostra longa, aut sublonga, haud dentata. Præda terrestris. The remarks made above are directly in opposition to these characters, and as the habits of not one-third of the Falconidæ are known, the character præda terrestris is premature.

But Mr. Vigors, as also Mr. Swainson, have pointed out, and that correctly, that each of the groups present in themselves a circle. Thus the former remarks, "when we descend into the details of any group which is subdivided into stirps returning into themselves, it is of little consequence at which subdivision we commence our examination; forming a circular series, they exhibit no natural break upon which we can fix as a regular land-mark to start from." But although each minor group can thus be resolved into itself in order to present a small circle, yet we shall find on investigation that each of the terminations of a particular group is so connected with the other adjoining groups as to form one grand circle.

Mr. Swainson has lately proposed an arrangement which however is far inferior to that of Mr. Vigors; the following is Mr. Swainson's arrangement:—

ORD. I. RAPTORES.

FAM. VULTURIDÆ.
Vultur.
Sarcoramphus.
Cathartes.
Neophron.
Catheturus.
Gypaëtus.

FAM. FALCONIDÆ.
Subfam. Aquilinæ.
Pandion.
Aquila.
Harpyia.
Gypogeranus.
Circaëtus.
Subfam. Cymindinæ.
Ibycter.
Polyborus.
Cymindis.
Nauclerus.
Elanus.
Gampsonyx.

Subfam. Buteoninæ.
Milvus.
Pernis.
Spyzaëtus.
Buteo.
Circus.
Subfam. Falconinæ.
Falco.
Harpagus.
Lophotes.
Aviceda.
Subfam. Accipitrinæ.
Ictinia.
Accipiter.
Astur.
Haliaëtus.

To enter into a minute examination of this arrangement, in order to point out its fallacies, would occupy too much space, and at the same time it would be superfluous. There are however one or two points which it is necessary for us to notice. To the genus Aquila the following characters are assigned, " wings lengthened, (the first quill short, the fourth and fifth the longest. Temnk.) tarsus plumed almost to the toes, head not crested. Inhabits chiefly the old world." As examples, Mr. Swainson gives the Aquila imperialis, chrysaetos, nævius, pennatus, albicilla, and leucocephalus.* We have here species belonging to two of the most marked genera among the Falconidæ blended into that of Aquila; viz., the Aquila properly so called, and Haliaëtus. Now the Falco albicilla and leucocephalus have not one of the essential characters given to his genus Aquila. We say *essential,* for nothing is more absurd than to enumerate as a generic character, a head not crested, seeing that it is to be met with in species

* I write the specific terms as they are given in Mr. Swainson's work; which is necessary for me to notice, as Aquila *nævius,* &c. must strike the reader.

belonging to several different genera. In the genus Spizaëtus we have some species crested and others not, and at the same time both of them possessing the essential generic characters. Moreover from the characters assigned to his genus Aquila, the wedge-tailed eagle (Falco fucorus, Cuv.) of New Holland is excluded; little more than the upper third of whose tarsus is feathered. But the characters of lengthened wings and feathered tarsus are equally common to the genera Morphnus and Buteo. As for locality, though his observation in one point of view is correct, in as far as the metropolis of the eagles is the Old world, yet still we find the most typical species also in the New; thus the Aquila chrysaetos, Haliaëtus opipagus, and H. leucocephalus are also found to occur in North America. From what we have just stated, it therefore appears that we have no character (unless the proportional length of the quill feather, which we shall afterwards examine) to distinguish an Aquila from Morphnus or Buteo. Nor is the genus Haliaëtus altogether done away with, it being placed in the sub-family Accipitrinæ upon very erroneous grounds. Thus the characters assigned to this sub-family are, "Bill short, suddenly curved from the base; the upper mandible armed in the middle of the margin with a large, obtuse, rounded tooth or festoon; under mandible truncated at the tip; cere moderate; feet moderate; tarsus in general smooth, naked; middle toe lengthened; hinder not much shorter than the inner; anterior claws very unequal, the inner being almost twice the size of the outer, and nearly as strong as the hinder. Head small; wings short; the quills internally emarginate at their base; tail rounded.

In regard to the above characters, in many instances they do not agree with the genera; thus, as already stated, in many species of the genus Accipiter there is no festoon, the cutting edge of upper mandible being quite smooth. In the genus Ictinia the tip of the under mandible is not truncated but rounded. We shall only notice the characters of one more of his genera, viz. Haliaëtus. Size and form intermediate between Astur and Aquila; bill large, straight when covered by the cere, strongly curved and hooked beyond; margin with a slight festoon in the middle; cere rather large, occupying nearly one-third the length of the bill; nostrils oval, obliquely transverse; wings lengthened, the third quill longest, feet rather short; tarsi slender, feathered beyond the knees; the front and back smooth; anterior scale transverse; posterior as if in one entire piece; lateral scales, and those at the base of the toes, very small and distinctly reticulate; toes strong; inner toe the shortest of all; claws grooved beneath, unequal, hinder and inner nearly of the same size, outmost much smaller than the middle; tail broad, rounded. Type, H. pondicerianus.

How Mr. Swainson can make the above characters correspond with those of his subfamily Accipitrinæ, under which the genus Haliaëtus is arranged, is quite extraordinary. Thus to the family he assigns, bill short, and cere moderate;—now in the genus the bill and cere are large. In the family the wings are short; in the genus they are long. In the family the tarsus is naked; in the genus they are feathered below the knees! These characters are quite sufficient to shew that this genus has nothing to do with the family to which it has been assigned. Moreover the absurdity of giving size as a generic character, must be evident to all who have paid attention to this department of Natural History. For example, is the A. pennata not equally characteristic in representing the genus Aquila as the A. imperialis, chryraëtos, or nigra? Is the Larus minutus not equally entitled to represent the genus Larus, as the Larus glaucus or marinus? Again, by this character the male and female of certain species of Falconidæ met with in New Holland would be put under separate divisions, seeing that the former is not a third as large as the latter. The same remark has been made by Audubon in regard to some species met with in North America. To the genus above mentioned, Mr. Swainson also gives as a character, "tarsus slender." No doubt it is not so large in the Pondicherry Eagle as in the Sea-Eagle, seeing that the former is not one-half the size of the latter. It is however equally large in proportion; and no person who has ever studied this bird in its native haunts on the Hoogly or the Ganges, where it occurs in vast numbers, in company with other Haliaëti, would for a moment doubt where its proper position ought to be in the ornithological system. Nor can we perceive that this tribe bears to the other members of the so-called sub-family Accipitrinæ, a greater affinity than any of the other members of the Falconidæ in general. Probably the reason is, that the genus Haliaëtus has a scutellated tarsus, and festooned bill, like the genus Astur; but these characters are common to all the Sea-Eagles, properly so called, the typical species of which Mr. Swainson, without assigning any reason, has, as already stated, arranged along with the Aquila, properly so called. Moreover, the members of the genera Ictinia, Accipiter, and Astur, are in their habits terrestrial; so is the type of the genus Haliaëtus aquatic; but probably it is his aquatic type of this division—one method of making characters suit theory.

We might notice, if it was necessary, the various arrangements which have been proposed by Illiger, Durmeril, Vieillot, and others; all of which are more or less defective. Let us now give our own views in regard to this group, founded on an examination of all the specimens contained in the magnificent collection of the Edinburgh Royal Museum; which in this department, at least in Britain, stands unrivalled. We have also examined the extensive collections of the Zoological Society of London, British Museum, India House, Liverpool Institution, &c.

That the Falconidæ present in themselves a grand circle, is quite correct; and as the centre of which we may take the most typical group of that family, viz. the Falcons properly so called, and from them, on either side, we have a group of genera arranged. As the type of the genus Falco, we take the Falco communis, or Peregrin Falcon; from it we are gradually led on to the genus Hierofalco; from it to Cerchnis; from this genus to Hierax; from Hierax to Harpagus; from Harpagus to Astur; from Astur to Accipiter; from Accipiter to Morphnus; from Morphnus to Pandion; from Pandion to Cymindis; from Cymindis to Haliaëtus; from Haliaëtus to Aquila; from Aquila to Circaëtus; from Circaëtus to Harpyia; from Harpyia to Torathropius; from Torathropius to Ibycter; and from Ibycter to Daptrius.

Again, when we proceed on the other side from the genus Falco properly so called, we have first the long winged typical Falcons; as a type we may take the Falco vespertinus of Europe, adopting the generic name Erythropus of Boié, and from it we are led into the genus Elanus; from Elanus to Nauclerus; from Nauclerus to Milvus; from Milvus to Gypaëtos; from Gypaëtos to Brevitarsus; from Brevitarsus to Pernis; from Pernis to Buteopernis; from Buteopernis to Ictinia; from Ictinia to Buteo; from Buteo to Circus; from Circus to Serpentarius; from Serpentarius to Bacha; from Bacha to Polyborus, which is connected again with the last genus in the upper series, and both of the terminations of the circle are connected to the Vultures through the genus Neophron. This arrangement may be represented in the following table:—

	Daptrius,
	Ibycter,
	Torathropius,
	Harpyia,
Aquilidæ.	Circaëtus,
	Aquila,
	Haliaëtus,
	Cymindis,
	Pandion,

Accipiteridæ.	Morphnus, Accipiter, Astur,
Falconidæ.	Harpagus, Hierax, Cerchnis, Hierofalco, * *Falco*, Erythropus,
Milvidæ.	Elanus, Nauclerus, Milvus, Gypaëtos, Brevitarsus, Pernis,
Buteidæ.	Buteopernis, Ictinia, Buteo, Circus, Serpentarius, Bacha, Polyborus.

By this arrangement we divide the genus Falco into several divisions. In the first, we include the Falco communis, subbuteo, &c. retaining the generic name of *Falco.* In the third, the Falco tinnunculus, tinnunculoides, &c. are included, and the generic term Cerchnis, Boié retained. The long wing Falcons, of which the Falco vespertinus may be considered the type, are arranged in the genus Erythropus, and for the Falco bengalensis, and Falco bidentatus, we have adopted the generic terms Hierax* and Harpagus,† which have already been given by authors.

We shall now enter more into detail, and point out the characters by which each of the genera is characterized, and also the connexion which they bear to each other, in order

* Under the genus Hierax, two species are included, viz. the one above mentioned, and another species lately discovered in South America, and which has been described in the Proceedings of the Zoological Society of London.

† Under the genus Harpagus two species are included, and both confined to South America.

to shew upon what ground our system of arrangement is based.

Characterising the genus Falco as we have restricted it, we have the following characters.* Bill short, curved from the base; cutting edge of upper mandible furnished with a powerful tooth near its tip; cutting edge of under mandible furnished with a notch corresponding to the tooth in the upper. Tip of under mandible truncated perpendicularly. Nostrils oval or rounded, and inserted into the lateral part of the cere, which is broad and partially covered with feathers or naked. Gape reaching nearly as far as the anterior angle of the eye. Plumage rather loose; wings long and pointed, reaching nearly to the tip of the tail; inner web of first primary quill and external web of second truncated, second primary quill longest, first and third nearly of equal length, and about half an inch shorter, the second and fourth much shorter. Tarsus of moderate length, reticulated, upper part feathered anteriorly. Toes scutellated and very long, the middle surpassing the external and internal by one joint. Claws long, sharp, compressed laterally, and grooved below. Type, Falco communis, laniarius, biarmicus, checquera, &c. Edinburgh Royal Museum.

Differing from the above characters, we have the Falco islandicus, forming, as already mentioned, the genus Hierofalco of Cuvier. In regard to this species there has been much dispute, owing to the Baron Cuvier having given as one of its principal characters, "bill furnished with a festoon," which is met with in but few specimens. In all those we have examined,† the bill was furnished with a powerful

* Our characters have all been drawn up from specimens in different collections which we shall refer to, for the information of others who take an interest in this particular department.

† In the Edinburgh Royal Museum these three specimens are adult male and female, and a young bird of the second year. In Professor Trail's collection there is a fine adult female. In the collection of the Zoological Society of London, there are two specimens.

and well marked tooth in the upper mandible, and corresponding to which there was a notch in the under, which is wanting in all the Falconidæ, which are only provided with a festoon. But the principal characters in which this genus differs from the genus Falco, is in the form of the tarsus, and in the wings not extending further than the upper third of the tail.* In the Kestrels, and in its numerous allied species, we have not only the wings considerably shorter than the tail, but also the tarsi in part scutellated, which is particularly the case with the Falco Cerchnis, Sparverius of America, forming a connecting link between the preceding genus and the genus Hierax, which presents the following characters:—Bill short, curved from the base, compressed, but convex laterally, cutting edge of upper mandible furnished with a prominent tooth, anterior to which there is a deep groove;† cutting edge of under mandible notched and truncated perpendicularly at the tip; gape not extending as far as the anterior angle of the eye. Nostrils rounded and inserted into the lateral and anterior part of the cere which is very narrow above, and gradually increases towards its base, and is partially covered with feathers. Wings rather short and pointed; second and third quill feathers equal, and longest; first nearly equal to the second and third; fourth nearly equal to the first; fifth much shorter than the fourth. Tarsus robust, rather long and scutellated, upper third feathered anteriorly. Toes very low and scutellated, the middle one being much the longest,

* Lesson, without assigning any reason, arranges the Falco laniarius along with the Falco islandicus in the genus Hierofalco; its proper place, however, as well as that of the Falco borigora, of which he is doubtful, is in the genus Falco, as we have characterised it. See Lesson Traite D' Ornithologie, p. 97.

† By many authors the species which is the type of this genus has been described as double toothed, which is not the case if properly examined.

the external longer than the internal. Claws large, much covered and pointed; the hind one much the largest. Type—Falco Bengalensis, Edinburgh Royal Museum. From the characters now given, it is evident that the genus Hierax presents many characters in common with the genus Cerchnis; but others again, as the short wings, and scutellated tarsus, lead us on to the next group, or Harpagus, which may be thus characterised;—Bill short, curved from its base, compressed, but convex, and bulging out laterally as in Hierax; cutting margin of upper mandible furnished with two teeth, the one a little anterior and above the other; from the second tooth the hook of the bill makes a very oblique descent. Under mandible furnished with a single notch, and truncated as in the other genera mentioned. Nostrils rounded, and inserted in the cere, which has the same form as in the genus Falco. Loral region partially covered with bristly hairs. Wings very short, not reaching within two and a half inches of the tip of the tail First quill feather very short, third and fourth longest, fifth longer than the second, which is much longer than the first. Tarsus of moderate length, a small part of its tibial end feathered, the remainder covered with broad quadrilateral scutellæ. Toes scutellated. The scutellated tarsus and short wings of this genus at once lead us on to the next division, or genus Astur, which is thus characterised;—Bill short, curved from the base, and much compressed laterally; cutting edge of upper mandible furnished with a festoon, cutting edge of under mandible smooth, truncated obliquely at the tip. Gape extending to the middle of the eye. Cere broad and naked. Nostrils oval, and inserted into the upper, lateral, and fore part of the cere. Plumage rather loose; wings short and rounded, reaching as far down as the upper third or middle of the tail. Fourth primary quill feather the longest; third and fifth equal, and nearly as long as the fourth; first much shorter than the second, which is intermediate in length between the sixth and seventh; inner web of the first, second, third, and fourth, truncated; outer web of the third, fourth, fifth, and sixth, also emarginated. Tail rather long and rounded. Legs feathered down as far as the upper third of the tarsus anteriorly. Tarsus strong, and rather lengthened, scutellated anteriorly. Toes scutellated, slender, and very long, middle one surpassing the others by nearly a joint, external toe longer than the internal one, hind toe very short. Claws long, much curved, pointed, and grooved below, hind one much the largest, internal much larger than the external. Types—Falco palumbarius, trivirgatus, albus, &c. Edinburgh Royal Museum.

By the above characters we are led into the next group, which differs only in the tarsus being more lengthened and slender, in the bill being devoid of a festoon, which however is not always wanting, many species being furnished with it, in the wings being proportionally shorter, and in the proportional length of the primary quills.—To this group the term Accipiter has been applied by some authors, Fringillarius by others.

[To be continued.]

Umballa Political Agency,
May 30*th,* 1840.

On the Structure of the Delta of the Ganges, as exhibited by the Boring Operations in Fort William, A.D. 1836—40. *By* Lieut. R. Baird Smith, *Bengal Engineers.*

The increasing interest attached to the preservation of detailed records of subterranean operations, and their acknowledged importance as materials of economic and scientific reference, have induced me to embody in the following pages the information relative to the geological structure of the Gangetic Delta, elicited by the boring operations recently in progress at this place. It is not my design to enter upon the mechanical details of these operations, as the Report of the Committee under whose zealous superintendence they have been prosecuted, renders this quite unnecessary; but as the practical character of that document necessarily precludes all speculations on the interesting results obtained (especially as connected with the geology of the locality), the following notes are intended to supply its deficiency in that respect.

It is now nearly six and thirty years ago (1804) since the first attempt was made to supply the serious deficiency of good fresh water in the town and vicinity of Calcutta by the introduction of the method of boring. The same want of success which attended this first effort, has attended each of the numerous consecutive experiments which were subsequently instituted, and it is but a few weeks ago that the most recent of the series was abandoned, after having been carried to the depth of four hundred and eighty-one feet by incessant labour, frequently during both night and day, for upwards of four years. In every recorded case the cause of failure has been of mechanical and not of natural origin, arising either from the very unsatisfactory character of the apparatus employed, the breaking of the rods in the bore, the slipping of the joints of the iron tubing, the deflection of the direction of the bore from the perpendicular, or some similar casualty.* The infant state of the art of Boring, and the difficulty of reducing its details to the comprehension of native workmen, to whom the whole was alike novel and strange, furnish us with ready explanations of the earlier failures, and these are scarcely in any way calculated to excite our remark, but it magnifies the difficulties of the undertaking, when we find that though all the modern improvements of tools, apparatus, and materials, were combined with increased experience and dexterity on the part of those employed, success could not even then be attained. The in-

* Vide note A.

efficiency of common and known means to overcome the difficulties encountered during the operations, threw the Committee on their own resources, and the result was, that new means were adopted, and new instruments designed to meet the peculiar exigencies of the case, so that though the main object of their labour has been left unaccomplished, they have still the satisfaction of knowing that the resources of the art of boring have been increased, and much interesting collateral information been developed, by their long continued efforts.

In proceeding now to detail the geological information elicited by the Fort William boring operations, it may be premised, that as the strata of the Gangetic Delta have been found on every occasion in which a section of them has been exposed to be almost identical in position and constitution, I do not deem it necessary to allude to previous boring experiments, farther than to record such individual circumstances connected with them, as may appear to throw any interesting light on the general question of the structure of the Delta.

The excavation of the bore was commenced on the 2nd of April 1836,* and after penetrating to a depth of 10 feet, through the artificial surface soil, a bed of blue clay, close and adhesive in its texture, was entered. As the bore descended this was found to become gradually darker in colour from the admixture of decayed vegetable matter, till from 30 to 50 feet, large portions of peat were brought up with the clay. Both on this and former occasions branches and fragments of the trunks of trees in a state of decay were found, and Dr. Wallich† has identified such of these as were red coloured with the common Soondri of the Sunderbuns, while he considered the yellow coloured varieties to

* Committee's Report.

† Asiatic Society's Journal.

be the roots of some climbing tree resembling the Briedelia. That the stratum of peat and decayed wood was formed from the debris of forests, which at a former period covered the entire surface of the Delta as the existing jungles of the Sunderbuns cover so large a portion of it now, admits not therefore of a doubt. In truth, the whole of the present site of Calcutta was in 1717* covered with dense masses of forest vegetation, and even so late as 1756, Fort William and its Esplanade formed part of a complete jungle, throughout which were scattered extensive salt lakes and marshes. As the town of Calcutta extended, the jungle was gradually cleared away, and the stagnant lakes filled in or drained; and we have now in these boring operations laid open the beds which the debris of these forests, accumulating for centuries, and consolidated by the intermixture of mud and silt from the waters under which they were so liable to be submerged, have contributed to form. Similar peat beds have been found in excavating the Circular and Entally Canals, at the respective depths of 25 and 9 feet, thus shewing the surface of the ground to have been slightly undulating.† It is much to be regretted that in the solitary instance in which bones were found in this stratum, at a depth of twenty-eight feet, they were destroyed by the workmen before any means could be taken to identify them. A most interesting opportunity of acquiring some information relative to the denizens of these vast forests, and of comparing them with those now inhabiting similar tracts throughout the Delta, was thus lost. In 1813 a quantity of bones was discovered in digging a tank in the vicinity of Dum-Dum, at a depth of 18 feet from the surface, associated, as were the above, with Soondri wood, and thus being satisfactorily shewn to have belonged to inhabitants of the then

* Hamilton's Gazetteer, Art. Calcutta.

† Vide note B.

existing Sunderbun forests and swamps. Dum-Dum is surrounded by shallow salt water lakes, and it is stated,* that many of the names of the adjoining villages indicate that the whole neighbourhood at one period consisted of a series of islands ; but we have no authentic record by which to estimate the growth of the Delta in these places, and hence it would have been doubly interesting to have been enabled to assign an epoch to the above remains. It would be useless to attempt doing so with the imperfect information recorded, but their great size led the officer by whom they were found, to conclude, that they did not belong to any of the animals now inhabiting the Sunderbuns. Succeeding these peat-charged beds, a stratum of calcareous clay, ten feet in thickness, is found, and intermixed with it are portions of that concretionary limestone commonly known in India as kankar. Occasionally this occurs in small grains with the appearance of land shells, sometimes it is found in thin beds of great hardness, and sometimes in its common nodular shape. Kankar occurs over nearly the whole of India, and abounds in the alluvial formations of Hindustan. In the vicinity of Calcutta, in the bed of the Salt Lake, it is largely met with in the nodular form, and in some of the jheels, or shallow salt marshes, it is known to be in progress of formation now, in thin layers. As the locality of the bore formerly presented features similar to these, we obtain a ready explanation of the occurrence of the kankar above alluded to. It has long been one of the desiderata in Indian geology to account satisfactorily for the existence of this singular formation, and the favourite theory appears to be, that it was derived from calcareous springs. That in some, perhaps in many, instances this may have been the case, I am not prepared to deny, but there are some of the phenomena connected with the occurrence of kankar, which seem to me

* Asiatic Society's Journal, vol. ii. page 649.

scarcely explicable on such a supposition. Thus the kankar at Ghazipoor is described by the Rev. Mr. Everest as "resembling much in the shapes it affects, the flints of the chalk strata. The bank of the river (the Ganges) shews a section of a layer about four feet thick, formed of these pieces. This layer is gradually lost in the clay above and below. In some places the layer or seam is double, with an intervening bed of clay, through which the lower kankar bed is said to branch off and join the higher. The beds are farther similar to those of chalk flint in the manner in which the loose pieces are imbedded in the clay, and in the layers being composed of detached pieces." The origin of the kankar is proved to be very modern, from the occurrence of existing fresh water shells, small planorbes, &c. in the clay on which it rests. The clay itself is calcareous. The kankar of Mirzapoor is described by the same observer as exhibiting like phenomena. In the sections exposed by the bed of the Jumna the kankar is found similarly in layers, between beds of clay and calcareous marl, and in every instance I have been able to find it, has been associated with mechanical deposits containing carbonate of lime. Now it appears some presumption against the whole of these vast collections of nodules being due to calcareous springs, that recent though their formation has been proved to be, there are no independent indications of the existence of the springs whence they could have been derived. So universal is the prevalence of kankar, that it is scarcely possible to believe the whole traces of its originating sources have been obliterated. Farther, from the appearance of the beds with which the kankar is associated, it is evident that no springs have been in action since they were deposited, and the nodules must consequently have been brought from a distance. There is some difficulty however in accounting for the occurrence of beds 4 feet thick, with no intermixture of foreign substances, but consisting entirely of nodular limestone, on this supposition. Detritus of such an origin is invariably mixed, and contains specimens of the different materials which the force of the transporting agent was capable of bearing along. The shooting of branches and the gradual passing of the kankar into the clay above and below, seem farther to militate against the idea of the operation of powerful, or even any, transporting agency. It has been said, that the kankar of India has no analogous formation in the world; but I conceive this to be doubtful, as it is known that the London clay* contains numerous contemporaneous nodules of hard marl or clayey limestone, which occur in regular horizontal layers at unequal distances, usually varying from four to forty feet apart. These nodules are called Septaria, from their being divided by partitions or veins of calcareous spar, and in their cavities are frequently found crystals of calcareous spar (carbonate of lime) and heavy spar (sulphate of baryta.) The Septaria are surrounded by crusts which contain a smaller proportion of lime than the central parts; and of the Ghazipoor kankar, Mr. Everest remarks similarly that its cavities are lined with crystals, and that while the fresh fracture is of a brownish grey colour, exhibiting the stone compact, the exterior is covered with a white or yellowish white crust. The chemical composition of the Septaria of the London clay is identical with that of the Ghazipoor kankar, consisting chiefly of carbonate of lime with silica, alumina and oxide of iron, or slightly ferruginous clay, and the natural cement stones of Harwich, Sheppy, and other places, are used for the same purposes in England as the kankars are in India.† In the tertiary basin of Paris similar tuberose masses are found in the clayey and calcareous marl of the fifth and sixth formations.‡ It is scarcely necessary to remark, that I do not mean to contend that the

* Cuvier's Theory of the Earth.

† Pasley on Cements, and Note. C.

‡ Cuvier's Theory of the Earth.

Indian kankars are contemporaneous with the similar concretions of the tertiary formations of England and France, I only wish to exhibit the analogy existing between them, as this may help us to some explanation of their origin. The analogy might be extended to several other members of tertiary formations, as the strata of the Isle of Wight, in which Mr. Webster,* informs us both the nodular and the flat form of concretionary limestone are met with, but I would now proceed to offer a few remarks on the probable origin of these substances.

The forms effected by the nodules of kankar, and the circumstances of their disposition in the clayey beds with which they are associated, have frequently been recorded by observers as being strikingly similar to those of the flints in the chalk strata, and it was these analogies which first led me to suspect that the information we possess concerning the origin of the one, might be made to bear upon that of the other. From the state in which the fossils of the chalk strata are found, many of them perfect in their most delicate details, some of the shells preserving even their fine pearly lustre, and the soft scales of fishes being often found beautifully preserved in the structure of flints, we are warranted in concluding that they were quietly entombed near the spots where they lived and died, and that consequently no transporting power of energy sufficient to bear from a distance the associated masses of flint could have been in action upon them. We are thus led to believe the flint contemporaneous, or nearly so, in its origin with the chalk in which it is imbedded, and as the flint occasionally passes imperceptibly into the chalk, the nodules of the one near the line of junction being replaced by those of the other, there is thus afforded an additional argument for the flints having been formed in the places were they are now found, and against their having been derived either from silicious springs, or other sources, and brought from

* Geological Trans. vol. ii. p. 209.

a distance. In like manner the flints which are found in the lower beds of the great gypsum formation of the Paris basin pass gradually and imperceptibly into the gypsum itself; a proof, (says Professor Jameson in allusion to this fact) of the contemporaneous origin of the two substances.* Similarly the peculiarly perfect and beautiful state of preservation in which the fossils of the London clay are found, would lead us to infer the quiet and contemporaneous formation of the horizontal beds of nodular limestone with which they are associated, and in truth this is put beyond a doubt from the circumstance that the Septaria have frequently been found to include fossils similar to those occurring in the body of the clay. From these analogous cases, and the consideration of others I have thought it unnecessary to detail, I have been led to consider the Indian kankar beds as being formations "in situ," and *nearly* contemporaneous in their origin with the beds of calcareous clay with which they are associated. This remark applies to the kankars of those localities where no proofs of the previous existence or operation of calcareous springs can be detected, and where the facts oppose the idea of transporting forces having been in action.

Conceiving then that the kankar beds are actually "in situ," some explanation is still required to account for the great difference between them and their associated strata; and here it must be fully acknowledged that our information is still but very limited, and that our reasoning must, as before, be chiefly from analogy. It has been already remarked, that kankar appears to be one of a class of substances formed under similar circumstances, and that if we could throw any light on the formation of one of these, we might thus gain an insight into that of the others. Now it is known from experiment that if a mechanical mixture of

* Cuvier's Theory of the Earth. English edition.

sand (silica) and clay (alumina) reduced to impalpable powder be made, by suspending the two substances in the same fluid, and if part of the fluid be evaporated till a plastic compound result, the silica of the compound will after it has stood for a short time undisturbed segregate into small hard nodules similar exactly to those of flint in chalk.* On comparing the circumstances of this experiment with those under which the class of bodies to which kankar belongs are formed, a striking and interesting similarity will be observed. Thus we know the chalk to be an aqueous deposit, and there must have been a period at which its consistence would be plastic as the above, it seems therefore to be no unwarrantable inference that those segregations of the particles of silica disseminated throughout the mass which now appear as flints, took place during this time. Similarly, and more closely analogous to the kankar, the London clay must also at one period have been in a plastic state, and as by analysis it is well known that calcareous matter is largely disseminated throughout its mass, it is probable that the nodular Septaria were then formed by the segregation of their constituents. It is only necessary to allude to the other analogous cases in the strata of the Paris basin, where the nodules are not confined to flint and limestone alone, but are of gypsum, hornstone, celestine, &c. all of whose associated strata are known to be of aqueous origin. These therefore furnish the grounds on which I have been led to consider the kankar as formed by the segregation of the particles of calcareous matter, disseminated throughout the body of the clay with which it is associated, and to be nearly contemporaneous in its origin with this. Of the peculiar circumstances which dispose substances to this segregation, of the proportion which the segregating material should bear to the general mass, or of the exact nature of

* Babbage. Economy of Machinery.

the attractive affinities in operation, we as yet know nothing; and the only experimental fact connected with the subject we possess, is that formerly alluded to. The great hardness of the kankar may be explained from the peculiar property bodies similarly constituted possess of forming stony masses under water. The chemical composition of the kankars both of India and England is identical with that of the artificial mixtures which have been formed for the purposes of hydraulic architecture. To exhibit this in one instance, I annex the results of the analyses of Roman cement and Ghazipoor kankar.

	Roman cement.	*Ghazipoor kankar.*
Carbonate of Lime, ...	73.3	... 72.0
Silica, ...	9.9	... 15.2
Alumina, ...	4.4	... 4.0
Oxide of iron, ...	11.3	... 7.0
Loss, ...	1.1	... 1.4
Carbonate of magnesia,	,,	... 0.4
	100	100

From these it will be seen how readily the induration of the kankar may be explained from its close affinity to a substance of which the well known property is to harden immediately on contact with water.

Underlaying the bed of calcareous clay in which the kankar first occurs, there is a thin bed of green siliceous clay, extending from 60 to 65 feet in depth. The clay then loses its colour, and continues to a depth of 75 feet, the lower portion of it furnishing nodules of kankar. At 75 feet a bed of variegated sandy or arenaceous clay commences, and continues to the depth of 120 feet, occasionally traversed by horizontal beds of kankar. Beneath this a stratum of argillaceous marl 5 feet in thickness is found, and succeeding it, there is a bed only 3 feet in thickness of loose friable sandstones, the particles of sand being held loosely together by a clayey cement. Argillaceous marl, 20 feet in thickness, follows the sandstone, terminating at the depth of 150 feet, when it passes into an arenaceous clay intermixed with waterworn nodules of hydrated oxide of iron, from which metallic iron was procured by Mr. J. Prinsep. Weathered mica slate is found attached to the clay of this bed, and throughout the entire range of strata penetrated, scales of mica have always been abundantly met with. At 175 feet a coarse friable quartzose conglomerate occurs, composed of pebbles of different sizes, though none are very large, cemented together by clay. At 177 feet, this conglomerate becomes smaller grained, and at 183 feet 3 inches, it is found to pass into indurated ferruginous clay, which continues with but little variation to a depth of 205 feet. Here another layer of sandstone, soft in its upper portion, but becoming more indurated, and assuming the lamellar structure as it is passed through, occurs; the thickness being however no more than 3 feet. Ferruginous sand with thin beds of calcareous and arenaceous clay prevail from 208 feet to 380. Kankar, with minute waterworn fragments of quartz, felspar, granite, and other indications of debris from primary rocks, are met with in the lower parts of this sandy deposit, where also are found those fossil bones which have given to these boring operations so much additional interest and importance.*

The first of these relics, Plate ix. fig. 1, a small bone, was brought up from the depth of 350 feet, filled interiorly, and incrusted exteriorly with the micaceous sand in which it was imbedded. The bone, of which a full size sketch is annexed, was considered by Mr. J. Prinsep to be the lower half of a humerus of some small animal like a dog, resembling the drawing of the corresponding bone of the hyæna in Cuvier, but entire identification was then impracticable, from the want of skeletons for comparison. "The bone," says the same gentle-

* Vide Pl. ix. fig. 1, *a. b. c.*

man, "is not thoroughly fossilised, for when heated by the blow-pipe it becomes slightly charred, and emits a perceptible odour, but the animal matter left is exceedingly small, and the whole loss on heating a portion of it to a white heat was only seven per cent, the greater part being moisture from the hydrate of iron with which it is impregnated. The greater part of the phosphate of lime remains, with a portion of the carbonate; the specific gravity is 2.63, the same as that of a fine specimen of polished ferruginous odontolite from the Himalaya; it requires the heat of an oxygen blow-pipe to fuse a fragment of it per se on platinum foil."

The second fossil was found in the same sandy bed, at a depth of 362 feet (Pl. ix. fig. 2, a. b.) It was considered to be part of the carapace or shield of a turtle, and to resemble much some of the fragments found so plentifully among the Jumna, Siwalik, and Ava fossils." It was mineralised to the same extent as the first specimen, having a specific gravity of 2.5, and losing under a red heat 10 per cent.*

A third fragment of bone, unfortunately however so injured by the auger as to make identification impossible, was found at a depth of 375 feet. At 380 feet, there occurred a thin layer, only two feet in thickness, of blue calcareous clay, thickly studded with fragments of shells, and at 382 feet this was succeeded by a layer of dark clay, composed almost entirely of decayed wood. The appearance of the clay was precisely similar to that of the black peat clay found at the depth of from fourteen to thirty feet from the surface, and formerly described. From the lower portion of it, several fragments of coal, of excellent quality, were brought up. The specific gravity of these curious and interesting specimens was 1.20, and they exactly resembled the rolled pieces found now in the beds of mountain streams, and which have always hitherto proved the means of leading to

* Vide Note D.

the discovery of the coal "in situ." Underneath this stratum, and in the gravelly bed which immediately succeeds it, there were found several other fragments of fossil bones. One was considered to be a small caudal vertebra of a kind of lizard, and the rest were fragments of turtles. These were discovered at the depth of 423 feet, and were associated with large rolled pebbles of quartz, both white and amethestine, felspar, limestone, and indurated clay. At 450 feet in depth two other fragments of fossil turtles were found, and associated with them there was a rolled fragment of vescicular basalt. Again at 464¼ feet, and still in the same, a fragment of rolled lignite, similar exactly to specimens now obtainable in Cuttack,* was discovered, and shortly afterwards the auger brought up a mass of decayed wood, rounded on the edges as if rolled in a stream, but not in the least carbonised, and being like in all respects to the fragments found in the Sunderbun alluvium. The gravel composed entirely of the debris of primary rocks, continued to the depth of 481 feet, where the bore was checked by the auger becoming jammed at the bottom of the iron tubing in such a way as to foil every attempt made for its removal, and to force the officers superintending the operations to bring them to a final close in April, 1840.

From the preceding details it will be observed that the Fort fossils were found in two distinct deposits, separated from each other by the interposition of a bed of shelly calcareous clay, and a deposit of carbonaceous matter ten feet in thickness, the remnants of some extensive forest which flourished at a period anterior to the deposit of the 380 feet of superincumbent sands and clays. The lithological characters of the superior and inferior fossiliferous deposits differ considerably from each other, the former being a fine and slightly indurated sandstone, the latter a coarse conglomerate,

* Journal Asiatic Society, vol. vi.

formed of the debris of primary rocks, imbedded in an arenaceous matrix. The fossils of the upper bed, which is about eighty feet in thickness, furnish the only specimens of the bones of mammalia obtained during the operations. These were associated with the remains of Chelonians, but no indications of the existence of Saurian animals were discovered till the shelly clay and carbonaceous bed were passed through, and from the lower conglomerate no mammalia were obtained. It is necessary, however, in thus stating in general terms the distribution of the Fort fossils, to recall to mind the extremely limited foundation on which such conclusions rest. A space whose diameter was no more than six inches, has furnished all the specimens described, and though this circumstance may be deemed a strong proof of the great abundance of such treasures in the strata penetrated, it can warrant inferences as to their general distribution and association only of the most limited range. It is, however, interesting to find that the conclusions drawn from the Fort fossils are to a considerable extent supported by the distribution of the remains in other localities which are probably of the same geological age as the lower deposits of the Gangetic Delta. Thus in describing the succession of strata, and the distribution of the fossils in the pass of Ambwalla, of the Sub-Himalayan series, Captain Cautley states,* "There are here three grand deposits; first, the lower with lignite, consisting of a coarse conglomerate full of remains, highly impregnated with hydrate of iron, the leading ones being Saurian and Chelonian, but abounding in bones and teeth of mammalia, vertebra, and teeth of fishes, and a few shells, but the latter are very imperfect and broken—their thinness would probably prove them fresh water. Second, the blue marl or clay filled with the fresh water shells above mentioned. Third, the upper, or grand deposit of the

* Asiatic Society's Journal, vol. vii.

larger mammalia, the remains perfectly fossilised, and existing in abundance in the superior strata of sandstone. The general inclination of all these strata varies from twenty to thirty-five to the horizon." It is most interesting thus to find a succession of strata at the base of the Himalaya so perfectly identical with that extending from about 450 to 480 feet below the surface of lower Bengal. The singular occurrence of thin beds of blue marl with shells, in both instances overlaying coarse conglomerate intermixed with lignite, and underlaying beds of sandstone, links the two classes of deposits in a remarkable manner, and would almost lead us to believe that they owe their origin to the same mighty ocean which reached to the foot of the mountains, and that by movements of elevation in one locality, or of depression in the other, their present difference of position was subsequently attained. The similarity of the distribution of the fossils in both instances will also be remarked, the mammalia chiefly abounding in the upper deposits, Chelonians and Saurians in the lower, while the mineralising material, hydrate of iron, is alike in all. The fossils of the Jumna, of the valley of the Nerbudda, of the Sub-Himalayan range, of the Irawaddi, have been identified with each other, and it appears probable that to this series may also be added the fossils of the Delta.* The conglomerate forming the matrix of the Ava remains, induced Dr. Buckland to assign them to diluvial formations more modern than either the recent marine sediments of the tertiary formations, or the antidiluvian freshwater deposits, and to the same epoch the other members of the above mentioned series most probably belong.

In conclusion, it only remains for me to express my grateful acknowledgments to Colonel D. McLeod, Chief Engineer, for the ready access he has granted me to all official papers or plans connected with the boring operations, from

* Vide Note E.

which I have obtained much interesting information and assistance.

R. BAIRD SMITH,

Lieut. Bengal Engineers.

Calcutta, 20th June, 1840.

NOTES.

Note A.—*List of the various Boring Experiments made at Calcutta, from* 1804 *to* 1840.

(From Committee's Report 1833 *with additions.)*

No.	Superintending Officers.	Date.	Locality.	Depth attained.	Cause of failure.
				Foot.	
1	Colonel Garstin	Dec. 1804	Well near Powder Mag.	75	
2	Ditto.	Aug. 1805	SW. of Arty. Barracks.	119	Auger broke.
3	Ditto.	Sep. ,,	SE. of Regt. Parade.	55	Ditto.
4	Ditto.	Oct. ,,	SE. of European Barks.	59	Ditto.
5	Ditto.	Nov. ,,	SW. of Artillery Parade.	80	Ditto.
6	Ditto.	Dec. ,,	Ditto.	127	Ditto.
7	Ditto.	Feb. 1806	Ditto.	94	Ditto.
8	Ditto.	March ,,	Ditto.	124	Earth fell in.
9	Ditto.	April ,,	Same operation resumed	127	Auger broke.
10	Ditto.	May 1814	SE. of Artillery Parade.	140	Suspended by rains.
11	Ditto.	Nov. ,,	Same resumed.	136	Auger broke.
12	Ditto.	May 1819	On Artillery Parade.	130	Ditto.
13	Ditto.	Apl. 1820	Ditto,	122½	Ditto.
14	Ditto.	May ,,	Near Triangular Barks.	128	Earth fell in.
15	Wm. Jones.	1815	Not specified.	70	Spring found.
16	Doctor Strong.	1826-28	Circular Canal.	70	Ditto.
17	Ditto.	Ditto.	South West Lake.	40	Ditto.
18	Ditto.	Ditto.	Near Circular Road.	70	Hard Kankar.
19	Ditto.	Ditto.	At Russa Paglah.	70	Earth fell in.
20	Ditto.	1832	Lock Gates Chitpore.	70	Water rose.
21	Strong, Ross and Kyd.	1830	Near Fort Church.	176	Shaft injured.
22	Ditto.	1832	Near St. George's Gate.	164	Earth fell in.
23	Ditto.	1833	Ditto.	170	Auger broke.
24	Boring Com.	1835	Chief Engineer's Yard.	150	Tubes deflected.
25	Ditto. *	1836-40	Ditto.	481	Jumper jamed & rods broken.

Note B.—*Analysis of the Peat of the Calcutta Alluvium.*

Volatile matter chiefly aqueous, - - -	62·0
Fixed Carbonaceous matter, - - - - - -	16·7
Red ash, - - - - - - - - - - - - - -	21·3
	100.

J. PRINSEP.

* Colonel D. McLeod, Chief Engineer, President.
Major Irvine, C.B., Engineers.
Captain Fitzgerald, ditto.
Doctor Strong.

Note C.---Analysis of Argillaceous Limes or Kankars.

	Gazipore. Kankar.	*Jumna.* Kankar.*	*Boulogne.† Stone.*
Carbonate of Lime,	72·0	42·2	61·6
Ditto of Magnesia,	4	...	...
Ditto of Iron,	...	...	6·
Silica,	15·2	57·8	15.0
Alumina,	4·	...	4·8
Oxide of Iron,	7·	...	3·0
Water of Loss,	1.4	...	9·6
	100.	100.	100.

Note D.---Analysis of Indian Fossils.

(1.) *Fossil Bones from the Valley of the Nerbudda.*

Carbonate of Lime,	14·0
Phosphate of Ditto,	85·5
Siliceous Ascicular Fibres deposited by infiltration,	·5
	100.

(2.) *Fossil Bones from the Bed of the Jumna.*

(*a.*)

Carbonate of Lime,	18·0
Phosphate of Ditto,	80·0
Brown Ockreons Residue,	2·0
	100.

(*b.*)

Phosphate and Carbonate of Lime,	17·5
Red Oxide of Iron,	76·5
Water,	6·
	100.

(3.) *Fossil Bones from the Banks of the Irawaddi.*

Carbonate of Lime,	25·
Phosphate of Ditto,	35·
Silica and Oxide of Iron,	41·
	100.

* Hard and thin Flag Kankar.

† Identical with the Harwich and Sheppy Cement Stones of the London Clay.

Note E.---The identity of Formation in the Sites of Indian Fossils.

The Fossils I have mentioned, Mastadon Elephantoides, &c., establish an identity of formation, between the upper beds of the Irawaddi deposit and the upper deposits, included between the Sewalik and the Himalaya Range. Several of them are the same as those found by Crawford and Wallich, and it appears that all along the foot of Himalaya, from the Punjaub down to the Irawaddi, there is a nearly continuous series of Tertiary Formations, more or less upheaved at different points along the line, but in all their great features, they are chiefly developed in the Jumna Gangetic portion, where they are elevated to upwards of 1500 feet above the Plains.---*Dr. Falconer, Jour. As. Soc.* vol. iv.

There is in every respect a complete analogy between the fossils of the Jumna, and those fortuitously discovered by Crawford, under the Banks of the Irawaddi. Their preservation is equally due to their conversion into, and impregnation with, Hydrate of Iron, and the words of Professor Buckland, would probably apply as well to the one as to the other.---*J. Prinsep.*

It is a curious fact that the size and description of the gravel adhering to the Fossil bones of the Jumna, exactly resemble those attached to the Jubalpur Fossils.

The Ava Fossils agree exactly with those of Central India, as regards the rolled gravel forming their respective matrices, but differ in the mineralising material, the first being Hydrate of Iron, the second Carbonate of Lime.---*J. Prinsep, Jour. As. Soc.* vol. iii.

Descriptive Catalogue of a series of specimens from the Delta of the Ganges, commencing at the surface of the ground, and extending to the depth of four hundred and eighty-one feet.

No.	Names and Characters.	Range. Begins at	Range. Ends at	Remarks.
		Feet.	Feet.	
1	Surface Soil,....	..	10	
2	Adhesive Blue Clay, ...	10	25	
3 a	Ditto Ditto with Peat, ...	25	35	
3 b	Ditto Ditto Ditto, ...	..	..	
4	Adhesive Clay, ...	..	40	
5	Dark Clay, with decayed wood, largely intermixed, ...	40	45	
6	Ditto Ditto Ditto, ...	..	50	
7	Calcareous Clay with Nodular Limestone or Kankar, ...	50	60	

Catalogue,—(Continued.)

No.	Names and Characters.	Range. Begins at	Range. Ends at	Remarks.
		Feet.	Feet.	
8	Green Siliceous Clay, ...	60	65	
9	Siliceous Clay with Kankar, ...	65	75	
10	Kankar from the above, ...	..	..	
11	Ditto Ditto, ...	..	..	
12	Variegated Arenaceous Clay, ...	75	120	
13	Variegated Clay, ...	..	..	Found at 80 feet.
14	Ditto Ditto, ...	..	..	.. 90
15	Ditto Ditto, ...	..	..	.. 95
16	Clay with Kankar, ...	..	..	.. 100
17	Variegated Arenaceous Clay, ...	..	..	.. 105
18	Ditto Ditto, ...	..	..	.. 110
19	Ditto Ditto, ...	..	..	.. 112
20	Ditto Ditto, ...	..	..	.. 115
21	Ditto Ditto, ...	..	..	.. 120
22	Argillaceous Marl, ...	120	125	
23	Loose Sandstone, ...	127	130	
24	Argillaceous Marl, ...	130	150	
25	Arenaceous Clay with weathered Mica Slate and *Nodules of Hydrated Oxide of Iron, ...	150	170	* Metallic Iron reduced from these.
26	Arenaceous Clay, ...	..	..	Found at 157 feet
27	Ferruginous Clay, ...	..	..	.. 164
28	Calcareous Clay, ...	170	175	
30	Arenaceous Clay, ...	..	..	.. 171 .. 7 inch
31	Coarse Friable Quartzose Conglomerate, ...	175	185	
32	Smaller Grained Ditto, ...	..	..	.. 177
33	Coarse Sand associated with Indurated Ferruginous Clay, ...	..	..	.. 183 .. 3
34	Micaceous Clay, ...	185	203	
35	Yellow Impalpable Clay, ...	..	..	.. 187 .. 4
36	Ferruginous Micaceous Clay, ...	..	..	.. 196 .. 10
37	Ditto Ditto Ditto, ...	..	..	.. 198 .. 9
38	Ditto Ditto Ditto, ...	..	..	.. 200
39	Ditto Ditto Ditto, ...	185	205	.. 203
40	Ditto Ditto Ditto, ...	..	..	.. 204 .. 5
41	Soft Sandstone, ...	205	208	
42	Micaceous and Ferruginous Lamellated Sandstone, ...	..	..	.. 206 .. 8
43	Ferruginous Sand with Clay, ...	208	380	
44	Arenaceous Clay, ...	..	..	.. 211 .. 6
45	Blue Ditto with Mica Scales, ...	..	..	.. 214
46	Fine Argillaceous Sandstone, ...	..	..	.. 220 .. 6
47	Ditto Ditto Ditto, ...	..	..	.. 227 .. 11
48	Sandstone slightly Calcareous, ...	..	..	.. 230 .. 11
49	Sandstone	..	..	.. 231
50	Fine Soft Ditto, ...	..	..	.. 233 .. 4
51	Ditto with Nodules of Limestone,	..	..	.. 257 .. 9
52	Fine Loose Sand with fragments of Quartz, Felspar and Granite, ...	300	324	.. 300
53	Sand slightly aggregated, ...	..	..	.. 326
54	Ditto Ditto, ...	..	..	.. 348
55	Shelly Calcareous Clay, ...	380	382	
56	Adhesive Ditto Ditto, ...	..	..	.. 381 .. 6
57	Blue Clay with large quantities of decayed wood, ...	382	392	

Arranged by R. BAIRD SMITH,
Lieut. Bengal Engineers.

Plants, characteristic of Different Nations. By Professor SCHOUW.

[No. 15 of a Series of popular Physical Lectures by Professor Schouw, published at Copenhagen, 1837. Translated for the "Calcutta Journal of Natural History," by Dr. Cantor.]

If we examine the geographic distribution and diffusion of plants, we generally speaking do so with reference to the different zones, climates, parts of the world, or to the different elevation above the sea, on which they are found; as for instance, when we inquire within which degrees of latitude the palms grow, in which parts of the earth the vine is cultivated, or at what elevation, the alpine vegetation appears.

At present, however, we propose to examine plants with reference to the different races of men and nations, to inquire which plants were originally distributed to each of them, and thus rendered of vital importance.

In the happy clime of the South Sea Islands, within the tropics, appears the *bread-fruit tree*, almost entirely supporting the inhabitants. This fine large tree with its rich foliage, yields a great number of farinaceous fruits, which when boiled, acquire a flavour like white bread. Three such trees are sufficient to support a human being during eight months of the year—the period during which the fruits successively ripen, while the rest of the year is supplied by roots that have been brought to perfection in the earth. As Captain Cook observed, it is easy in these islands to provide for oneself and children; a man needs only to plant ten such trees, and his family will have plenty of food; and besides, the wood affords material for boats, tools, &c. and the woody tissue for clothing.

Another tree, conspicuous particularly on the low oceanic coral islands, and no less so in the Indian archipelago between Asia, and New Holland, as well as on the coasts of

India, is the *cocos palm.* The stem is used, the fruit presents the almond-like kernel, oil, and milk ; the shell is converted to utensils, the woody tissue (coir) surrounding it makes excellent cordage, the leaves are used as thatch, and, lastly, the toddy is a produce of this tree.

To New Zealand, the '*New Zealand flax*' (Phormium tenax) is characteristic. The fibres of the leaves surpass in strength, by far, our hemp or flax, and are by the natives applied to garments and cordage.

Spices, such as the *clove, nutmeg, pepper,* and *ginger,* are characteristic to the Malays of the Indian islands, although India possesses all of these spices in common with the archiphelago.

The *Maize* (that of all kinds of grains which yields the richest, but also the most uncertain harvest) was originally given the American tribes, with whom it was largely cultivated at a considerable elevation; thus, for instance, at the sun-temple of the Incas, on an island in the Titicaca lake, 1200 feet above the level of the sea, it was cultivated, with difficulty, as an offering to the sun, and that the grains produced at that spot might be distributed to the people, who looked upon a single maize-grain, grown at the temple as a sanctified and propitious object. In North America also the maize was cultivated before the first arrival of the Europeans.

America was endowed with another splendid gift—the *potatoe,* which also succeeded in the higher regions, and the farinaceous tuber of which afforded an excellent article of food.

In the table land of Mexico the *Maguey-plant* (Agave americana) the vine of the Mexicans, was cultivated long before the time of the Europeans. In its native soil this plant shoots forth blossoms after a period of eight or ten years (in other climates it requires a much longer time), and when the gigantic peduncle is about developing itself, there is an immense afflux of sap, which is daily tapped during several months. This juice is allowed to ferment, when it is converted into a beverage (Pulque) of a pleasant acid taste, but a very disagreeable, putrid, smell. In other respects also this plant is important to the Mexicans, who from the fibres of the leaves, know how to prepare an excellent substitute for hemp. At an elevation greater than that of the Agave in Mexico, and in Peru and Chili beyond the limit of rye and barley, another characteristic plant appears—the *Quinoa* (Chenopodium quinoa) the small, but numerous and very farinaceous seeds of which, afford an article of food which is much in use either boiled into the consistence of a thin porridge, or toasted (the chocolate of the high-land.)

The greatest number of the American aborigines, however, (particularly in the lower countries) were, and are still, ignorant of agriculture, and occupy a low step of intellectual culture; generally speaking, these tribes possess no characteristic plants. And yet among them, there is an instance of a nation, whose existence is closely connected with a single wild-growing plant. The country of the Guaraun-Indians, on the lower part of the Oronoco river, is annually inundated during the rainy season, at which period this tribe lives in trees, (the Mauritius palm,) the petiole of which the natives convert into hammocks, which they sling between the stems. In this manner they live, make fires, eat the plentiful fruit of the palms, make a kind of palm wine from the sap, and bread of the sago-like marrow.

If we turn our attention to Africa, we find in its northern part, as in the north of Arabia, the large desert-zone, so very poor in plants, where the nomadic Arabs received a valuable heir-loom in the *date-palm,* the numerous fruit of which provide not only the people themselves, but also their camels and horses with food; the stems yield wood, the petioles and the leaves afford materials for cordage.

In the southern part of Arabia the coffee appears as the characteristic tree, to which the Arabs are indebted for their most common beverage. The Hindoos possess two plants of high importance—*the rice* and the *cotton;* the former of which forms almost the daily bread of these people, who scarcely eat animal food, while the latter almost exclusively provides them with clothing. Without these two gifts of nature the Hindoo cannot exist, and a failure of the rice crops causes an universal famine.

The shrub characteristic to the Chinese is easily found: it is the *tea,* making a beverage, to them the same as wine is to the vine countries, or beer and spirits to the north of Europe.

The nations inhabiting Europe and the western part of Asia, constituting what is denominated the Caucasian race, have as original characteristic plants, *wheat, barley, rye,* and *oats* (which are commonly called the European kinds of grain, although scarcely with truth, as the western part of Asia appears most likely to be their original home.) These, and particularly wheat, form the chief objects of agriculture, and the principal bread of the Caucasian race.

The southern part of Europe, and that part of western Asia which is bounded by the Mediterranean, possess a remarkably characteristic plant in the *olive tree,* the product of which, the oil, serves not only as an illuminating material, but also as butter, to the southern Caucasian nations.

Also the *vine* is a gift belonging to those nations, with whom its cultivation is of the greatest importance, as affording a beverage in common use between the 30th and 50th degrees of north latitude.

The Laplanders, belonging to the polar race, possess no characteristic plants, unless the *reindeer moss* be considered as such, which indeed forms the principal food of their domesticated animal—the reindeer.

In the preceding sketch we have exclusively considered such plants as were originally distributed to the different nations; great revolutions, however, have taken place in their distribution, and the existing relations are greatly different from the original.

A closer examination will however prove, that the Caucasian nations almost exclusively have effected those revolutions, which also will be found to have gone hand in hand with the rising culture. The Caucasian nations, and particularly the Europeans, have known by degrees how to transplant the characteristic plants of other nations and races to their own home, and have thus fetched the nobler fruits, such as the almond, the apricot, the peach, from Asia Minor and Persia, the orange from China. They have transplanted the rice and cotton on the coasts of the Mediterranean, they have brought the maize and the potatoe from America to Europe, where they support millions of human beings, and have often prevented famine when other crops failed. By industry and extensive trade they have obtained the products of such foreign characteristic plants as cannot thrive with them, and thus procured for daily use the tea of the Chinese, the coffee of the Arabs, the rice and cotton of the Hindoos.

And yet, far greater appears the influence exerted by those Caucasian nations, called Europeans, in the revolutions which have taken place in the diffusion of characteristic plants, if we look to their colonies, where countries have almost changed into the possession of an European population. They have not only introduced in their colonies their own characteristic plants, or such as they had in early times transplanted at their home, but having become possessed of countries of different climates, they have carried there such plants as could not succeed in the mother country, and by these means have been enabled to collect the characteristic plants of almost every other nation. Thus we trace the cause to the European sorts of grain being largely cultivated throughout North America, in the highlands of Mexico and South

America, in Chili and Buenos Ayres, in South Africa, the temperate New Holland and Van Dieman's Land; to the cultivation of the vine at Madeira, the Canary Islands, in South Africa, and the highlands of South America; to the extensive cultivation of rice and cotton in the warmer parts of North America and in the Brazils; to the cultivation of the coffee and sugar-cane in the West Indies and the Brazils; the nutmeg and the clove in the Isle of France, Bourbon, and in several of the West Indian islands; and, to conclude, thus also we trace the cause of the tea plantations in the Brazils, in Java, and India, and the cultivation of New Zealand flax in New Holland.

The Europeans indeed have introduced characteristic plants to other races of men, who knew how to appreciate them; several European and tropical plants, for instance, formerly unknown, grow now in the South Sea Islands.

The remnants of the aborigines inhabiting the table lands of Peru, Chili, and Mexico, have received European plants; the negroes of the west coast of Africa have received the maize, the tobacco, and several other American plants from the Europeans. It is astonishing however to perceive how little the other human races have contributed to the diffusion of the characteristic plants; the Arabs indeed are entitled to the merit of having spread the cotton, sugar-cane, the coffee, and the date palm, but then they belong to the same principal race of men as the other Caucasians. It would however appear, that the Chinese have procured the cotton plant from Hindoostan, and that the Japanese have introduced the tea shrub from China.

The Europeans, or rather the Northern nations of Europe, consequently, are the people who, partly in their own home, partly in their colonies, have collected the characteristic plants of most other nations; thus it is that their own country, and particularly the north of Europe, is very poor in characteristic plants, for all the most important cultivated kinds are introduced into the north of Europe, (the cabbage, turnip, carrot, and asparagus are perhaps indigenous, but then they are of less importance.) Here then, we find a grand proof of the mental superiority of these people, who at the same time have exemplified that the poor man's child endowed by nature with rich mental gifts, may get on in the world better than even the rich heir himself. I am not sure whether there might not be some one or another, who, in this revolution, either fancies he beholds a dangerous disturbance in nature, or fears, that the nations, by gradually appropriating the peculiarities of their neighbours, might sink more and more into a dull uniformity. Similar fearful forebodings greet our ears now and then, and complaints have been heard, that the journals of modern travellers contain fewer and fewer interesting sketches of the most different nations. Not only in Europe have vanished so many national characteristics, that being in a saloon in Moscow, one might easily fancy oneself in Paris, but those charming pictures of the Southern Islanders, which we received from the first circumnavigators, are now changed into reports of how the natives dress in European style, launch ships, erect schools on the Pestalozzian principle, and found churches.

High up in the Himalayas, some 7000 feet above the sea, where the wilds of nature were seldom visited except by a few Hindoo pilgrims, a sanitarium, or a Spa, has been erected, with numerous European houses, where, as Jacquemont informs us, the elite of fashion, dressed in pumps and silk stockings, ride in their britzkas to stylish dinner parties, and feast on champaign and hock.* Where not long ago nature remained in her aboriginal grandeur in New Holland, where savages on the lowest step of culture used a few branches to protect themselves against the vicissitudes of the weather, and fed upon sea-shells, the scene has

* May we hope to see the seats of British rule in India, characterised by higher instances of European improvement than this?—Ed.

changed into European towns, with hotels, caffées, billiard rooms, reading cabinets, and horse races.

The incalculable advantages derived from the increasing intercourse of nations, and by these means the accelerated march of civilization, not only with regard to bodily well-being, but also with regard to intellectual life, ought in themselves to be sufficient to chase every complaint of increasing uniformity. Nay, what is more, it might with reason be asserted, that civilization far from producing uniformity between nations, on the very contrary sets the national peculiarities off in stronger colours.

It ought indeed not to be overlooked, that by culture many dormant intellectual powers, many new relations, are called into existence; but the thus awakened intellectual faculties are not all developed in the same manner, the new relations are not the same everywhere, and thus withal, in spite of the uniformity, which to a certain extent undoubtedly is produced, a number of new discrepancies appear, which by far exceed the original ones. Who, for instance, shall dare to doubt, but that a greater difference exists between the English and the French nation, than between the Negroes of Guinea and Mozambique, or between the different savage tribes in the interior of the Brazils?

On the Method to be adopted in conducting Mineralogical Surveys. By WILLIAM JAMESON, ESQ. *Bengal Medical Service.**

Of all the departments of Natural History, there is probably not one which has made more rapid advancement within these few years than that of geology; vast tracts of country have been examined, and numerous observations made in all the great continents, which tend to shew, that there exists, as was first clearly pointed out by Werner,

* Revised and enlarged from the "*India Review.*"

in the crust of the earth, arrangement as perfect as is observed in the zoological or botanical kingdoms. In the geological department we have every thing presented to our view on a colossal scale, when compared with what we meet with in zoology or botany; but the laws which regulate the arrangement are as unchangeable, and unvarying, as we see in either of these; and the geologist can now tell with as much certainty the relative position which mineralogical specimens when presented to his view ought to hold in the geological system, as the zoologist or botanist can with regard to animals or plants. Moreover, the experienced geologists from an examination of a few specimens, can, with great precision, not only determine the relative age of the country in which they have been found, but also point out whether that country is likely to afford minerals of value in an economical point of view. Each mineral has its own determinate arrangement and distribution, and is accompanied with its own suite of minerals. Thus, for example, bituminous coal is always found to be associated with several, or all, of the following rocks, viz. sandstone, bituminous shale, slate clay, fire clay, and clay ironstone, which occur in greater or less quantity, and in extensive coal fields are all found to exist. The same is the case with metals; and if the minerals which are well known to be associated with particular metals are found to occur in quantity in any district, then we are entitled, even if the metal is not at first presented to our view, to infer, that it exists there, and that upon proper search being made it will be found. We make this statement in order to point out the value of mineralogical characters, which have been much neglected, and in no country more than in India.

Before laying down the plan which ought to be adopted in conducting mineralogical surveys, we shall first give a rapid sketch of what has lately been done in this department.

In regard to Europe, there scarcely remains a tract which has not been more or less examined, and authorized geological maps have been published by the respective governments. The French Government have lately published a magnificent map, coloured geologically under the guidance of Beaumont, and Dufrenoy. The Austrian and Prussian Governments have also published splendid geological maps. In addition to what has been done by the different governments, many splendid maps have been published by private individuals, viz., Von Buch, Hoffmann, Boué, Von Dechen, Oeynhausen, &c., and in the transactions of many of the continental Societies and periodicals, an immense number of valuable observations will be found. Nor is Great Britain behind in this department. The island has been investigated in all directions. In England many valuable observations have been published by Smith, Greenough, Buckland, Phillips, Sedgewicke, Lyell, Murchison, and others. In Scotland, Jameson, MacCulloch, Playfair, Fleming, Boué, Necker, &c. have by their labours left little to be done; and Griffiths, Weaver, Portlock, &c. have given us much information with regard to Ireland. Last year a geological map of Ireland, coloured under the direction of Griffiths, was laid before Parliament. At present the geological department connected with the great Trigonometrical Survey is conducted under the able superintendence of Major Portlock. Nor must we omit to mention that Murchison has published a most extensive work on the Silurian system—a name given by him to a series of slates, limestone, and sandstones occurring between the old red sandstone and greywacke series, and probably, as supposed by Professor Jameson, a mere extension of the former. It is not a partial formation confined to England, for it has been met with in Scotland,* and in many places on the European continent,† and no doubt from the specimens which we have examined in the collec-

* Professor Jameson in Lectures. † Phillips' Geology, p. 85.

tion of the Asiatic Society of Calcutta, it will be found in great abundance in India.* In regard to North America, we know a little from the excellent reports which have been published by Rogers, Featherstonhaugh, &c. When we draw a contrast however between what has been done, and what remains to be done, the former forms a mere iota to the latter. The whole of Asia, Africa, Australasia, and South America are in a manner unknown. In the last of these continents Humboldt, Pentland, &c., have done, no doubt, a vast deal, but still it forms but a small part when compared with the vast tracts of country which remain unexplored. The same remark applies to India. From the researches of Turnbull, Christie, Hardie, Adam, Heyne, Calder, Govan, Voysey, Buchanan, Webb, Herbert, Gerrard, Jacquemont, Franklin, Sykes, Malcolmson, McClelland, Hodgson, &c., we have acquired much information. The observations however, of many of these authors are not always to be faithfully relied on, being made in so loose and unsatisfactory a manner, colour alone being frequently taken by them as their principal character in distinguishing and classifying rocks. It is now time for Indian geologists to be more cautious in their statements, and allow the stigma, cast out by foreign naturalists to be removed; viz., that every "red sandstone in India belongs to the new red sandstone,"† or that "geologists in India are self-taught." Many of the topographical accounts lately published are any thing but creditable, as far as geology and mineralogy are concerned; the observations in general being of no value either in a mineralogical or economical point of view, no method whatever being adopted.

* In our conclusion in regard to the occurrence of the Silurian rocks we are correct, having found them occupying large tracts amongst the Himmalya. We shall afterwards give a much more detailed account than we have as yet given. See *Journ. As. Soc.*

† Jacquemont's letters, &c.

A new spirit of investigation is happily gaining ground in this country; not only are geologists studying minutely the relative position which rocks bear to each other, but also the embodied fossils are receiving a share of attention, in order to ascertain the relative age of the different formations. Lately a most interesting discovery was made at Cherra Poonjee by Dr. McClelland, viz. an ancient Sea-beach, whose present height is upwards of 1500 feet above the level of the sea. He has also shewn that most of the fossils belong to species now extinct, proving that it belongs to the oldest tertiary series, or Eocene epoch of Lyell. That nearly the whole of Bengal, the upper provinces extending as far as the Himalayan mountains properly so called, belong to a recent geological epoch we have ample evidence to shew; we shall also prove, and that too from phenomena, which admit not of a doubt, that extensive volcanic convulsions took place at a time when species belonging to every genus of mammalia, with the exception of man himself had appeared; that after the destruction of a vast number of these animals, many genera of which are now extinct, by a deluge which extended its ravages probably over the whole of India, that is over those parts of India which had emerged from the waters of the ocean, we had shortly afterwards another upheavement, caused in a similar manner, and followed again by another deluge, which swept across a large portion of the Himmalya. By the fossils organic remains, the medallions of a former world, we are thus enabled to connect bygone days with the present—to state that there have been successively created, and successively destroyed, whole worlds of animals and plants—that the earth itself has existed for thousands and thousands of years ;—but that man, the master-piece of creation, is comparatively speaking of very recent origin.

In regard to the geology of England, much, as already stated, has been written, and excellent geological maps have been published by Smith, and Greenough. At present Mr. De la Beche is engaged in colouring geologically the maps connected with the great Trigonometrical Survey. The geology of Scotland has also been minutely examined, and lately a map was published from materials collected by MacCulloch, most of which, however, were pillaged from Professor Jameson, who for the last 12 or 14 years has had in his possession materials collected, from personal examination, for a geological map, but his other numerous avocations have as yet prevented him from making use of them. In 1838 he called the attention of the Wernerian Society to the great want of a regular survey of Scotland, which led to the appointment of a Committee of the Society, which was ordered to communicate with the Royal, and Highland Societies, and to request of them to draw up memorials, petitioning government to recommence the Trigonometrical Survey, which was immediately done; and upon the respective memorials of each of the Societies being transmitted to government, an order was given for a certain number of the individuals engaged in the Irish Survey to be drafted to Scotland, and before we left that country, Col. Colby, the chief engineer, had arrived in order to see the survey properly begun; we may therefore hope soon to see finished this important national work. In laying the report before the Wernerian Society, Professor Jameson accompanied it with a statement of the points of greatest importance to be attended to in the mineralogical department, which however he has not as yet published, and considering that it might be of great importance to those engaged in drawing up topographical accounts, we have been induced to give an account of the method proposed.

I.—*Geographical Part.*

1.—General and particular Geographical account of the country.

2.—Description of the surface of the country, α. Ranges of mountains, extent, mode of connexion, shape, acclivities; heights, as ascertained by the barometer or sympesometer. β. Single mountains, shape, acclivities, magnitude, height. γ. Valleys, extent, shape, character of cliffs and precipices, inclination and nature of the bottom, height above the level of the sea, and mode of connexion with neighbouring valleys. δ. Plains, extent, appearance of their surface, including lands, steppes, deserts, oases, &c. height above the sea. ε. Caves and caverns, their position, how formed, rocks in which they occurred, contents.

3.—Description of rivers, magnitude, under which is included their length, breadth, and depth; direction and fall; velocity; inundations and their effects, retardations, eddies, &c.; height above the level of the sea at different points of their course; nature of their bank; character of their scenery; comparison of their former with their present state; bars at their mouths, and deltas; physical and chemical properties of their water; quantity of sediment contained in their waters at different seasons of the year; temperature; and, lastly, description of the animals and plants that inhabit them.

4.—Description of lakes, formation, situation, distribution, magnitude, under which is included their length, breadth, circumference, and depth; temperature at different depths; colour; height above the level of the sea; chemical properties of their waters; animals they contain, plants that grow in them; character of their scenery.

5.—Description of springs, magnitude, temperature, height above the level of the sea; rocks from which they issue; their chemical and physical properties, incrustations found around them; quantity of matter brought from the interior of the earth by them; geognostical situation and geographic distribution; animals that occur in them, and plants that grow in their vicinity.

6.—General observations on the physiognomy of the surface of the country, in relation to other countries.

II.—*Mineralogical Part.*

1.—Description of the different soils in connexion with the fundamental rock, whether transported or untransported. Chemical analysis of the more remarkable and curious soils.

2.—Description of jungles, bogs, &c. their magnitude, height above the level of the sea, various remains found in them, uses, clearance, draining, &c., plants that grow on their surface, and animals that live in and near them.

3.—Description of marl beds, their length, breadth, and depth, their height above the level of the sea, rocks on which they rest, the substances with which they are intermixed, and the alluvial matter and soil which cover them. Chemical examination of the different marls, and mode of digging and searching for them.

4. Description of the different rocks of which the country is composed according to their various relations, age, &c.

5.—Mineralogical description of the mineral veins and beds that occur in the country.

III.—*Economical Part.*

1.—Description of the various kinds of ores found in the country, with their distribution.

2.—The mode of mining in particular spots depending on their local situation, the expense of mining and quarrying, and the particular tracts pointed out where trials of greater or less extent may be advantageously carried on.

3.—Descriptions of the different kinds of limestones and marbles, quarter of the country where they occur, magnitude of the beds, mode of quarrying them, chemical analysis of the different limestones and marbles in the country, with the view of ascertaining their value in agriculture, building, and statuary.

4.—Description of the different kinds of slates that occur in the country, places where the best kind are found, mode to be followed in quarrying them, characters to be used for distinguishing good from bad slate, and a statement of those symptoms which indicate the presence of slate.

5.—Description of the different species of precious stones that occur in the country, places where found, mode of searching for them, and of estimating their value.

6.—Description of the different kinds of building stones found in the country, places where found, most eligible spots for quarrying them, mode to be followed in quarrying them, and the kinds of building for which the different kinds are best calculated.

7.—General observations on the probability of finding coal in the country, with a statement of the best mode of following out such favourable appearances as may occur.

8.—General observations on the mineral riches of the country, and a comparison of its mineralogical structure with that of other countries.

Umballa Political Agency,
Aug. 15*th,* 1840.

Remarks on Dracunculus. *By* Mr. J. McClelland.

A communication from Mr. Brett, in the August number of the " India Journal of Medical and Physical Science," reminds me of a promise I had made to examine three specimens of Guinea-worm with which he very kindly favoured me. About fifteen years ago the subject created much interest in India, particularly in Bombay, where the disease is very common throughout a large proportion of that Presidency. The first volume of the transactions of the Medical and Physical Society of Calcutta contains no fewer than six papers on the subject,* and from the spirit with which the inquiry seems to have been undertaken, and the scientific character of those by whom it was carried on, we might have hoped that some new fact, calculated to place our knowledge of this tropical disease on an improved and satisfactory footing, would have been by this time elicited. In each of the communications enumerated below, a progressive advancement may be observed, and had the Medical Society not been diverted from its original object, and its transactions discontinued, this disease, which is peculiar to hot climates, might by this time have presented to the medical world, a lasting monument of the zeal and public spirit of the profession in India, with which the question naturally rests. Dr. Bird, whose communication was presented to the Medical Society in March 1824, supposes this disease to be endemic in particular parts of the country, particularly in Guzerat, and that it is chiefly prevalent from the end of May, to the end of September. Dr. Smyttan and Dr. Kennedy confirm the opinion of Dr. Bird as to the disease being confined to certain tracts of country presenting, as before remarked in the West Indies by Dr. Chisholm, a peculiar geological structure. They also concur with Dr. Bird as to the season during which the disease is chiefly prevalent, and Dr. Singlton is further of opinion that it does

* Observations on Dracunculus, or the Guinea-worm. By James Bird, Esq., Assistant Surgeon, Artillery, Bombay. 2. On Dracunculus, by Richard Kennedy, M.D. Surgeon to the Residency, Baroda, Bombay. 3. On Dracunculus, by George Smyttan, M.D. Surgeon of Artillery, Bombay. To which may be added, as connected with a similar subject. 4. On the worm found in the eyes of the horse, by P. Breton, Esq. Surgeon on the Bengal Establishment. 5. Observations on the Filaria, or thread-worm found in the eye of horses in India, by William Twining, Esq. Surgeon to his Excellency the Commander-in-Chief. The foregoing papers are contained in the 1st volume of the work alluded to. In the 6th volume the subject is resumed by C. Morehead, M.D. Assistant Surgeon, Bombay Service.

not prevail with equal intensity at all seasons in the same place. Dr. Morehead however states that at Kirkee, where the disease was very prevalent in 1832, it set in as early as March, and that the admission of cases into the Hospital of H. M. 4th Light Dragoons for the six following months were as follows—April 7 cases; May, 57; June, 64; July, 48; August, 26; September, 3; but no mention is made of the date at which the rains set in at this station, or the general character of the place in regard to moisture.

Dr. Morehead coincides with the authors previously alluded to, as to the peculiarity of the earth and soil in districts in which this disease occurs, and offers certain general views of much interest on this head. Dr. Scot, Surgeon of the 1st. Battalion of Madras Artillery, in 1821 communicated to the "Edinburgh Medical Journal" the fact of Dracunculus having appeared among the troops at St. Thomas's Mount, Madras, in June, one year after they had returned from an expedition to the banks of the Tumbudra; none were affected but such as accompanied the expedition in question, with which they were absent from the Mount from February to June. Dr. Kennedy, in a note attached to Mr. Scot's paper in the work referred to, states, that the hill fortress of Copul, when it was taken from Tipoo Sultan in 1791, was notorious for being infested with Guinea-worm, an observation which he remarks is at variance with the opinion which restricts the appearance of the disease to moist soils, or humid atmosphere.

These are the main facts that have been elicited in India, and it appears unquestionable from them that the disease is peculiar to certain districts only; but it does not appear to depend on the moisture of those districts, or to be contracted at any particular season. A certain period of time, equal to about twelve months from the first arrival in an affected district, is requisite for the development of the disease. Another fact in the history of this malady may be considered also as ascertained, namely, that the endemic causes may be overcome in affected districts by improved comforts and medical police, particularly as we learn from Sir J. McGregor, that Bombay was about forty years ago a common seat of the disease, since which time however, as appears from subsequent writers, the troops stationed in, and near the Fort, have been almost exempt from the disorder.

Much of the discrepancy in the opinions of medical writers on the subject of this disease, has arisen in my opinion from regarding it as one and the same in whatever part of the world it has been observed. The knowledge of the ancients with regard to the Guinea-worm, was probably derived from the only tropical parts of Egypt and Arabia in which the disease was likely to occur, and with which they were acquainted. They are not, however, very good authorities on the subject of worms; and as the species with which they were acquainted must have been derived from the westward of the Euphrates, it is possible that the identity of the Indian as well as the West Indian species, which occasion the disease we call Dracunculus, are different from the Dracunculus of the Romans and the Greeks. It is probable even from what is known of the distribution of animals, that the Dracunculus of the West Indies is different from the Dracunculus of the East, and that even in the East we may have several species, subject to different laws of propagation and development; a circumstance that seems to have escaped all those who have written on the subject. Nothing can be more vague, more unscientific, or unsatisfactory, than the various descriptions we have seen of the Guinea-worm by medical writers.

Some speak of it as an *animalcule*, some as an *insect*, some as a *gordius*, or earth-worm, some as a *reptile*, and some deny its being any thing more than a *detached absorbent vessel*, or a *nerve*. With regard to the manner in which it enters the cellular tissue, little is to be expected from those who have so vague an idea of the nature of the animal, on which of course its habits depend. Some contend that it is imbibed into the alimentary canal with water, and others, that its ova are absorbed by the skin. Neither of these conjectures seem to be correct; the young which are extremely numerous, are produced alive, and although full of life and activity when first extracted, they soon expire after being emersed in water, or separated from the blue milky fluid with which they are exuded. These circumstances, as well as the incapacity of the parent to survive long after having been removed from the body, would not appear to countenance the idea of their identity with any kind of external worm. Still, as certain authorities have declared that animals essentially the same do exist in waters and soils, we should not be justified in denying this to be the case, at the same time it may be reasonable to hope that such worms when met with out of the body will be in future preserved. Having been requested by Mr. Brett to accompany him to the Body Guard Hospital, for the purpose of seeing a case of Dracunculus, the animal was found protruding for about eight inches from behind the inner right ancle, and when touched, shewed evident signs of vitality, even at the narrow pointed extremity, although that part was somewhat shrivelled and dry. It was examined by a small lens, and found to correspond with the part usually presenting in such cases, which seems to be the tail; the head being seldom seen, unless when the animal is extracted entire. Of six specimens examined, one only is possessed of the head; all six have the caudal extremity perfect, with the exception of certain injuries to which they were exposed in the act of extraction. The tail is attenuated to a very fine sharp point, and bent like the point of a cobbler's awl. It is also armed with a few rough points, probably for the purpose of forcing its way through the cellular tissue. Some however are without these points, having the tail smooth, but in other respects the same. We have represented these distinctions Figs. 1, 2, 3. Plate x, because it is desirable to know whether they are sexual, as they are supposed to be, or whether they may not be characteristic of different species. The oral extremity, or that in which the mouth is situated, is represented, Fig. 4 b. c. from the only instance in which I observed it. I may here remark, that it is the radiations by which the mouth is surrounded, and the low organization of these animals, that induced Cuvier to remove them so far from the earth worms, which are further distinguished from Dracunculus by red blood, a semblance of a skeleton in the circular rings by which the body is surrounded, as well as by a distinct nervous system.

To return to the consideration of the tail, which from being the part that seems generally, if not always, to present itself under the skin, is that with which we are best acquainted. On separating the body within three inches of the extremity, a bluish white fluid escaped. This on having been accidentally touched by a Codrington lens proved to consist almost entirely of young animals perfectly formed, and in all respects like their parent, except indeed that they displayed more energy and life. The number of young contained in a single drop of this fluid must at least have been a thousand. When immersed in a drop of water they seemed to live so long as their mucous envelope continued attached to them, but when exposed to the water they soon died. Near the caudal extremity there are certain irregular openings, probably connected with the generative functions, or with the state of development of the young, particularly as these apertures are not observed in all specimens; figs. 1, 3, are possessed of them, and figs. 2, 4, are without them. It is right however to say, that they may have been occasioned by violence in the two first mentioned specimens, otherwise we should be inclined to refer the circumstance of the caudal extremity always presenting to the surface, where it occasions an irritation, and eventually protrudes, to a natural function connected with the distribution of the young.

It does not appear that these animals multiply in the body to such extent as the vast number of young which they contain would lead us to suppose them capable. Indeed, considering the pain and irritation which a single individual is capable of producing, we cannot suppose that the powers of human life could long survive many of them. What then becomes of the millions of young which a single adult is capable of producing? To let them loose in the unfortunate body which the parent parasite itself inhabits, would be contrary to the ordinary economy we observe in Nature for the preservation and distribution of the young; such a multitudinous brood would rapidly destroy the animal on whose life their own would depend. We are therefore rather inclined to the belief, that when the parent worm is prepared to dismiss the young brood, it irritates the skin by means of the sharp point of the tail, and thus causes a pustule through which the point of the tail passes, and the young are allowed to escape externally with the discharge.

Our observations on the young themselves may afford a clue to their future progress, and to the *cause* of the disease. A drop of the milky substance in which they were contained having been submitted to the microscope, the young were seen in full enjoyment of life and energy. Two or three drops of water were then added, when a few of the young which extricated themselves from the mucous, and entered the water soon died, the others continued to evince signs of life as long as the proper secretion in which they were enveloped remained sufficiently soft to admit of their motions being perceptible, which was for two hours after they had been taken from the parent. They were then left on a glass under the microscope, and 24 hours after, the mucous being perfectly dry on the glass, they were then moistened with tepid water, when several of the young were again seen to be in motion, the caudal extremity quivering and flowing freely about, the body writhing, but still remaining fixed by the head to the hardened mucous. They were then rolled up in cloth and exposed to the steam of hot water, with a view of setting the heads free, but this temperature being too great for them they were destroyed, thus depriving us of the means of making further experiments as to the length of time the young are capable of remaining torpid, and the circumstances most favourable to their resuscitation.

Fig. d. d. Plate x. represent the young magnified to 100 times their natural size. Their entire length would consequently be no more than the breadth of the finest hair; so that every case of neglected Dracunculus would, according to these observations, yield thousands of minute imperceptible particles, in which a numerous progeny of the young are ready again to be called into activity, on coming into contact with the moist relaxed skin.*

I had proceeded thus far in my observations, when Mr. Brett pointed out to me a paper by Dr. A. Duncan, Bombay Medical Service, in the 2nd part 7th volume Calcutta Medical Transactions. Dr. Duncan had also found Dracunculus in India to be a viviparous animal, filled with living young. In an extensive practice he always found the large ones full of young, and the small ones to be without them. Whether this is owing to the latter being males, or to their not having attained to maturity, is a question which yet remains to be determined. But from their not being usually

* The size of the young is still further diminished by their habit of coiling themselves up. Dried in this state they would be no larger or more formidable in appearance than the smallest mote we could discern floating in a sunbeam admitted into a darkened room, and which we admit into our lungs by thousands, at every inspiration. It appears to me to be great folly to dispute as to whether such minute particles can enter the human body by the stomach or by the skin.

found in pairs, they would appear to be hermaphrodite—a conclusion to which I felt inclined from my own observations.

Dr. Duncan next remarked the tail of the young to consist of a fine sting-like extremity, which they can fix to any opaque object, and if appropriate to their nature they can work themselves into it, thus affording, he remarks, an easy solution of the opinion of Mr. Clot, and others, that attendants on patients, and *dogs* moving about them, get the disease.

Dr. Duncan also conceives that when the time arrives for producing its young, the worm exerts itself to get out of its nidus, which also corresponds with the opinions already stated.

Dr. Duncan however found that when the young are discharged into a glass of water, they may be seen swimming about in it; but he has omitted to say how long the young live in water. The old, he says, live for six days in this element, but he has never known any survive a fortnight.

After becoming dry, Dr. Duncan regarded the young as dead, but it does not appear that he made any attempt to resuscitate them by moisture—a very important point connected with the elucidation of the disease, on which we are desirous of seeing further experiments made, our own having been confined to a single observation. Dr. Duncan found the young very plentiful in the abcesses which form after breaking the worm, but never found any alive, or at least so lively as in other circumstances; but here also they may only have remained in a torpid state, particularly as no attempts were made to restore them. Dr. Duncan's paper is the most workmanlike and useful, both in a scientific and practical point of view, we have seen on the subject. The district in which he observed the disease, is composed of trap rocks, and the soil and pools abound in the rains with a worm smaller and more slender than the *Nahroo,* or Dracunculus, but otherwise exceedingly like that species. Here however, we must find fault with the usual inference derived from this resemblance, until we are either furnished with specimens of the worms in question, or a satisfactory description of them. Under these circumstances we would confer a benefit on science in general, and our own profession in particular, by carefully collecting the most perfect specimens of the worms we extract in practice, together with all worms found in wells, tanks, and mud in affected districts, particularly such as the natives believe to be identical with Dracunculus, and placing them in the hands of some one conversant with the subject, and who would undertake its elucidation. A few small phials might be sufficient to hold a collection, if carefully chosen, that might reconcile the most opposite opinions on the subject of Dracunculus, now so nicely balanced that it were idle to cast our own into either scale. It appears to us probable, however, that we have many kinds of Dracunculus, even in India; should this prove to be the case, some may be endemic during the hot season, in dry arid tracts, some during the rains in low moist situations, and some peculiar to the cold, or winter months. We have hardly a reason for concluding, as appears to have been taken for granted by Dr. Chisholm and all subsequent writers, that the disease of Grenada, which appears there during the winter, is the same as that which appears in the East Indies during the rains, however the general form of the animals that occasion the disease in both cases may correspond. The wide geographical range between the East and West Indies, is of itself a sufficient reason to cast a doubt on the identity of the two animals, independent of the difference of the seasons at which they are developed, and the opinions regarding the manner in which they are introduced to the cellular tissue of the human body. Another supposition which Dr. Chisholm and other writers on this subject seem to have adopted, still more inexcusably, because it is in the face of well established facts, namely, that the parasites of certain fishes, horses, &c. are the same as those found in the human body. Not only are the parasites of fishes different from those of the human subject, but each species of fish in which they occur seems to have parasites peculiar to itself; nor have any of these been found in the bodies of mammalia, nor have those of the mammalia been found in the human subject. Indeed this is altogether a *terra incognita* in the philosophical world, and one of the first objects of research should be to determine whether the same parasites are peculiar to the same animal in parts of the world remote from each other, or whether parasites, like most other beings, are confined to certain geographical divisions, and if they are subject to laws of distribution independent of those of the animals they inhabit. Let us commence with the parasites of the human species, as most important, and inquire—

1. If there be more species of Dracunculus in India than one?*

2. If any species corresponding with this, or these, inhabit the waters or soils of any part of India?

3. What are the species inhabiting waters, soils, plants, or animals in India, corresponding most closely with Dracunculus?

4. Is Dracunculus in India the Guinea-worm of Africa, and *Malis dracuncula* of the West Indies? The method of proceeding should be by extensive analysis of what has been done on the subject hitherto—by copious notes on the development of the disease in different districts, and on the habits of corresponding parasites in other bodies, as well as on the worms of ponds, plants, and soils; in all cases collecting and preserving specimens in spirits of the animals alluded to;

* Before we could do much in this inquiry it would be necessary to consult the work of Professor Rudolphi, on the entozoa of the human body, of which we can find no copy in Calcutta. It is barbarous to quote Linnæus as an authority on this subject.

and, lastly, the preparation, of microscopic drawings, dissections, and descriptions of all these. I shall be happy to undertake this last duty for those who may not have the requisite facilities for performing it themselves.

Fig. 1, Plate x. The magnified drawing represents the extremity that first presented itself, and which is probably the tail; the two pointed bodies situated at its termination, are not of course perceptible to the naked eye. The other extremity of the specimen was imperfect, having been broken off. Fig 1 a. natural size of the specimen.

Fig. 2, another specimen, in which instead of pointed speculæ the extremity is convoluted and smooth. The other extremity of the specimen is imperfect, having been broken off. *2 a.* natural size.

Fig. 3, resembles the first, and is furnished with an aperture on the side of the head.

The difference between the first and third figures may be the result of violence used in the extraction of the animals, but I can scarcely conceive that any appliance that could be used could affect a part so minute as not to be preceptible to the naked eye.

Fig. 4, represents the head and tail, of the only perfect specimen I have seen. The tail, 4 a. is pointed and recurved as usually observed; 4 c. is the mouth, the head being bent in the specimen as here represented, and the mouth directed upwards and radiated.

Figs. d. d. The young as seen under the microscope.

In conclusion, we may remark that cleanliness is the best safeguard against Dracunculus, and in the treatment of the disease care should be taken not to wound the animal. When this accident has happened, it would be desirable to prevent the lodgement or escape of any of the young. Scalding water would be sufficiently destructive, but when the article on which a lodgement may be suspected is not of much value, the safest precaution would be to burn it. There may be certain districts in which the soil and air may be more congenial to the young in their torpid state than others. They would be exposed to fewer dangers in the soft impalpable soils of volcanic or of trap districts, than in sandy or stiff clayey tracts, and once established in places like the former, it would be more difficult to eradicate them. This however, is only offered as a probable way of accounting for the curious correspondence that has often been observed in the geological structure of districts affected with Dracunculus, both in India and the West Indies.

Notes on an alleged species of poisonous Lizard, &c. By J. Grant, Esq.

At a discussion, or perhaps more properly speaking, conversation—held many years ago at a meeting of the Medical and Physical Society of Calcutta, a few points of general and scientific interest were mentioned, respecting which information was deemed desirable. One of these was suicide, whether it prevails to a great extent or otherwise among the natives of India, and if effected by poison—the sort of poison most used, &c.? Another was regarding the existence of the Biscopra, a description of it, &c. Waiving for the present the first of these topics altogether, it has struck me that a few notes though of a desultory kind respecting the second, and one or two others, may not be unacceptable; but I beg the reader before hand to anticipate nothing of a novel, or, strictly speaking, even of a scientific character in this paper. Indeed, it is rather with the hope of exciting some of your readers and correspondents to further inquiry, on the subjects introduced in these observations, than from any idea that they possess any merit of their own, that they are submitted.

I have frequently heard mention made of the Biscopra in the Upper Provinces—but the Bengal reader most likely will ask, what is a Biscopra? Popular report states it to be a kind of lizard, whose bite is certain death. It is said to be found in old walls and ruins, to be a few inches only in length, and to be wonderfully agile and nimble, so that to catch it is very difficult. Up the country I have spoken with natives who declared, that they had frequently seen it, and who spoke of it with entire conviction of its fatal capability. The belief in the creature's existence, however, extends even to respectable Europeans; who most likely derived that belief from the reports of natives, without much inquiry on their own part. At the time that the conversation I have alluded to occurred at the Medical and Physical Society, I wrote to several of my friends up the country, requesting of them to procure for me, if possible, a living or dead Biscopra—and sure enough, an old brother officer sent me a specimen, preserved in spirits, of what he believed to be a Biscopra.

The probability is, that much of what has been reported of the fatal result of the Biscopra's bite is fabulous. It is an old proverb—"give a dog a bad name, and hang him." Alas! the consequence may apply to nobler creatures than the poor dog; but, be that as it may—the ban of the venerable saying applies to several harmless reptiles and insects. I recollect as a boy believing that the bite of the dragon-fly was a fearful thing. This was believed by hundreds of children besides me, and for ought I know, may be credited by hundreds of children, even in this boasted age of intellect. Some of the lizard family, as the Chalcides, the Apodal, and Anguina, approach in externals, if not in habits, so near to the snake family, that it is not surprising, they should, by ignorant persons, be regarded with feelings of dread, from their resemblance to that reptile, which men may be said universally to hold in intuitive horror. Accordingly, we shall find the ryot of Behar, and the highland peasant concurring in the belief that there is a lizard in the moors and bogs of Albin, and the jungles, or weed-covered ruins of Hindoostan, whose bite is deadly. But even in old England we have the traces of a similar notion; thus, the Duke of Suffolk, in the play of Henry VI. (part II.) cursing his enemies, imprecates after the following fashion—

---------- " Poison be their drink!
Gall, worse than gall, the daintiest that they taste!
Their sweetest shade, a grove of cypress trees!
Their chiefest prospect, murdering basilisks!
Their softest touch, as smart as lizards' stings!"

And again in the third part of the same drama—Queen Margaret thus retorts on Richard Plantagenet (Richard III.)

---------- " But thou art neither like thy sire, nor dam;
But like a foul mishapen stigmatic,
Mark'd by the destinies to be avoided,
As venom toads, or lizards' dreadful stings."

In the highlands of Scotland, it is the Lacerta vulgaris that is thus calumniated, and in India we have the Biscopra, a serpent-headed lizard. An old brother officer I have said, kindly sent me a Biscopra, preserved in spirits, from Meerut, which I regret to say, is no longer in my possession, nor procurable for the purpose of reference. The person bitten by a Biscopra, it is said, either dies immediately, or lingers for a day or two; the symptoms being the same as in a case of snake bite. I have spoken with two respectable natives, one of whom declared that he knew of an individual in Calcutta having died in three days from the bite of a kind of lizard, and he informed me that a Mohurrur of the late Rajah of Burdwan, many years ago died from the same cause, in the same space of time.

Not unfrequently beneath the surface of a popular belief may be found traces of truth. Approaching as the Lacerta family do in several respects to the snake tribe, it were scarcely philosophical to deny the *possibility* of such a creature's existence, as a fanged lizard. I was accordingly very desirous of putting the matter to the test of experiment; and offered a reward to any one who would bring me a living Biscopra, or a poisonous lizard of any kind. Several *janwars* were brought to me accordingly, including some ferocious Cobras di Capello with undrawn fangs, but no Biscopra was forthcoming. Indeed the word is not known to Bengallees—but there is a medicine called Bis-kupra, or Bish-khupra, used in Bengal by native practitioners, as a remedy in pulmonary affections and intermittent fevers of long standing. I reiterated my desire to have a lizard whose bite was considered deadly, and the common Goshamp was brought to me. At length a friend (belonging to the civil service) managed to catch for me in an old wall at Baraset a most active Lacerta, which the natives assured him was capable by its bite of inflicting instantaneous death. "Now," thought I, "or never, am I to be blessed with the sight of a real and *genuine* Biscopra!"

Determined to lose no time in putting my formidable friend's powers to the proof, I confined him within a transparent glass vessel where he was quite at his ease. He was an exceedingly lively little fellow, about five or six inches long, and his skin presented the appearance of irregular streaks of small beads of a dark grey and a lighter shade, alternating, as well as I can describe from recollection—for unfortunately the specimen itself, preserved in spirits, and a very accurate painted representation of it, which I presented to my friend Mr. J. T. Pearson, of Darjeeling, have both been swallowed by the Ganges, in one of those fits of gullibility which that sacred river occasionally exhibits. Succeeding in catching a 'ridiculus mus,' I determined to introduce him to the Biscopra, which by the way resembled very nearly the one forwarded to me from Meerut—save that the latter was considerably larger, and his head more pointed and snake-like. I accordingly dropped *mus* into the glass vessel, in which I could conveniently watch the motions of both parties. No sooner was the lizard favoured with the company of his unexpected visitor, than they two began to fight most desperately. I leave it to others to say why these two, who had never met in their lives before, should commence their acquaintanceship in a manner that threatened to prove fatal to one of the parties. Perhaps it may be regarded as an apt illustration of strong and active prejudice, or *hatred* at first sight. Be that as it may, it seemed as if they had predetermined to devour, or to be devoured. The combat, however, was but short and indecisive, though extremely spirited. A not uncommon result of a quarrel was also observable here, for both parties left off by mutual consent, each 'went his ain gait'—or in other words, quietly took up his position on one side of the glass house, nor evinced afterwards the slightest desire to renew the combat, in which it is proper to state, that the lizard was the offensive and mouse the defensive party; though as the battle thickened, it was impossible to say which was plaintiff or defendant. After leaving them together for half an hour I withdrew the mouse by means of a string fastened to one of his legs, and kept him for about seven hours, when not the slightest ill consequence following the combat, I let the little hero loose again. If this lizard then is to be regarded as a Biscopra, it is plain that the bite of the creature is not fatal even to so insignificant a being as a mouse. I believe that the lizard in question, as well as the one I received from Meerut, was a young Goshamp. I kept the former alive for many months, feeding it on cockroaches, which it always seized by the head, swallowing it rather slowly as a Boa constrictor bolts his prey. He would devour four or five of them at a time, and then stop till he felt hungry again. At length after growing considerably larger than he was when I first received him, the lizard died, perhaps from want of sufficient exercise. One of my native friends to whom I shewed it called it *Godhoree* (pronounced Gédree), and said that it grew to the length of two or three feet, and that when full grown its bite was deadly, which I very much doubt; but the former portion of the opinion confirms my own, that it was a young Goshamp. From all I have heard then, I presume that there is no such creature as a Biscopra, though I have no doubt that the bite of a Goshamp, young or old, may sometimes prove fatal, but not from the operation of any specific venom. I have heard that the Gecko of Java has produced serious inflammation by falling on the hand. I have also conversed with intelligent old officers, who informed me that during Lord Cornwallis' operations against Tippoo Sahib in the Mysore, and the occupation of Pulgatchery by the British army, there was a general impression that the bite of the Chameleon and the common Blood-sucker (known by the name of Girget) was dangerous, and sometimes deadly. They were killed therefore wherever found. This was partly occasioned by the death of an officer who laid hold of a Chameleon with his naked hand. The creature is naturally very sluggish and phlegmatic; but being frightened and squeezed in this way, it in self-defence bit the officer in the hand, and he died three days afterwards. This fact I had from a quarter that left it beyond a doubt.

Although the Lizard tribe then may be acquitted of the charge of producing deadly effects by means of fangs or a specific venom; yet is it perfectly consistent with reason that the mechanical injury of their bite may terminate in erysipilatous or other form of inflammation, and even death itself. A rusty nail, or a pin's scratch may, in some peculiar states of constitution merge in equally serious results. The human bite may also prove very injurious; and I have known the collision between the teeth and the back of the hand in dealing a blow abrade the skin, and produce very formidable inflammation. The scratch of a Tiger's claw is well known to produce a wound, sometimes very difficult to heal. Perhaps independent of the mechanical effect, putrefactive matter from the tearing up of his prey may adhere to the tiger's claws, or it is possible that they may have a noxious exudation, which by inoculation festers a wound?

In the second volume of Kirby and Spence's excellent work on Entomology, occurs this passage:—"Hasselquest says that the Gecko is very frequent at Cairo, both in the houses and without them, and that it exhales a very deleterious poison from the lobule between the toes; he saw two women and a girl at the point of death, merely from eating a cheese on which it had dropped its venom. One ran over the hand of a man who endeavoured to catch it, and immediately little pustules, resembling those occasioned by the stinging-nettle, rose all over the parts the creature had touched."

I have seen a dog run up to the common house lizard of this country (a variety of Lacerta agilis) and try to lay hold of it, but he soon let go again, seemingly considerably incommoded and his salivary secretion much increased. A cat again will devour a lizard without hesitation, beginning at the tail and crunching away—all but the head, which he leaves.

The house lizard in India in passing over the face or any part of the human body, produces by the contact a blistered surface. The common belief, so far as I have been able to learn it, is, that this effect is produced by the creature's urine. Be that as it may, I have no doubt of the fact that the contact of the creature does produce the irritation of the skin alluded to.

A somewhat similar effect is said to be produced by the contact of a large species of house or godown spider. I had often heard of this, but with some measure of incredulity. It is not always easy to catch the spider in the fact, but circumstantial evidence is against him. I have now seen several cases where the peculiar affection was attributed to the contact of a spider. One of the best marked was that of a mosaulchy, a servant of my own. He had gone to bed quite well, but towards morning feeling something crawling over his face, he slapped the part smartly with his hand, killing a large spider thereon. The part immediately became very painful, and when he shewed himself to me, the upper side of his face was much swollen, and the surface partially blistered, while the lids of the eye of that side were so swollen as to close them completely on the ball. A slight irritative fever supervened, and the smarting for three or four days was very painful, and it was some weeks before his face lost traces of disfigurement, when the skin about the malar region desquamated. The only remedy used was cold cream, with the exhibition of a saline purgative. I send you a representation of the spider that is accused of producing these inconvenient effects by its contact, for though no draughtsman, my rough sketch taken many years ago, from the life, may be deemed better than none, and will give the readers of these notes some idea of the insect. How then is the effect produced? Here the insect was crushed upon the part, but it is said that the creature's mere contact will prove injurious; supposing this to be true, how does its contact prove injurious?

In the 3d volume of Kirby and Spence's work, in referring to Puncta upon the integuments of some insects, occur the following remarks—" The other impressed puncta so often to be seen on the different parts of various insects, which sometimes so entirely cover the surface that scarcely any interval is discoverable between them, though in many cases they appear to be mere impressions that attenuate but do not perforate the crust—yet in others, perhaps equally or more numerous, they are real *pores*, which pass through the integument. If for instance you take the thoracic shield of the cockchaffer *(Melolontha vulgaris)* and after removing the muscle, &c. hold it against the light, with the inner side towards the eye, you will see the light through the puncture. * * * * * Whether the pores in the other parts of the body are for transpiration, is more than I shall venture to affirm; but as insects sometimes perspire, at least this has been ascertained with respect to the hive bee, this must be by means of some pores."

We learn that some insects under alarm, discharge a fluid from the joints and segments of their body. The scorpion when assailed, or put in pain, appears as it were all at once bedewed with a copious dark sweat. This coming in contact with the human skin would in all probability prove very irritating. Seeing that some insects undoubtedly have pores, and the circumstance of a scorpion's evincing a perceptible exudation, being taken into consideration—is it not probable that the irritation caused by the contact of a spider may arise from acrid transpiration, involuntarily caused by the insect's alarm on finding itself on a warm animal surface, or by the mechanical crushing it may undergo when killed on some part of the human body? The spider of which I have endeavoured to give a figure* has very formidable tentacula,† perhaps fangs may be a proper term, but as I have not dissected one of these insects, I cannot decide whether they are hollow poison tubes or not. Lister relates (Kirby and Spence) that he saw a spider, when upon being provoked attempted to bite, emit several times small drops of very clear fluid. At any rate, that some juice or fluid in the spider is venomous and irritating, is sufficiently shewn in an anecdote derived from Turner, a writer on cutaneous diseases, quoted by the authors already cited, of a woman whose custom it was, every time she went into the cellar with a candle, to burn the spiders and their web—"she had often observed, when she thus cruelly amused herself, that the odour of the burning spiders had so much affected her

* Pl. xi. fig. 5. † Fig. 5 a.

head, that all objects seemed to turn round, which was occasionally succeeded by faintings, cold sweats, and slight vomitings: but notwithstanding this, she found so much pleasure in tormenting these poor animals, that nothing could cure her of this madness, till she met with the following accident. The legs of one of these unhappy spiders happened to stick in the candle, so that it could not disengage itself; and the body at length bursting, the venom was ejaculated into the eyes, and upon the lips, of its persecutrix. In consequence of this, one of the former became inflamed, the latter swelled successively, even the tongue and gums were slightly affected, and a continual vomiting attended these symptoms. In spite of every remedy the swelling of the lips continued to increase, till at length an old woman, by the simple application for fifteen days of the leaves and juice of plantain, together with some spider's web, ran away with all the glory of the cure."

Aprops de bottes. In the first number of the work in which I have the honor of writing, a list of desiderata in the Entymology of India is given. One of these runs thus, "record any instance of death by insects, by bees, wasps, &c." This is not very specific, since it does not state whether the death to be noticed is that of man alone, or of various animals. Be that as it may, in a little work entitled, "Medico Topography of the Ceded Provinces, South-west Frontier," published in 1826, by a friend of mine, now no more,* occurs the following passage—"The bees usually construct their combs on the thick branches of large trees, and a swarm of them when disturbed are very formidable. I once saw several officers and men of the Ramghur Corps, in Sumbhulpore, considerably annoyed by a swarm of bees, and they avoided a continuance of their stings only by flight from the spot. Several valuable pointers and greyhounds belonging to the

* The late Mr. Breton, Surgeon to the Ramghur Battalion, and afterwards Superintendant of the Seminary for educating Native Doctors.

commanding officer of the Corps, that were fastened to a tree, and could not get loose when the dog-keeper ran away and left them tied, were stung to death. A tattoo and a bullock were also killed by the bees. Of this occurrence Mr. Assistant J. Grant, who was present, and was himself stung by the bees, can bear testimony."

The occurrence alluded to took place on the 17th June, 1818, close to the Mahanuddee river, and within five or six miles of Sumbhulpore, at a spot called Jumra. The detachment consisted of the Ramghur Battalion, the left wing of the 2d Batt. 4th Regt. N. I. (now called the 23d) and some Resallahs of Irregular Horse. It was a cloudy and pleasant morning, and after an agreeable march we halted at Jumra, which had the appearance of being a forsaken village, or rather the site of one, surrounded by deserted old groves of mango, saul, and peepul trees. The clashies were in the act of pitching the tents, and the officers were sitting down on chairs, which were placed under the shade of the trees, when suddenly we saw Lieut. Douglas (the son of Admiral Douglas) running towards us in a most wild manner, and two sepoys, one on each side, apparently furiously assaulting him with branches of trees. The scene was unaccountably strange, and we were speculating upon what could possibly be the meaning of it, when all at once, as if by the fiat of an enchanter, myriads of enraged bees rushed upon us, stinging us wherever the skin was unprotected. Some rash hand, it appears, had disturbed the colony in breaking down some peepul branches to feed the elephants. I never, considering such an apparently insignificant foe, witnessed such a scene of confusion. I remember, as if it were but yesterday, that while still puzzled at trying to account for poor Douglas' extraordinary movements and those of his pursuers, I happened to turn my head, and saw Major Roughsedge, who commanded the brigade, suddenly turn his horse's head and gallop away furiously in the contrary direction, while a shout arose of "*back again!*" "unpitch tents!" I had soon enough to do to take care of myself, without looking to others. But for the sepoys, we (I mean the Europeans of the detachment) would have been most seriously affected by these inveterate insects. With branches of trees with which they flogged away the bees, they succeeded in partially protecting us; I say partially, because notwithstanding our utmost care, we were severely stung, and the necessity of keeping the eyes closely shut, for fear of their being stung too, rendered us all very helpless. The scene too, though it was serious enough to the sufferers, had a strong dash of the ludicrous in it, of which we were not quite aware till we saw each other afterwards face to face, and compared notes. Among those most cruelly visited, was my lamented friend Capt. David Ruddell. Who that knew that fine soldier and generous and accomplished man, that does not love his memory? Poor David! I remember on going up to him that we both burst into a hearty fit of laughter, and the reason was, the ludicrous change in physiognomy which the little avengers had produced, for independent of swelling and redness where they stung, they left their stings in the skin, so that Ruddell's face looked exactly as if it had a beard of a hoary hue, from his chin to the top of his forehead; as others came up, they presented with less or more variation, the same appearance. He who suffered most, however, was Lieut. Brett of the Ramghur Corps. In an evil hour he lost his cap, and thought of getting under a blanket, (his bed and bedding having reached the ground) but hosts of the enemy got under his covering, before it could be folded round him, and his struggles to get loose again from his diabolical tormentors were misunderstood into efforts to keep himself under the blanket, and at last poor Brett burst out, and it was hard to say, whether he was most indignant with the bees, or with his native friends, who in their kind endeavours to help him made matters worse.—An admirable illustration of the Spanish proverb, "Save me from my friends!" My friend Capt. H. Templer, 23d Native Infantry, (one of the very few survivors of the scene) escaped, if I remember right, indifferently well. But for the sepoys, we should really have suffered very seriously. As it was, though we laughed it off, I must say for one, that I felt as if a little more stinging would have brought on a severe irritative fever. What made the thing more ridiculous, was the deprecating tone in which a veteran Sergeant, MacGregor, declared that they were only *moss* bees, just as if their identification could have in the slightest degree lessened the annoyance of their visitation. All the time too, he affected to waive them off with an air of indifference, but being rather bald, his head appeared to offer a fine subject to the enemy, who forthwith belaboured him in such numbers that he made a retrograde movement, and ceased to say any thing further about moss bees. The countless squadrons of these infuriated insects literally drove us out of the encampment, and we had to move away in another direction, some two or three miles, the bees gallantly following us—though many of them might be seen lying about dead or dying. Major Roughsedge lost seven or eight valuable dogs, (greyhounds and pointers) by this onslaught of the bees; they were, as stated by Mr. Breton, tied to a tree, and the Dooreah ran away, so that the poor animals had no one to help them. With every one indeed it was *sauve que peut*. People in the snugness of the closet may laugh at details like these, but, from this and other bits of experience, I am convinced that nothing can be more terrible than a visitation of innumerable insects. Without any affectation, I think an action between man and man, even with the deadliest weapons, is far preferable, for the worst of your insect foe is, that you can hardly get at him. A tattoo and a bullock were also killed by the infuriated bees. The former instinctively rushed towards the Maha

Nudee, pursued by thousands of them; but alas! the water was so shallow at the place that he could not escape them. I heard also that the Dooreah, or coolee who had charge of the dogs, died in consequence of the inflammation produced by the innumerable stings of the bees, but for this I cannot vouch; perhaps my very few surviving brother officers, who were spectators of the scene, may recollect whether this was the case or not. I have nothing further to observe, save that no one thought in the confusion, and terror even I may say, of the scene, to keep specimens of the bees, but they were much of the size and appearance of humble bees.

The point with which I mean to end this gossip, refers to the existence of the Cobra Manilla. The belief in a reptile so called, and reputed to be most deadly, is very general. I have never seen the snake myself, and although for many years I have been in the habit of inquiring after it, I have never met a person who gave me any other than a very vague and loose account of it, or who could positively declare he had seen one himself; though, as is often averred of ghosts, he knew very respectable individuals who declared that friends of theirs had seen it. Its size is said to be about that of a tobacco pipe, its length some eight or ten inches, and its bite uniformly and speedily fatal! Dr. Russell, the able author of the splendid and valuable work on Indian Serpents, never saw a Cobra Manilla, although some supposed specimens of the reptile were sent to him, which, however, turned out to be the young of other venomous sorts. Neither do I find in the able Spicilegium of Dr. Cantor a description of a snake such as the Cobra Manilla is said to be. I have heard it described as of a dark blue or black colour, with light coloured slender bands or spots. This description perhaps comes near the young of the Karraitta (Boa Lineata of Shaw), the Gedi Para-goodoo of Malabar. According to the natives, who generally exaggerate, its bite (the young of the Karrait, brought as a Cobra Manilla,) always produces immediate death, which Dr. Russell was led to suspect the truth of, from finding that on repeated trials, it seldom killed chickens in less than half an hour, and dogs in an hour and a half; when full grown, on the other hand, it is one of the most formidable of poisonous serpents. A friend of mine lost a beautiful male spaniel at Baraset many years ago, which chasing a hare, jumped into a bush, and was bitten by a snake, on which the poor creature retreated instantly out of the bush, turned round two or three times, and fell down dead, before his master could run up to him, and not surviving the bite more than a minute or two, if so much. The snake was killed, but unfortunately not preserved. It is said to have been a thick short one, marked with black rings. The dog's mouth was enveloped in foam, and its body immediately swelled enormously.

There are two periods when the bite of a snake is peculiarly deadly, viz. at the commencement of the hot weather, when after hybernation it has all its energies fresh, and at coupling time. The bite of large and old serpents is more dangerous, generally speaking, than that of small and young ones, and does not depend so much, it would appear, upon the intensity, as the quantity of the poison inoculated. From the experience of Dr. Reuzger, a German physician who spent six years in Paraguay, where there is a great variety of poisonous serpents of the genera Crotalus, Lachesis, Cophias, Elaps, &c. it appears that the danger of their bite varies according to the situation of the bite. Wounds of vascular parts, and of large blood vessels, are generally followed by speedy death. The effect, he states, is much slower when the poison is applied to denuded tendons or nerves; and in parts that contain no vessels, as the callous cuticle of the soles, no effect is produced. The time in which the bite of a snake may prove fatal, varies considerably. In the year 1819, at Dinapore, I had a striking instance brought to my notice of the deadly effect of the bite of what was called a Karrait. About 1 o'clock A. M. I was roused out of bed to go and assist a native woman who had been bitten by a snake. I instantly threw on my dressing gown and went to the door, where I found a woman of about thirty, strong and healthy, though apparently in a fainting state, lying on the charpoy, in which she had been carried by her male relatives. One of the men was her husband, who told me that his wife, while asleep by his side, on a mat on the floor, had been bitten by the reptile, which she not knowing what it was, gave a push to with her foot; when it fixed its fangs on the great toe of one foot, and as there was a light in the hut, he started up, and saw a black looking snake move rapidly towards his brother's bed, on the other side of the hut; the reptile bit his brother too. He then gave the alarm to his neighbours, and they instantly set out for cantonments. From my inquiries, and the distance of the people's hut from my quarters, I am convinced that barely twenty minutes, or half an hour at furthest, had elapsed from the time the woman was bit to my seeing her. On being bit she felt excruciating pain in the foot, which was speedily followed by overpowering giddiness and sickness. While this conversation was going on I had my finger upon the poor woman's wrist, there was however no pulse, she was quite dead, and the distracted husband could scarcely be made to credit it, entreating that I would do something. To please the poor man, I conveyed eau de luce in a spoon into the woman's mouth, but of course it ran out again, and he at length became convinced that all was over. The brother who had been bitten too, recovered, for the simple reason I presume, that the greater part, or nearly the whole of the secreted venom had already been inoculated into the first victim. The marks of the fangs were very distinct, and full of thin blood that oozed out from them. Dr. Breton published many years ago the case of a man bitten at Hazaribaugh, who survived the bite of a Cobra Capello (if I recollect right) 48 hours, or upwards. Lately there was a lamentable casualty published in the papers, of Lieut. Atkinson, who survived the bite of the reptile three or four days. I wish we had the particulars of this case, for it is only by comparing results, that accurate conclusions as to pathology and treatment, can ever be arrived at; nor is the death by a snake bite of a gallant officer in the prime of life so common an event, that the particulars should be a letter sealed to the scientific world in general, or at any rate to the medical section of it. Dr. Reuzger (already quoted) says, that in some instances the symptoms go on gradually, and that the sufferer does not die till the 14th day. In cases that do not end fatally again, he contends that serious after-effects follow even at so long an interval as three years. Serpents themselves die from the bites of venomous serpents, and even from their own.

In a paper published lately by Dr. Knox of Edinburgh,* he ventures to state that no *external character whatever* can well be trusted in the determination of a snake; for there are many innoxious snakes which are so closely imitated in their external appearance by others truly poisonous and exceedingly dangerous, that he feels warranted in declaring, "that *no snake*, however much it resembles a harmless one, or those of a class known to be harmless, should ever be handled, until the person be perfectly assured of its death. Again, on the occasion of a person being bit by a snake, and the dead reptile being produced, the surgeon ought not to rest satisfied with the external appearance of the snake, but proceed, without a moment's delay, to ascertain the presence or absence of poison fangs; the result must direct his practice. In case of the snake having escaped, excision of the part bitten, ought immediately to be resorted to."

* In the Lancet.

According to Dr. Reuzger (who wrote on the subject before Dr. Knox, or at least published the results of his experience many years before him) the best method of treatment, is the removal of the wounded limb, or the excision of the bitten part, and the subsequent scarification and cauterisation of the wound. If the necessary instruments are not at hand, the wound must be sucked, and repeatedly washed with acrid and pungent washes, as lemon juice, brandy, &c. and afterwards covered with gunpowder and pepper, or powdered cantharides. A tight bandage should be tied round the limb, and an emetic should be given as soon as possible, &c. With reference to the necessity of excision, Dr. Knox coincides most emphatically in opinion with Dr. Reuzger; his words are these—"I now come to the determination of the opinion so generally entertained, that the bite of several poisonous snakes is almost inevitably fatal; and I believe that it is so, if proper remedial means be not speedily adopted. The SOLE REMEDY *is the excision of the part bitten;* all other means seem to me only dangerous delusions." Now as the field of Dr. Knox's experience in this matter was South Africa, where there are snakes of the most deadly character, his opinion is entitled to the greatest consideration. Indeed I may be allowed to observe, that on *any* point of pathological science, it is so. Surely then, the question of whether there be, or be not remedies apart from excision and cauterisation for the bites of poisonous serpents, is one of very great importance; so much so, that I earnestly entreat those of your readers who may have it in their power, to increase our stock of information on this subject, to do so. It is said, that the Mongoose or the Ichneumon, after a combat with a snake, runs away to feed upon, or at least to chew some herb, that acts as an antidote to the bites he may have received. I was once a witness to such a combat, and the snake, a fierce Cobra Capello with formidable fangs, was soon demolished. I had placed the combatants in a six dozen empty wine box, so that neither could escape. The snake from the first, appeared perfectly aware of the formidable antagonist he had to deal with, and wanted to avoid the combat. The moment he had killed his foe the Mongoose wanted to escape, but I would not let him; at length he evinced the greatest anxiety and restlessness, and began to stagger, I then let him go, he kept staggering on through a field of grass, in which I lost sight of him. Suffice it, that in the course of an hour or so he appeared quite well again; what he ate, or whether he ate any thing of an alexipharmic character at all, I cannot say; but the belief, or rather the averment, is very general that he does so. It is also said, that the *saump wallahs* protect themselves, by rubbing their hands and bodies with the juice of the plant, used by the Mongoose as an antidote, called *Amrool*, which abounds in Bengal.

It may not be deemed irrelevant to state here, that at one time entertaining doubts whether carbonic acid gas would kill cold blooded animals, or at least reptiles, I determined to submit the matter to the test of experiment. I procured for the purpose one of the largest and most ferocious Cobra Capellos I ever saw, and introduced him into a large glass jar, to which I adapted the necessary apparatus for eliciting the gas. For a considerable time the reptile appeared to care nothing about it, but as the new element began to fill the glass vessel, his alarm became extreme, and he instinctively kept his head above the stratum of mephitic air. At length his struggles to escape became terrific, and he tried to force a passage through the upper part of the vessel with his nose, and at length dropped down dead to the bottom, where I left him immersed in the gas for half an hour, to make sure of him. He had coiled himself, and was stiff and dead. Had he been poisoned with prussic acid, I should have expected to have found his body quite pliable. Whence the difference?

Calcutta, 2d July, 1840.

EUROPE:—*a popular Physical Sketch. By Professor* SCHOUW. *Translated from the second edition, by Dr.* CANTOR, *Assistant Surgeon, Bengal Medical Service, doing duty with H. M's. 26th Regt. on expedition to China.*

PREFACE.

The imperfect and unscientific manner in which the manuals of Geography treat of the physical condition of the earth, and the ignorance so frequently displayed by persons, in many other respects occupying a high step of intellectual culture, have chiefly called forth this sketch. I have tried to render the physical relations intelligible even to those who possess no rudiments of the physical sciences, but I have often felt how difficult a task it is, in geography, to exhibit their results in a popular manner, if the acquirement of the rudiments cannot be presumed. THE AUTHOR.

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Scandinavian Peninsula.—If a man supposes himself transported to the Arctic Ocean in order from thence to commence a journey through Europe, he will first have to pass through an elongated peninsula, called Scandinavia (Norway and Sweden), surrounded by the sea and its gulphs, and connected to the rest of Europe by a rather broad isthmus, proceeding from the eastern side of its northern frontier. The length of the peninsula, as well from north to south, as from north-east to south-west, is about 960 geographical miles; the breadth from 200 to 380.

The sea cuts numerous very deep, narrow, and curved friths or inlets into the west-coast, along the shore of which are spread numberless rocky islands, whereas the east coast, formed by the Gulph of Bothnia, is nearly without any friths at all, and containing few islands, and those of small extent. The greater part of the peninsula is occupied by one continued chain of mountains, extending from the Varanger Ford in the north, down to the south-western extremity (from 71° north lat.*). This chain first proceeds under the denomination of 'Lapland mountains,' and Kiölen from NNE. to SSW. forming the frontier between Norway and Sweden, then under the name of 'Dovre' from ENE. to WSW., and resumes to the southward its former direction under the appellation of 'Langfield,' 'Sognefield,' 'Hardangerfield,' situated near the southern coast.

The north-eastern extremity of the chain slopes gently towards the White Sea, while a number of extensive, lowly situated lakes ('Wenner,' 'Wetter,' 'Hjalmar,' 'Mälar,') form a natural frontier towards the SE. The chain has no ridge above, but is flat, forming numerous extensive tracts, which although not even, at the most present an undulated surface, and are called mountain-plains. Their height, and

* The distance between the line (Equator) and the North pole, is divided into 90 degrees, each of which is about 60 geographical miles.

therefore for this reason very cold climate, render them mostly uninhabited, and journeys from the one side of the mountain chain to the other, are often performed with great difficulty; the usual distance from the last fixed habitation on one side amounts from 40 to 48 miles, or even more, to the nearest inhabited place on the other side, and even where high-roads traverse these table lands, the traveller is still obliged to cross tracts composed of the most rugged and barren rocks. That part of the road which runs along 'Dovre,' a distance from 32 to 40 miles, has for this reason been provided with what is called in Norwegian 'Fjeldstuer' (i.e. rock-chambers) for the accommodation of travellers, and the change of post-horses, ('Skydsskifte.') On 'Filefield,'* where the chain is unusually narrow, the breadth still amounts to some eight miles.

On the east side, the chain slopes very gently towards the gulph of Bothnia, and its lower part terminates with a perfect plain. Side branches frequently form extensive transverse† valleys, such as the valleys of 'Herje,' 'Oster,' 'Guldbrand,' 'Valders,' 'Halling;' often the whole chain deviates laterally, forming tolerably flat tracts above, such as 'Lapmarkerne' and 'Tellemarken,' which mean the different varieties of surface, as the 'Dal,' (i.e. valley,) and 'Mark' (i.e. field). The western side is very steep, and the deep narrow friths or inlets, like huge clefts cut into the solid rocks, appear as substitutes for the valleys. To the traveller traversing the mountain plains, these friths are very often not perceptible till quite close, and then he may look down a depth of several thousand feet, where small inhabited spots on the banks, put him in mind of human dwellings. The rocks

* The road from Christiania to Bergen traverses Filefield; that from Christiania to Drontheim runs over Dovre.

† Valleys of the same direction as the mountain chain are called *longitudinal*, whereas such as form a somewhat large angle with the chain are denominated *transverse*.

themselves are so steep, that communication, even between neighbours is kept up by water.

As a natural consequence from the quite different angle of inclination of the two sides of the mountain chain, it follows that the eastern side presents large and extensive rivers (Torneâ, Kalix, Luleâ, Piteâ, Umeâ, Angerman, Indal, Liusna, and Dal, pouring their waters into the gulph of Bothnia ;—Clara into the Wenner lake, and Glommen and Louven into the North sea :) whereas the western side offers small and short rivers only. The occasionally even surface of the chain frequently causes two rivers to communicate; thus for instance in Lapland the Torneâ joins the Kalix river.—Lässövärkvand, a lake between Dovre and Langfield, sends rivers to both sides of the chain, and whenever Glommen happens to have a surplus of water, part of it is discharged at Kongsvinger through the Wrangs-river into Wenner lake. On the mountain plain itself, and particularly at the eastern foot of the chain, are found a number of very large lakes, among the former, are the mountain-lakes of Torneâträsk, Lomijauhr, Oresund, Tämund, and Miösvandet; among the latter, Enareträsk, Luleâ, Wattnen, Storsion, Miösen, and the above mentioned four large Swedish lakes. The western side possesses no such lakes. The Scandinavian mountain chain abounds with huge waterfalls, among the highest of which are Rjukan-Fossen (i. e. the smoking waterfall,) whose waters fall perpendicularly to a depth of 853 feet,* and Börring Fossen, of 960 feet.

Taken altogether, the chain is loftier towards the southern extremity; the greatest heights are found in the Hardanger, and Sognefielde, where an elevation of 4800 feet above

* Here, as throughout, the heights were left by Dr. Cantor as given by Schouw in Parisian feet, but we have reduced them to English.—A work of considerable trouble, but which we trust will render the paper more useful to the English reader, particularly as the list includes all the principal altitudes in Europe.—Ed. Cal. Jour. Nat. Hist.

the level of the sea occurs ;* in Dovre 3200, and in the southern part of Lapland 2666; but among the highest mountains are,

Gousta (Tellemarken,)	6,150 feet.
Justedalsbrä, ...	6,400
Skagestöltind (Sognefield,)	8,160
Lodalskaabe, ...	6,602
Sneehätten (Dovre,)	7,572
Syltop, ...	5,874
Sulitelma,...	6,182

The Scandinavian mountain chain (with which are not included the low rocks in the southern part of Sweden separated by the above mentioned lakes) consists chiefly of *primitive* formations† (Urformation) among which gneiss‡ is the prevailing rock; limestone, so frequently found in other mountains, plays here a subordinate part; coal occurs not at all, and fossils are scarce; but metallic ores, particularly iron and copper, abound, and silver is also found.

The eastern and western side of this chain differ very much, not only with regard to the *temperature* of the atmosphere, but also with regard to its moisture. On the western side, what is commonly called a coast, or island climate, is the prevailing, i. e., a damp, hazy atmosphere, fre-

* Whenever an elevation above the level of the sea is given, it is the vertical height from the sea, without any reference to the nature of the declivity.

† Primitive formations are such as commonly form the basis for the others; they are generally speaking chrystalline, and contain no traces of fossil animal or vegetable remains. 'Flöts rocks' rest upon the former, generally speaking in alternate strata, and consist frequently of fragments of primitive rocks, and contain fossil remains of animals and plants.

‡ Gneiss, like granite, consists of three parts: viz., quartz, felspar, and mica, which last occurs more scaly, than in the granite, in which the mica is granular, and placed in different directions; whereas the mica in the gneiss is placed in parallel strata.

quent rain, mild winters and cold summers; the eastern side has a continental or inland climate, i.e., a clear sky, dry atmosphere, little rain, warm summers, and severe winters.

Stockholm, Upsala, and *Christiania,* have pretty nearly the same annual mean temperature,* viz. 42.12° Fahrenheit,† which is 4.5° lower than that of Copenhagen, but the winter is in the first mentioned place 5.6° colder than in Copenhagen, whereas the summer is only 2.2° less warm. The mean temperature of Ullensvang, in the province of Bergen, is 1.18° higher than that of the first named place, whereas the winter is 4.5° milder, and the summer 1.1° colder. A somewhat similar result is obtained on comparing Drontheim to Umeâ. At the North Cape the winter is but little severer than in Stockholm, but the summer heat is not greater than the heat of the autumn in Stockholm. In Enontekis, a small town in Lapland, the summer is 11.2° warmer, and the winter 22.5° colder, than at the North Cape. The following table, shewing the mean temperatures, will render the comparison easier.

	Latitude.	Year.	Winter.‡	Summer.
Stockholm, ...	59° 30′	42.12°	25.3	61.2
Ullensvang, ...	60°	44.3	29.8	90.1
Drontheim, ...	63° 30′	32.8°	23.	59°
Umeâ,......	64°	35.3°	14.	57.8°
North Cape, ...	71°	32°	24.2	43.2
Enontekis, ...	63° 30′	28.5	2.	54.5

* By mean temperature, is meant a mean number extracted from the register of every day during a number of years.

† The temperatures which were given according to Reaumur's scale, we have reduced to Fahrenheit's scale throughout this paper.—Ed. Cal. Jour. Nat. Hist.

‡ By winter is understood the three months of December, January, February;—by summer, June, July, August.

In Enontekis* the mean temperature of the year is 2.2° lower than the mean temperature of the coldest month in Copenhagen, the winter temperature is 29.2° below that of Copenhagen, and yet the summer temperature is only 9° below that of Copenhagen. Sixty-eight years' observations show the greatest heat in Stockholm to be 95°. In Umeâ and Enontekis quicksilver occasionally freezes, which requires a temperature of 70° to 72° below the freezing point of water.

The annual *quantity of rain*† is in Stockholm and Westerâs 19 Paris inches, but in Bergen 77½ inches.‡

Although the results of those single places cannot be considered conclusive as to the whole of the eastern and western side of the mountain chain, yet connected with general experience, they induce us to believe that the quantity of rain is much greater on the western side of the Scandinavian peninsula than on the eastern. The exhalations rising from the sea, and the causes by which currents of air loaded with vapours are carried against steep rocks, and thus converted into rain, account chiefly for the damp climate and foggy atmosphere of the western side. Thus also the influence of the sea renders the heat more equal, and causes the summer to be less warm, and the winter less cold, because the sea is never frozen during the winter, and the moisture of the sea-air diminishes the heat of the summer.

* Enontekis is situated 1,440 feet above the sea, and has consequently a lower mean temperature than if situated on the sea level.

† The annual quantity of rain is found by collecting the rain in a graduated vessel, measuring the quantity of water whenever it rains, and by adding together the results. When the annual quantity of rain in Stockholm is said to be 19 inches, it means, if the rain of the whole year round was allowed to remain on the earth, the surface would at the close of the year be covered with a sheet of water 19 inches in depth. Snow comes in, of course, under the calculation of rain.

‡ The register of the Pluviometer, or rain guage, stands throughout in Paris inches, as in the original.—Ed.

The mountain chain checks the influence of the sea on the east side.

A man ascending a mountain will find the temperature decrease, and will, provided the mountain be sufficiently high, arrive at an elevation, where the cold is so intense, that the snow never melts. An imaginary line drawn through all the points, above which snow never thaws, is usually called the *snow line.* At the North Cape this line is met with at an elevation of 2346 feet in the southern part of Norway, at a height of 5546 feet. On the western side the snow line is lower than on the eastern, because the snow is not so easily melted in foggy, damp summers, as it is under a clear sky. From the large masses of snow at Folgefonden and Justedasbräen, in the province of Bergen, huge ice masses ('Iisbräer,' 'Iökler,' 'Gletscher,' glaciers,) descend as far down in the valleys as the corn fields, and in consequence of their extent and slow descent from above, the summer is not capable of thawing them. Below these glaciers appear a kind of ice-hedges (moraines) i.e. huge accumulations of earth and stones carried down by the avalanches, or falling glaciers. All the rivers originating from these, are of a milky colour, because they are loaded with dissolved particles of rocks. In Finmark these ice masses, or glaciers, descend as far down as the sea.

The Scandinavian peninsula abounds with forests, chiefly consisting of two kinds—of *fir,* and *birch.* Oak is found as far as Söndmör (63° north lat.) on the western side, and on the eastern only as far as Gefle (60° 30′ north lat.) Beech only at Laurvig, in Norway, (59° north lat.) and in Sweden not at all to the northward of the large lakes. Of the three first mentioned predominant forest-trees, the birch extends nearly to the North Cape (70 to 72° north lat.), the *firs* to Alten (69 to 70° north lat.) and one kind to Kunnen, on the western side (67° north lat.) On the eastern side, the last mentioned *fir* extends a few degrees higher to the northward, finding the climate more favourable than it is on the coasts. The *hazel* bush thrives better on the western side, where it extends to Helgeland (65° 30′ north lat.) while Angerman river (63° north lat.) forms its eastern frontier. The *lime* tree also has a greater northern range on the western side, viz. to the 64° north lat. (Öreland) than on the eastern, 63° north lat. The *elm* reaches about 63° north lat. on both sides. On ascending the mountains to a certain height, the traveller loses both the firs and meets only with the birch ; still higher, this tree also vanishes, and with it all forest trees ; low bushes only then appear, particularly the *dwarf birch* (a smaller kind of birch,) and a few small kinds of willows, a number of little herbs with proportionally large flowers of beautiful pure colours (alpine vegetation), and several kinds of mosses, among which are the Reindeer and Iceland moss, which form the very extreme altitude of all vegetation.

Thus, taking height into consideration, a division of three zones might be established ; viz. the zone of the *pine* trees, of the *birch*, and of the *alpine vegetation.* At the southern part of the mountain chain the firs reach 2986 feet, the birch 3733 feet ; in the northern parts of Lapland the former 700 feet, the latter 1600 feet.

The *cultivation of grain* extends farther to the north than might be expected. At Malangerfiord (69° north lat.) grain ripens every year, and even as far as Lyngen and Alten (70° north lat.) ; and on the eastern side, in the ‘ common districts’ of the frontiers of Norway, Russia, and Sweden, grain is still cultivated. At Enontekis, at an elevation of 1440 feet, is also found a little grain, which however arrives to ripeness only every third year. Cultivation of grain is also found in places where the annual mean temperature is below the freezing point, while in Switzerland it ceases at a mean temperature of 41° above freezing point, and in the South American mountains at 54.5 above the same ; from which facts may be concluded, that the cultivation of grain depends more on the mean temperature of the summer, than on that of the year round. The long summer days give to the northern countries, in proportion, a considerable, although brief summer heat, which indeed enables the grain to ripen. Yet not every kind of grain; only barley extends so far northward. The northern extremities for the different sorts of grain may be fixed as follows:

	West-side.	East-side.
Barley, ...	70° north latitude ...	70°
Rye, ...	67°	65° to 66°
Oats, ...	65°	63° 30′
Wheat, ...	64°	62°

The cultivation of wheat however is of consideration only to the southward of 60° north lat. Taking elevation into consideration, cultivation of grain ceases in the southern Lapland (67° north lat.) at about 853 feet; in the southern parts of Norway (60°) grain is not expected to ripen at a greater height than 2133 feet.

The extremities of the most important fruit trees, are:

	West side.	East side.
Apples & plums,	63° 40′ N. L. Tuttero +	62° 30′ Sundsvall,
Cherries, ...	63° Ertvaagö, ...	63°
Pears, ...	62°	62°

Peas are, generally speaking, cultivated to 64° 30′ on the western side; and to the 63° on the eastern side. From experiments which the Horticultural Society in London caused to be made, peas succeed at Hammersfest (71° north lat.) in favourable summers only, whereas cabbage, turnips, carrots, spinage, and salad, are easily cultivated there.

Also potatoes thrive thus far to the northward, but asparagus is cultivated on the western side to 61° north lat. only.

The most important *domesticated animals* with the Norwegians and Swedes are the ox, sheep, goats, horses, and swine; and the reindeer with the Laplanders; for although the latter animal is found in a wild state from the southernmost mountain plains in Norway to the most northern extremity of the peninsula, (i.e. from 59° to 70° north lat.) it forms nevertheless the most important domesticated animal of the Laplanders. The great abundance of Reindeer-moss on the table lands, renders it very easy to keep this beast.

The elk is not found higher than 64° north lat., and is scarce.

Of wild beasts, are found the bear, the lynx (Loss), the glutton (Vielfrass) the wolf and the fox; the blue, and the white fox, and the polar bear, are inhabitants of the northern regions. The lemming (*Mus lemmus,* Pallas) is a kind of mouse, now and then appearing in large herds.

To the inhabitants of the mountains belong, besides the wild reindeer and the above mentioned beasts of prey, also certain birds as the ptarmigan (Fjeldrypen), the capercallie, and the snow sparrow. Remarkable is the great number of gnats also that appear during the summer months in Lapland and on the southern great mountain plains, by which the inhabitants of the foggy western coasts are less annoyed.

On the west coast of Norway, particularly in the northlands, where the fishermen congregate at Lofoden by thousands, in the month of February, fish are very plentiful.

The most important fishes are the 'Cablian' (*Gadus morrhua,* Linné, *Morrhua vulgaris,* Cv.) the 'Torsk' (*Gadus callarias, Brosmiuns,* Cv.) the ling, and the herring. Whales visit the coasts.

The greatest number of the inhabitants of Scandinavia belong to one principal race—*Scandinavians* (Norwegians and Swedes). In the northern part are also found 'Laplanders' (Norwegian, 'Finner') who belong to a quite distinct race, viz. the polar race; they are small, well knit, of a yellowish colour, with broad faces, flat noses, and black bristly hair. The southernmost Laplanders are found at Köraas.

The chief occupation of the Scandinavians is fishing, on the western side; grazing and agriculture on the eastern, where also hunting, wood-cutting, and mining, form important occupations. A thin population, and few towns, cause the peasantry in many parts to excel in mechanical and domestic industry. The Laplanders lead a wandering life, without fixed habitations, and subsist chiefly by their reindeer, and fishing, from which originate the denominations of 'Fjeldfinner' (mountaineers) and 'Söfinner' (See Laplanders).

South of Sweden.—It has already been mentioned that the southern parts of Sweden are cut off from the rest of the Scandinavian peninsula by a number of large lakes, and a considerable depression in the country. The thus separated part (55° to 59° north lat.) possesses no large continued chain of mountains, but several smaller ones, with a few lofty mountain peaks and ridges. The highest mountains are Taberg, near Jönkjöbing 1,120 feet, and Kinnekullen, near Wenner lake, 906 feet; the small ridges Hallandsaas and Kullen are lower still, and the southern extremity of the peninsula terminates in a perfect plain. In the south and east appear the islands of Bornholm, Oland, and Gulland; in the first of which, Rytter Knagten is the highest point, 512 feet.

The south of Sweden although rich in lakes, possesses no important river. The mountains consist not only of primitive formations, but also of stratified rocks, in which appear coals, which, however, do not belong to the older, or proper coal formation. Of the mean temperature of this district an idea may be formed by comparing Stockholm and Lund.

	Annual.	Winter.	Summer.
Stockholm 59° 30′ north lat.	42.1°	25.3	61.2
Lund, 55° 30′........................	45.5	29.8	62.3°

At Lund, situated near the southern frontier, the annual mean temperature is consequently 3.4 higher than at Stockholm (1.12 lower than in Copenhagen,) the winter is 4.5 warmer than in Stockholm, but the heat of summer exceeds that of Stockholm by 1.1 only, which proves that the difference between the seasons is not so great as it is to the northward of the large lakes. The annual quantity of rain is—

Stockholm,...	19 inches.
Vesterås, ...	19
Lund,...	19½

In more mountainous parts the quantity of rain appears to be greater; thus, for instance, in Wexïö, it is 23 inches.

The forests, like those of the more northern parts of the peninsula, consist chiefly of *firs* and *birch*, and in the southern part the *beech* is not uncommon. On the western side the latter tree extends to Gothenburg (58° north lat.) but on the eastern to Calmar only (56—57° north lat.) *Oak*, on the contrary, ranges all over the south of Sweden, and in particular in the southern provinces.

The plain and warmer Scania (Skaane) is more calculated for *agriculture*, than any other part of the Scandinavian peninsula.

Finland, like the south of Sweden, is situated SE. from the great mountain chain in the southern part of the Scandinavian peninsula; thus Finland is situated SE. from the northern part, between 60° and 66° north lat., extending 360 miles from N. to S., and 280 to 320 miles from E. to W. These two tracts of country display a similarity not only in their situation, but also in the circumstances that they abound with lakes, and possess but low mountains. The Alands-Islands form a natural connecting bridge.

Finland is best imagined as a very low mass of mountains, flat above, consisting of numerous lake basins (depressions with lakes in their centres) declining steeply towards the gulph of Finland, more gently towards the gulph of Bothnia. The highest mountain exceeds not 1280 feet. A greater number of lakes, and still fewer rivers than in the south of Sweden, are found here. The mountains of Finland blend imperceptibly into the eastern, flat part of the Scandinavian and Russian plain. The White sea, and the lake Ladoga, form a tolerable line of demarcation.

Like the east side of the Scandinavian mountain chain it is colder, and the difference between summer and winter, is greater than on the west side, thus the mean temperature of Finland is still lower, and the difference between the seasons still more considerable, which may be perceived by comparing the mean temperature of Scandinavia to Uleâborg and Abo.

	Annual.	Winter.	Summer.
Umeâ, 64° north lat.	35.3°	14.0°	57.8°
Uleâborg, 65°	33.1°	11.8°	57.8°
Stockholm, 59° 30′	42.1°	25.3°	61.2°
Abo, 60° 30′	39.8°	21.9°	60.1°

The quantity of rain in Abo, 22 inches, is a little greater than that of the south of Sweden, most likely in consequence of the situation between the two gulphs of the Baltic sea, but it is much less than that of the western coast of Norway.

The forests consist particularly of *fir* and *birch;* oak, however, extends to Biörneborg (61° 30′ north lat.) Cultivation of grain is considerable.

Iceland.—To the west of the Scandinavian peninsula, far out in the ocean, this large island is situated between 63° 30′ and 66° 30′ north lat., extending about 260 miles from E. to W. and 180 from N. to S. The outline presents a somewhat rounded form, although the northern part is an isolated peninsula, connected to the rest by a narrow isthmus. On the north and west side the ocean cuts many extensive friths into the island, (Eya-, Skaga-, Breida-, Faxa- fiord. This is less the case on the east and south side. The general appearance is rocky, and the interior of the island consists of one continued mass of mountains, the loftiest part of which is situated in the south-eastern part of the island, forming precipices towards the sea. The highest mountains are Oräfa-Jökul, 6400 feet, Oster-Jökul, 5653 feet. In the south-western part Hekla rises to a height of 5333 feet, from which it will be perceived that the mountains of this island are less lofty than those of Scandinavia.

In consequence of the south-eastern being the highest part of the island, its waters generally speaking have a direction to the north and east, and the greater number of extensive rivers run towards the north country and the south-west coast, whereas the eastern and south-eastern coast receive but few rivers of considerable size. The largest rivers in the north are, Blanda, Herads, Vandene, Skialfandaflod, and Jökul-Aae;—in the east, Fliotsdals-Aae;—and in the south-west, Olvessaae, Thiorsaae, and Hvitaae. The most extensive lakes are, Thingwalle-vatn, Hvitaar-vatn, and My-vatn. Iceland abounds in hot springs ('Hverar') the temperature of which frequently approaches, or even reaches, the boiling-point. Many of them contain silex, which when the water evaporates, accumulates in these springs to such an extent as even to stop the water, which then is obliged to find some new opening. The hot spring most celebrated is Geyser,* a kind of natural spring, sending its waters to a perpendicular height of 106 to 313 feet, not however continually, but at regularly fixed intervals. The cause of this phenomenon is attributed to subterraneous vapours, which when accumulated to a certain quantity, conquer the pressure of the water, and throw it high into the air.

The *mountains* of Iceland are chiefly volcanic, i. e., produced by fire. In many the fire is still active, as in Hekla, Krabla, Oräfa-Jökul, Kötlugio-Jökul, and Eyafield-Jökul,

* This name is applied either to an entire district abounding with hot springs, or to the largest of them, i. e. the old Geyser, which however of late but seldom and slowly sends forth its jets. 'Strokken' is at present (1835) more active.

from the interior of which flows lava ('Hraun') which with ashes, stones, water, sand, and clay, thrown out through the craters, frequently cover extensive districts. Of useful mineral productions, are found sulphur (the most extensive mines at Husabig and Krisuvig,) and 'Surtarbrand,' i. e., flat pressed, carbonized trunks of trees found among the strata.

Considering the locality, Iceland enjoys a mild climate, and particularly mild winters.

	Annual.	Winter.	Summer.
Reykiavig, ... 64° north lat.	39.8	29.8	55.6
Eyafiord, ... 66°	32	20.8	45.5

The mean temperature of Reykiavig is consequently equal to that of Norway of equal latitude, and 4.5° higher than that of Umeâ.

The winter is 6.8° milder than at Drontheim, and 15.7° milder than in Umeâ, but then the winter is of much longer duration, for during five months (November to March) the mean temperature is below freezing point. The mean temperature of the summer in Reykiavig is 3.3° lower than at Drontheim, and not quite so high as in Umeâ.

The climate of Reykiavig is still milder compared to that of North America, particularly the interior part; for at Nain in Labrador, situated 7° more southerly, the annual mean temperature is 7.8° below the freezing point, and the winter 32.6° below the same. In Fort Enterprize, at the latitude of Reykiavig, in which Capt. Franklin wintered, the annual mean temperature, from probable calculation, appears to be 20° below the freezing point, and that of the winter —55.5° below zero.

But the results found at Eyafiord tend to prove that there is a great difference between the southern and northern part of Iceland, much more so than might reasonably be expected from difference of latitude.

At Eyafiord the mean temperature is 32°, about equal to that of the North Cape, notwithstanding Eyafiord is situated

*

5° more to the southward. Nevertheless this climate even becomes mild when compared to that of North America.

This considerable difference between the southern and northern part of the island is probably produced by the mountains which separate them, and by the *drift-ice*, which by a current from NE. is carried towards the east coast of Greenland, and from thence to the northern coast of Iceland, where it remains occasionally till the month of June or July, when it is carried in an easterly direction into the Atlantic ocean.

The atmosphere is rather damp and foggy, and the weather variable.

As above mentioned, the snow line in Scandinavia is lower towards the coasts than in the interior of the country and on the eastern side of the mountain chain, because the foggy and cloudy sky of the coasts prevents the snow from melting. In Iceland, exposed to the influence of the sea to a still higher degree than the west coast of Norway, the snow line might fairly be supposed to be lower, which in fact is the case, for it is met with at an elevation of 2666 to 3200 feet. All mountains covered with eternal snow and ice are in the Icelandic language called 'Jökler;' and such enormous masses of ice which descend into the valleys, are from their slowly proceeding motion called 'Skrid-Jökler,' synonymous to the Norwegian 'Jisbräer,'—i. e. avalanches.

The *Flora* of Iceland is nearly the same as the Norwegian. On the mountains the *dwarf-birch*, the little kind of willows, and the Iceland moss are common. Of trees, Iceland produces but two, the *birch*, and the mountain ash; and they attain no great height. The scantiness of trees cannot originate in want of heat, as trees are found both in Scandinavia, in Siberia, and in North America, in localities whose annual and summer climate is by far colder; the cause must therefore chiefly be attributed to the misty, damp sea air, the strong gales, and the variable weather. In Scandinavia also the frontier of forest-trees sinks toward the sea; thus no trees are found on the rocky coasts of Norway, and the pernicious influence of the sea air on trees may be traced on the west coasts of Jütland. These peculiarities in the climate, particularly the variable cold summer, prevent the cultivation of grain in Iceland, although it succeeds much higher to the northward, and under a more severe climate in Scandinavia. Our common fruits do not arrive to perfection, but cabbage is cultivated to a large extent, potatoes, turnips, radishes, and several other vegetables, succeed perfectly well.

The want of forests is made up by *drift-wood* floating towards the coasts, particularly the northern. The drift-wood consists chiefly of firs and birch, although trunks of trees growing in warmer climates, are frequently found, and it is supposed that this wood is partly brought, by a north-eastern current, from Siberia, where the rivers carry it down to the coasts; partly by the great current in the ocean (the gulf-stream) proceeding NE. from the gulph of Mexico.

The most important domesticated animals of the Icelanders are *sheep*, next to which the ox, the horse, and the goat. The horned cattle are a small breed, and so are the horses, which however notwithstanding are strong and nimble. Wild birds, particularly water-fowl, one of which, the eyder-duck, produces the highly appreciated eyder-down, are found in plenty. Although the reindeer was not introduced till last century, it now abounds in a wild state in the interior of the country. The polar bear, conveyed from Greenland on the drift ice, is an occasional visitor. The coasts swarm with *seals*.

Various species of the genus Brosmius, Cuv. (Torsk) salmon, and herring, are the most important fishes.

The Icelanders belong to the Scandinavian race of men. Their food consists chiefly of mutton and fish; bread is an article of luxury with them; also Iceland moss and several kinds of sea-weed (Söl) are eaten, and in some parts the grains of a kind of oats (Sandhavre, Melur) which is found both in a wild state, and cultivated here and there.

Färislands. A group of small islands, the largest of which are Suderöe, Sirömöe, Osterö, and Vaagöe, situated between 61° 30′, and 62° 30′ north lat. to the south-east of Iceland, and nearer Scandinavia. They are very rocky, and steep promontories rise 1066 to 2133 feet above the sea. To land on the island of Dimon, it is necessary to be hoisted on shore from the boat. The interior of these islands rises in terraces ('Hamre'), and terminates in lofty peaks ('Tinder') of which the highest are Slattaretind on Osteröe, 2880 feet, and Skiellingfield on Sirömöe, 2506 feet; coal and opal (a beautiful gem used for ornaments) are the most remarkable mineral products. The climate is that of islands; the winter is mild, the summer cold and damp, the atmosphere foggy, and the weather variable. The islands possess no forests. Of grain, *barley* only succeeds, and that even not always; turnips and potatoes thrive, but gooseberry and red currants never ripen. Agriculture of course is very trifling, and the chief occupation of the inhabitants consists in sheep grazing, and the manufacture of wool. Many are engaged in hunting wild birds, abundant on the rocks of the coasts; as the precipices however, are all very steep, the sport is extremely dangerous; the birds being caught in a little net attached to a pole. The bird catchers sometimes allow themselves to be lowered by a rope down the perpendicular rocks. Eyder-down is also collected. The fishery is rather considerable; the most important fish is the 'Grind,' a kind of dolphin, which however frequently absent themselves from the coast.

Shetland and *Orkneys.* These two groups of islands are situated SE. of the Färislands, towards Scotland (between 58° 30′ and 61° north lat.) They evince great similarity to the latter island, yet they are, particularly the Orkneys, less rocky, and their rocks, chiefly sandstone and slate, are of a less sharp form. They produce no trees, and agriculture, (chiefly barley and oats) is insignificant.

The British Isles. (Great Britain and Ireland) between 50° and 58° 30′ north lat. Both are of greater extent from N. to S. than from E. to W., and are consequently of an elongated shape, yet the length is proportionally greater in Great Britain than in Ireland. The length of Great Britain from N. to S. is 550 miles, that of Ireland 280; the breadth of Great Britain varies from 60 to 280 miles; that of Ireland from 80 to 160. Although the sea cuts many friths into the west coast of Ireland, yet the general outline is pretty regularly rounded, whereas in Great Britain, in consequence of her many bays, the breadth is very variable, and in Scotland those bays (friths) are very narrow and deep. On the west coast of Scotland, and between England and Ireland, are found numerous islands, although none of considerable size appear on the west coast of Ireland, or the east coast of Great Britain.

Scotland, or the northern part of Great Britain, is divided by two natural lines of demarcation into three parts, viz., the Highlands, the Midlands, and the Lowlands. The one of these lines is formed by two deep friths, Murray Frith and Loch Linnhe, a number of elongated lakes, Lock Lochy, Lock Ness, &c. and by the Caledonian canal, all of which rise but little above the sea, and form a ditch as it were, from NE. to SW. separating the Highlands from the rest. The other line of demarcation, running more towards E. and W. is produced by the Clyde and Forth, and by an intermediate low tract of country, through which is cut a connecting canal. In all three parts of Scotland are found mountain chains from SW. to NE., viz. two in the Midlands, one in the Lowlands, and a fourth in the Highlands. The NE. coast of the Highlands is rather flat, and the higher parts are situated towards SW. where Ben Vyvis attains a height of 3733 feet.

The northern chain, in the Midlands, is called the Inverness mountains, among which Ben Nevis, 4373 feet, is the highest in Great Britain. The second chain is called the Grampians, among which Cairngorm is 4053 feet.

Both of these chains, generally speaking loftier and steeper on the western side, are separated by a long lake, Loch Awe, by Rannoch Moor, and by the river Spey, consequently by a line running from NE. to SW. Less considerable are the mountains of the Lowlands, the direction of which is the same as that of the former, but whose north-eastern part, (Hartfell, 3306 feet) is the highest.

In England the mountains are completely thrown on the west coast, and appear in three separate portions; one in the northern provinces, where Hellwyln is 3000, and Skiddaw 2986 feet; a second in North Wales, where Snowdon attains a height of 3626 feet; and a third portion in the south-western part (Devonshire and Cornwall) where Dartmoor, 1813 feet, is the highest. The rest of England presents either hillocks, or is quite flat, which has caused the great number of canal communications between the most distant ports. Thus, for instance, the Thames is connected with the Irish channel.

The least connected are the mountains in Ireland, where they, generally speaking, appear near the coasts, whereas the interior of the island is either hilly or quite flat. A flat tract runs across the country, from Dublin to the Bay of Galway, which has nowhere an elevation exceeding 320 feet, and where, in consequence, a canal has been cut. To the highest points in Ireland belong Macgillycuddy's Reeks, 3413 feet, and Nephin, 2666 feet.

From this statement it will be perceived that the mountains of Scotland are higher than those of England; but they all fall short in height compared to the mountains of Iceland

and Scandinavia. As in Scandinavia, the mountains in Great Britain rise, generally speaking, on the west coast, where they are very steep, remarkably so in Scotland; in Great Britain, however, there are many isolated masses of mountains; in Scandinavia there is but one continued. In consequence of the westerly situation of mountains, the larger *rivers* have generally speaking an easterly direction, instances are afforded by the Thames, Ouse, Trent, Tyne, Tweed, Tay, and Spey. The Severn indeed empties its waters on the west coast, but it must be borne in mind its source is on the eastern side of the Welsh mountains. The Clyde, on the contrary, runs from E. to W. Ireland possesses but one large river, the Shannon, which flows through a part of the above mentioned flat transversal tract of country, and whose mouth is on the west side.

Ireland and Scotland abound with extensive *lakes* (Erne, Neagh, in Ireland; Loch Lochy, Loch Ness, Loch Lomond, in Scotland;) whereas England possesses no lake of any extent.

Scotland consists chiefly of primitive rocks, and has, with the exception of the southernmost part but little lime, in which respect this country is like Norway. Primitive rocks are found in the eastern part of England, but it consists otherwise of 'Flöets' rocks, and more recent formations, abounding with lime, particularly in the southern part. In Ireland primitive rocks appear, as well as more recent formations. In some of the Hebrides, on the west coast of Scotland, and on the northern coast of Ireland, appears basalt, which in many places forms pillars, and occasionally picturesque grottos (Staffa, Giant's Causeway.)

The products of the greatest importance in England are the coals, which are found chiefly in the northern provinces, in the central part, and in South Wales. Tin and copper mines are worked in Cornwall; lead and other metals occur also.

The following table will afford a notion of the climate of the British Isles :—

		Annual.	Winter.	Summer.
Edinburgh, ...	56° north lat.	47.75°	38.75°	57.8°
Dublin, ...	53° 30′	48.87°	39.8°	59°
London, ...	51° 30′	50°	38.75°	61.2°
Penzance, ...	50°	51.12°	42.12°	60.1°

The annual mean temperature of Edinburgh is but little higher than that of Copenhagen, but the winter is 7.85 warmer, whereas the summer is 57.6° colder; Edinburgh consequently partakes much more than Copenhagen of an island-climate, (which indeed might be anticipated from the locality of these two cities,) and this generally speaking holds good with all the British Islands.

The difference between summer and winter is less in Dublin than in London, which is situated farther distant from the influence of the sea; but the difference between the seasons is particularly small in Penzance, in the south-western extremity of Great Britain, where the mean winter temperature is equal to the mean temperature of the month of April in Copenhagen, and yet the summer temperature is not higher than that of Stockholm.

The *climate* of the British Isles is very damp and rainy, and a hazy and cloudy sky is much more frequent there than on the continent. The quantity of *rain* from a mean number of observations in many localities may be fixed at 23 inches on the east coast, and 39 inches on the mountainous west coast, in single places this quantity increases to 60 inches, or more. The number of rainy days also (the snowy of course included,) is very great; thus 208 for Dublin, 178 for London, while the number in Copenhagen amounts to only 134. The greatest quantity of rain falls in summer and spring. Snow falls in less quantity than in the same latitude on the continent; in the south-west of England and Ireland it seldom remains for any length of time. Perpetual snow of any consequence, does not appear, because the mountains are not sufficiently lofty, and yet on Ben Nevis, Snowdon, and others, the snow remains the greater part of the year, and single spots are covered even during summer.

In Scotland the forests consist chiefly of *fir* and *birch*, also *oak*, and in the most southern part *beech*. Edinburgh (59°) may be laid down as the northern frontier of the latter tree,* which consequently does not extend so far north as in Norway, but still much farther than in the eastern part of Europe. Most of the Scottish mountains are without forests, and are moorlands covered with heaths. In England and Ireland *oak* and *beech* form the chief feature in the forest vegetation, and in the most southern part of England (to about 51°) appears also the chesnut. *Hazel* is common in either island. With regard to the Flora, the British Isles differ very little from the continent of the same latitude; in the Highlands the dwarf-birch with many of the Norwegian mountain plants appear. The damp climate, the mild winters, and cool summers, render in England the grass-vegetation conspicuous, and the verdure of the meadows luxuriant. Such plants as do not require beyond a certain degree of summer heat and sunlight to develop the finest properties of either fruit or seed, are in this country brought to high perfection; for instance, all sorts of esculent vegetables and fruits; but the more southern fruits never arrive at perfection in Great Britain. Thus in a latitude of 55° to 56° (the latitude of Copenhagen) walnuts and mulberries don't ripen, grapes fall green to the ground, and peaches are brought to perfection by artificial heat only. Nevertheless some difference in this respect appears to exist between the east and

* Professor Schouw doubtless refers in this, and all similar cases, to the range of indigenous plants, see page 418, where he speaks in doubt of the forests of the north of Germany, many of them being plantations. Beech trees have however been extended in Scotland at least as far as Elchies in Strath spey.---Ed.

west side. In the south-west peninsula of England (Cornwall, 50° to 51°) neither apricots nor grapes arrive at perfection, and yet, in consequence of the mild winters, myrtles, laurels, and other trees,* which do not thrive in a much more southern latitude on the continent, are found here in the open air. The effect may be traced even on the grain; the eastern part of England is much more calculated to ripen wheat than the western, for which reason a corn trade is in England carried on from east to west, while cattle are carried from west to east; and while wheat succeeds exceedingly well on the east side of Scotland, the northern part of the west side grows almost exclusively oats.

Wheat constitutes in England the predominant kind of grain, and the most common bread; *barley*, however, (for beer) and *oats* (for cattle) are also grown; *rye* is exclusively cultivated in the northern provinces.

The east side of Scotland produces *wheat* and *barley;* the Highlands and the west side, *oats.* In Ireland *potatoes* and *oats* form the chief objects of agriculture; wheat and barley are less common.

Although *Horticulture* is in some parts of Great Britain brought to the highest degree of perfection, this art is upon the whole not very common, because vegetables and fruit form no considerable items among the articles consumed by the mass of the people. Of fruit, apples and gooseberries in particular abound.

The breed of cattle is far advanced, particularly in England; the damp and temperate climate is, as before observed, very favourable to the enterprise and love of improvement innate in the British nation. Cattle, sheep, horses, swine, and in Scotland goats, are the common domesticated animals.

The wolf and the bear are extinct in Great Britain. Agriculture and grazing form the most important occupa-

* Camellia japonica, for instance.

tions of the inhabitants of the British Isles; but the situation of these islands, and the character of the people, have rendered commerce, navigation, and manufactures, of greater importance here than with any other nation.

North European Plain.—South of the Baltic, the North Sea, and the British Channel, appears an extensive tract of country, without mountains, which might be denominated the North European plain. Towards the south this plain is surrounded by several mountains, of which the Harz and the Weser mountains proceed farthest to the north; towards east and west, the mountains continue diverging from the coasts, in consequence of which the plain becomes broader towards east and west, than in the centre; still the Danish peninsula is situated exactly to the north of the Harz, and ought, from its physical condition, to be comprised under this plain, as well as the Danish islands, (Bornholm excepted) Rügen, and some smaller islands off the coasts of Holland and France. Towards the west the plain is circumscribed by the Atlantic; towards the east it is imperceptibly lost in the East European (Russian) plain. The river Niemen and the sources of the Dnieper and Dnister might represent the limits.

The western part of the plain is situated between 46° and 49° north lat. (the west coast of France); the central between 52° and 58° (from Harz to Skagen), and the eastern part between 50° and 55° (from the Carpathian mountains to the mouth of Niemen.) The plain consists of Northern France, Belgium, Holland, North Germany, Denmark, Prussia, and Poland. In some parts the sea forms extensive bays, as Zuidersee,* Lümfiord,† Pommersches-Haf,‡ Frisches-Haf,§ Curisches-Haf.|| Although this tract of country is flat, and upon the

* At the estuary of the Rhine, † and the entrance of the Baltic.

‡ The estuary of the Oder, § and the estuary of the Weichsel, || and of the Neimen; Fiord and Haf, being equivalent to the English terms Frith and Bay.—Ed.

whole uniform, yet it is not so altogether. In the north-western part appears a ridge (Montagnes d'Arrée) of about 523 feet mean height (highest point 1013 feet) which is followed by a tract of hilly country (north of France and Belgium) and towards the southern part some low ridges appear, as Côte d'or, Plateau de Langres, the Ardennes, the mean altitude of which is from 853 to 1066 feet, and no where beyond 1813 feet. Farther to the eastward is quite a flat district, partly below the level of the sea, and therefore protected by dikes, consisting of Holland, East Friesland, north of Hanover, and the west coast of Holstein and Slesvig; after this again a somewhat hilly country appears—Denmark and the southern coasts of the Baltic. The highest points are Himmelbjerg (Jütland) 544 feet; Aborrebjerg, (Möen) 476 feet; Veirhöi (Sjelland) 395 feet; Stubbenkammer (Rügen) 576 feet. To the south of the hills, forming a dike as it were to the Baltic, is spread the great North German sand district (Hanover, Brandenburg) whose highest points are Golmberg, 592 feet; Duberow Berg, 472 feet; upon which follows another ridge between the Vistula and Niemen along the Baltic, whose mean height is 373 feet, and where Hasenberg rises, 633 feet above the level of the sea; to the south of this ridge, plain varies with hilly country.

The plain is watered by several extensive *rivers,* as Loire, Seine, Rhine, Weser, Elbe, which pour their waters into the Atlantic and the North Sea; Oder and Weichsel (Vistula) whose mouths are in the Baltic. The sources of the Rhine are the Alps; those of the rest are the central European mountains. *Lakes* occur in Holland, Holstein, Sjelland, Meklenburg, and on the Prussian ridge.

Although naked rock appears in single spots, as primitive rock in Montagnes d' Arrée; lime in the north of France and Belgium; gypsum at Segeberg and Lüneburg; chalk at Möen, Rügen, and other places, yet such instances are exceptions, for generally speaking the plain in question is covered by strata of loose earths, particularly sand and clay, which in most places contain loose stones of considerable size, or, as they are called, boulders. The strata themselves appear to be formed by a universal deluge, and the boulders to be carried from the nearest mountains, particularly the Scandinavian. The turf, a production still forming, is very common, particularly in Holland, the NW. of Germany, and Denmark. Amber is thrown upon the coasts of Prussia and the west coast of Jütland. Mines of course are not to be expected in this tract of country.

The mean temperatures will be perceived by the Table.

	Latitude.	Annual.	Winter.	Summer.
Paris,	49° north lat.	51.12°	38.75°	64.6°
Hamburg,	53° 30′	47.75°	32° ...	63.5°
Copenhagen,	55° 30′	46.62°	31.9	63.5°
Berlin,	52° 30′	46.62°	31.9	64.6°
Königsberg,	54° 30′	43.2°	26.4	60.1°
Danzig,	54° ...	46.62°	31.9	64.6°
Warsaw,	52° ...	47.75°	29.8	68.°

By comparing these mean numbers among themselves, and by what has been stated before under the head of British Isles, it will be perceived that the mean temperature decreases, and the difference between the seasons increases, towards east, and with the distance from the sea. At Copenhagen, the same latitude as Edinburgh, the winters are 7.85° severer, but the summer heat exceeds that of Edinburgh by 5.76°. Warsaw, 3° 30′ more southerly than Copenhagen, has severer winters than the latter city, but the summer heat is greater than at Paris, situated 3° more southerly.

The difference between summer and winter at Warsaw is 38.2° at Paris 26.8°, and in London 22.45°. Berlin, 3° more southerly than Copenhagen, but much more distant from the influence of the sea, has nearly a similar temperature.

*

The quantity of rain is less on the continent than in Great Britain; it may fairly be fixed for Holland at 25½ inches.

North of France and Belgium, ... 22 „

Denmark, north of Germany, and Prussia, 20 „

Westerly winds prevail all over the extensive plain, which is also the case in Great Britain, but this preponderance decreases towards the East, and the westerly winds are more prevalent in England than in Denmark, more frequent there than in Russia. This is particularly the case during summer, but during winter on the continent the easterly winds are as frequent as the westerly, which is also to a certain degree the case in Great Britain. In most places the easterly is the most common spring wind.

The forests of the north of France and Belgium consist chiefly of *oak* and *beech*, as also in Denmark, and on the coasts of the Baltic. As for Denmark and the neighbouring parts of Germany, beech decidedly predominates, and appears to thrive better than in any other country. The sandy North German plain produces *fir* and *birch*, many forests however are plantations. In the eastern part of the plain (Poland) pines as well as broad-leaved trees are found, as also some remains of the huge aboriginal forests, particularly on the frontier of the Russian plain (Lithauen). The *beech* there does not quite reach the northern frontier of the plain, for it ceases at 53°, whereas in Norway it still grows at 59°. No less remarkable is the large tracts of the North European plain covered with *heather* (Erica), the largest of which is a zone extending through Hanover and the centre of the Danish peninsula.

An extensive plain like this, with a temperate climate, must be well calculated for *agriculture*, for which reason this, as well as the East European plain, may with propriety be looked upon as the granary of Europe. The different sorts chiefly cultivated are *wheat*, *rye*, *barley*, and *oats*. With the exception of France and Belgium, where white bread is common, rye bread is the most universal. Barley is particularly consumed in brewing beer, which is the common beverage, except in the NW. part of France, where cyder (cidre) is used, and in that part of central France, situated to the south of the vine-frontier. Also *buck-wheat, potatoes,* beans, and peas, are much cultivated as important articles of food. *The North European fruits,* apples, prunes, cherries, pears, are common; the more southern fruits are apricots and peaches; the latter however are only brought to perfection by artificial means. The cultivation of *hemp* and *flax* is important, particularly in the eastern part of the plain.

The *domesticated animals* are, horned *cattle* (particularly in the marshy countries) *horses,* (are of a strong breed, in Normandy, Holstein and Jütland) sheep and swine. Goats are scarce, as they are more calculated for mountain pastures.

Of *wild beasts,* stags abound, which is also the case on the British Isles, whereas they are rare in the Scandinavian peninsula, and even there they are confined to the southern part. In the eastern part (Poland) are found elks, bears, wild hogs, and the European bison (Urus); in the central part the hamster (Cricetus); but hares, foxes, and wolves are numerous all over the plain; the latter are however extinct in Denmark. The inhabitants are chiefly engaged in agriculture and grazing cattle; but there are some manufacturing districts, as Belgium; and owing to the great extent of the plain an inland trade, particularly in the eastern parts, is flourishing. The inhabitants of the coast, are chiefly occupied in fisheries and navigation.

[To be continued.]

Remarks on the Moschus Memina. *By* Lieut. S. R. Tickell.

Geoffroy's Cuvier, *Memina* (Knox's Ceylon), *Tragulus Memina* (Boddaert), *Indian Musk* (Pennant), *Chevrotain á peau de marquét laches blanches* (Buffon) *Mügee* (in Hindustani) (Yär Kole), *Gandwa* (Oaria.)

The present drawing was taken from a stuffed specimen which I had previously kept alive for several months.* It was brought to me when quite young, and about 9 or 10 inches long, by a Kole woman, who, while gathering sticks in the jungle had surprised a pair of them among some rocks, and secured one in a basket, which she threw over the animal before it could escape. The other dived under the rocks and was lost.

Its disposition was tame and unsuspecting, and it was easily reared by suckling a goat, which it learned to do without difficulty until strong enough to shift for itself, when it readily ate Doob, and other sorts of grass. It was playful at times, especially during the cool of the mornings, frisking about like a kid, but did not show the agility possessed by other kinds of Deer. The stride of the animal is limited from the great curvature of the back, the legs appearing drawn together or tucked under the body. During the heat of the day it remained concealed dozing behind some box, and towards evening its faint plaintive bleating might be heard ere it emerged in quest of food. Sometimes when being patted or played with, it emitted a different tone, like the grunting of a rabbit.

* Lieut. Tickell has not favoured us with the drawing alluded to, disappointed no doubt with our Calcutta lithographies of subjects of this nature. Even a bad impression is perhaps better than none, especially of objects that have not hitherto been faithfully figured. If our native artists are ever to be improved, it must be by bold examples of drawing, such as Lieut. Tickell's. Under these circumstances we trust that we shall be occasionally favoured with his spirited sketches, while we promise to devote more attention in future to this very essential department of a Journal of Natural History.—Ed.

This and two other specimens I have seen (one of which I kept alive in Chota Nagpoor) were all too young to show the long canine teeth which, according to Geoffroy, project considerably beyond the upper lip. In these, the canines were short and triangular, and entirely concealed. The hoofs are extremely narrow, hollowed or scooped underneath, and the animal walks entirely on their tips, this gives the legs a rigid appearance—the only way I can account for the erroneous idea prevalent among the Hindoos, that it has no knee-joint, and in resting leans against a tree. The teeth are thus arranged: in the *upper jaw*, incisors 0, canines 1, molars 6, on each side. *Lower jaw*, incisors 4, canines 0, molars 6, of a side. The front incisor is broader at the edge than the root, the other three being pressed together, narrow, and sloping outwards. The molars are trenchant, (at least the two foremost ones) unlike those of ruminants in general; but being unable to examine the teeth well, without spoiling the skin of the only specimen I now possess, I must wait for another opportunity to describe the skull more fully. The eyes are large and prominent, apparently best fitted for a subdued light. The fur is finer than that of deer in general. The tail is not above an inch long, and concealed by the hair of the haunches. There is no lachrymal sinus in front of the eyes, which peculiarity together with its being destitute of horns, is the generic trait separating it from Cervus (the deer proper.)

The Memina is found throughout the jungly districts of central India, but from its retired habits is not often seen. It never ventures into open country, where its want of speed would insure its easy capture, but keeps among rocks, in the crevices of which it passes the heat of the day, and into which it retires on the approach of an enemy. In these the female brings forth her young (generally two in number) at the close of the rains, or the commencement of the cold season. The male keeps with the female during the rutting season (about June or July), at other times they live solitary.

An idea prevails among the people in Singboom, not altogether void of probability, that at the season of the fall of the leaf, the "Yar" never ventures beyond a few yards from its cave, as in walking along it sticks its sharp pointed hoofs through the fallen foliage, which accumulates in such bunches on its legs, as to cripple its movements altogether, should it prolong its rambles.

The young are about the size of a large rat, and the adult animal does not exceed in bulk a full grown jack hare. The body is thick and heavy in proportion to the legs, which are exceedingly delicate and taper. The fur above is olivaceous, each hair being ringed with dark-brown and tawny. The throat, lower parts, and inner sides of the limbs are dull white. From the jaws a pale stripe extends in a broken line along the neck and sides, with several longitudinal patches of the same colour above and below it.

Remarks on a species of Berōe. By J. MACPHERSON, ESQ. *Assistant Surgeon, Bengal Service.* Plate xi. figure 2.

On the 29th of February, 1840, latitude 40° south, longitude 31° 14′ east, the "Jumna" sailed through several patches of discoloured water, the brownish colour of which was ascertained to depend on the presence of a number of minute Acalephæ. On examination, their organisation was found to be uniform. The animal consisted of a transparent gelatinous bag, nearly one inch in length; at one end round and closed, with two tentacula; at the other, having an aperture with rounded lips, which alternately contracted and dilated. The open extremity moved first, so that the tentacula always remained in the rear. Near the closed end there was a slight circular constriction, within which was seen a double row of whitish yellow points, forming almost a complete circle, in the centre of which, was a small yellow body divided into three arms. Two transparent folds (with something like a canal at their free borders) extended internally from one end of the animal to the other. About half a dozen circular lines constricted the sac slightly at regular intervals.

About two hours after their capture, the yellowish central mass began partially to evacuate itself gradually through the open extremity, and a few hours afterwards the double row of yellowish points began to disengage itself, and escape through the same opening. It immediately began to move about with a lively vermicular motion, the whole mass moving as one body. A few hours afterwards it began to separate, and it became evident, that the double row was merely an aggregate of independent globules. In a few hours more, the globules had all separated from each other, and increasing rapidly in size, resembling the parent animal in every respect, the tentacula alone not being developed, and the size of the young animal being only about a sixth of that of the old. In less than thirty-six hours after their capture all the Acalephæ died.

I examined about eight of these Acalephæ, and in all, the same process took place. It is difficult to say what the object of the previous partial evacuation of the yellow central body could be. It was also difficult to determine in how far the powers of the parent animals were impaired by the act of reproduction, as the whole mass died so soon. They certainly moved about with less vigour. The young animals must have developed themselves very rapidly, for when the double row of globules was at first examined with a pretty powerful magnifying glass, it was impossible to discover their structure. The animal showed no trace of phosphorescence, and did not possess any stinging power.

Description of the figures; 2, Plate xi., a. the animal as it appeared when caught, with its circular transverse bands, d. the lower end with the aperture, e e the tentacula of the upper end, b. the animal after the evacuation of the double row of globules, c. the young animal.

Remarks on Miscellaneous Subjects. *By* J. McClelland.

I. *On a species of Aphis destructive to indigo*, Pl. xi. fig. 1. —In the Jessore district, we have been informed that the indigo this year suffered severely from a blight; we have not heard whether this has been general, or if it has only been confined to particular lands, nor have we had any particular account of the period at which the blight appeared, or the kind of weather that preceded it. The river, however, we know to have been unusually high, and to have done considerable injury to crops situated in low grounds, from which we should infer that it was the higher lands that suffered from the blight, the inundation being sufficient we should suppose, to account for any injuries that could happen to the plant in low grounds. Having been informed that an indigo plant in Mr. Thomas's garden, in Park Street, was affected in a manner exactly similar to that of a considerable proportion of the indigo crop in Jessore and the Midnapore districts, I visited the garden, and found a single indigo plant in the midst of a shrubbery having all its leaves, particularly the younger ones, puckered and drawn together like the frill of a cap. To common observation this appeared to be the effects of blight, but as no other plant in the shrubbery was affected in the same manner, it at once became apparent from this, that the injury was occasioned by some insect; and on minute inspection, the larvæ of a species of *Aphis*, or rather *Gallinsecta* of Degeer (since they appear to have but one articulation in the tarsus) was seen. Fig. 1, plate xi. is a magnified representation of the insect in its nymph stage; its natural size is little larger than the point of a pin. The perfect insect I have not seen, but among the Aphides the larva is said to differ but little in appearance from the parent. To the naked eye the larvæ appear to be contained in a minute hairy secretion deposited on the upper surface of the leaf, causing it to contract and curl up, and the plant to wither. The larvæ are inactive, hardly perceptible, and in searching for them the nymph, or insect in its second stage of development is seen running over the leaf; it is of a grey colour, and covered with hair or down. Fig. 1, *a*. Pl. xi upper part of the body shewing the elementary elytra. Fig. *b*. lower portion, with the oral orifice between the insertion of the first and second pair of feet; *c*. one of the antennæ which has six articulations, the last of which is, longer than any of the others except the first, terminates in a hairy point; *e*, anterior leg of the right side; *f*, middle, and *g*, posterior leg of the left side. The tarsi have but a single articulation terminated by a minute hook, and the body, elytra, and limbs are fringed, the latter irregularly, with tufts of bristles.

These insects do not destroy indigo by perforating the leaves, but by causing their contraction into folds, apparently for the retention of moisture after rain or heavy dew, which seems to be essential to the larvæ. I have collected several specimens of this insect, which I shall place in the hands of some eminent entomologist, so that any further description or attempts to identify it from me would be unnecessary. It is we may remark, quite different from the turnip fly described, p. 299, by Dr. Pearson, which also appears to be another insect destructive to indigo.

II. *Remarks on Delphinus Gangeticus*, Roxb.—There was a good opportunity afforded for collecting information regarding the several peculiarities of the Gangetic dolphin on the recent destruction of the sunken hull of a ship by gunpowder, effected by Capt. Fitzgerald of the Bengal Engineers. A column of water was thrown up to a considerable elevation by the explosion, and with it, a considerable number of fishes and other animals; amongst the rest, two fine specimens of the Gangetic dolphin, which have since been preserved by Colonel Powney. About forty years ago, Dr. Roxburgh described for the first time a male specimen, since then no further information has been collected regarding this interesting species, and unfortunately the two preserved by Colonel Powney, (the female in particular,) are so injured by the manner in which they are prepared, as to render it difficult to glean much information from them.

The Cetacea, of all animals, are those which exhibit the widest range of analogies with other classes. Their form, and the element they inhabit so closely correspond with those of fishes as to induce ordinary observers to consider them as belonging to that class, and to regard it as an absurdity in naturalists to place them in any other. From the fact of their living in the ocean and the large rivers, in which their motions are performed by fins, it is difficult to conceive that they present a skeleton corresponding with that of Mammalia, that the pectoral fins present an *os humerus*, a *radius* and *an ulna*, bones of the *carpus* and *phalanges* of the fingers, the latter corresponding both in the number of fingers and articulations with the bones of the human hand. Nor can ordinary observers, unacquainted with natural history, be made to understand, without a doubt as to the credulity of naturalists, that these animals which though consigned to inhabit the ocean, breath elastic air by means of nostrils and lungs, the same as land animals, and like them would be drowned if prevented from rising above the surface to respire. The male Gangetic porpoise is five feet in length, the female about eight inches shorter, and is every way proportionally more slender ; and this is almost the only information we can derive from the two specimens before us that has not been given in Dr. Roxburgh's description of the male. There is however much to be yet learnt regarding the structure of both sexes of this species, for which fresh specimens would be necessary. They are seldom caught, but should this happen again by any accident, we trust the opportunity of supplying many interesting questions connected with their organization, will not be lost sight of.

III. *Ophiocephalus Barca.* Buch. We have been favoured by C. D. Russell, Esq. of Rungpore, with two specimens of this species of fish, together with some very interesting particulars regarding its habits.

Buchanan, who but few things have escaped, remarked that this species which he found in the Bramaputra river near Goalpara, inhabits holes, dug like those of the *martin,* that is, a kind of swallow, *(Hirundo,)* in the perpendicular banks; in these he says it lurks watching for its prey with its head out, and notwithstanding its strong variegated colours, it is an ugly animal.* We have long been familiar with this species, which is common throughout Bengal, but we were never so fortunate as to see it on a high bank overlooking the waters, or comfortably enjoining the fresh breeze, with its head projecting from a bird's nest. Indeed there are no high banks for the enjoyment of either birds or fishes in Bengal. Hence perhaps, according to the following account (which has been published in the Journal of the Asiatic Society of Bengal, 1839, p. 551) this species appears to visit Boutan, we presume for the benefit of the mountain air.

"*On the Bora Chung, or Ground Fish of Bootan.*

"*To the Secretaries to the Asiatic Society.*

"Gentlemen,---The following account of the *Bora Chung,* or as it may be called, the Ground-Fish of Bootan, is so extraordinary, as to be worthy I think of the attention of the Asiatic Society, for so far as I know it is new. I am indebted for it to Mr. Russell, of Rungpore.

"The Bora Chung is a thick cylindrical fish, with a body somewhat like a pike, but thicker, with a snub nose, and grows from three pounds weight, to a length of two feet. The colour is olive green, with orange stripes; and the head speckled with crimson spots. It is eaten by the natives of Bootan, and said to be delicious.

"The Bora Chung is found in Bootan, on the borders of the Chail Nuddee, which falls into the river Dhallah, a branch of which runs into the Teestah at Paharpore. It is not immediately on the brink of the water, however, that the fish is caught, but in perfectly dry places, in the middle of a grass jungle, sometimes as far as two miles from the river. The natives search this jungle till they find a hole, about four or five inches in diameter, and into it they insert a stick to

* Vide Gangetic Fishes, p. 67, fig. xxxv.

guide their digging a well, which they do till they come to the water; a little cow-dung is then thrown into the water, when the fish rises to the surface. Mr. Russell has known them to be from six to nineteen feet deep in the earth.

"Mr. Russell describes their other habits as not less curious. They are invariably found in pairs, two in each hole; never more nor less. He has not met with any less than three to four pounds; but as before said, they grow to the length of two feet. He has seen them go along the ground, with a serpentine motion, very fast, though the natives say they never voluntarily rise above the surface. In some places they are very common, and live a long time when taken out of the water, by being sprinkled over occasionally with that fluid. One which Mr. Russell thinks to be the female, is always smaller, and not so bright in colour as the other.

"I regret this account is so imperfect, especially as I have seen the fish, for when I was at Titalya in March last, Mr. Russell very kindly sent me two of them. Unfortunately I was on the eve of starting with my family for the hills, and in the bustle of packing up, I had not time to examine them, intending on my arrival here to describe, and preserve the specimens for the Society. And still more unfortunately, I was unable to convey them up here, having been for want of carriage obliged to leave even many of the necessaries of life behind. Mr. Russell undertook to bring them with him; but one of them died and was thrown away in the plains, and the other made its escape from the vessel in which it was confined at Punkahbarry. He has promised to procure other specimens, so I hope soon to have the pleasure of sending some to the Society's Museum."

"J. T. Pearson."

"Dorjeeling, 10*th July*, 1839.

Through Mr. Russell's kindness we have been enabled to identify the Bora Chung, or Ground-Fish of Bootan, with *Ophiocephalus Barca*, and it will be seen how fully Buchanan's account of its habits correspond with that of Mr. Russell, as given by Dr. Pearson. We are not yet fully prepared to form an opinion on this subject, but we have long been desirous of arranging the result of our observations on the *Ophiocephali* of India, and when an opportunity for doing so arrives we shall endeavour to elucidate this curious habit in one of the species. In the meantime if any of our readers could favour us with details regarding the habits of any of the other species of the group, we should feel greatly obliged. With regard to *Ophiocephalus gachua*, another member of the same family, Buchanan observes that it is very common in the ponds and ditches of Bengal, and is one of those fishes which are supposed to fall with rain from heaven. In fact with the first heavy showers of the season, it has often been seen leaping and wriggling in the grass; and by both natives and many Europeans is supposed to have fallen with the rain. I have, however, no doubt, says Buchanan, that the animal when thus discovered has been in search of a more commodious abode. During the dry season, he continues, it has suffered much from being pent up in half putrid water, so that when the first heavy rain falls, it is eager to enjoy the grateful supply of fresh-water, and wriggles among the moist grass in search of more room, and of the food which must have been nearly exhausted in the pools that it formerly occupied. We have here given a figure of *Ophiocephalus Barca*, 3, Pl. xi.

They are very abundant in the plains of Bengal, but except in the curious instance brought to notice by Mr. Russell, we never knew them to inhabit mountains, but perhaps the Chail river, in the vicinity of which Mr. Russell found them, is not much above the level of the plains.

IV. *Stone and Marble quarries at Mirzapore.*—We have been favoured with a small box of geological specimens by Mr. Hay Stewart of Mirzapore, consisting of lithographic stone, roofing slate, flag stones, marble slabs, limestone, common serpentine, iron ore, and coal, from the hilly districts adjoining Mirzapore. We are happy to find that Mr. Stewart intends to open quarries of the above useful stones, and we trust he will find sufficient encouragement to justify the first outlay, which must be considerable. The lithographic stone, flag stones, and marbles, we should think would afford a handsome return; the former in particular, as the stones now in use are imported from Europe. The sandstones are particularly well adapted for pavement, and from the numerous variety of colour, from flesh red to yellow, grey, white, and mountain green, are particularly well adapted for ornamental floors. They would, we conceive, be next to marble in appearance, and almost equal to it as a remedy for damp floors. The beds of flag stones are naturally fissile, splitting easily into large broad flags like the lower beds of the old red sandstone, or Yorkshire paving at home. These flagstones are in fact identically the same as the flagstones of Yorkshire and South Wales, the peculiarities of which shall be pointed out in our next notice of Mr. Murchison's work. The economical value of these stones for paving, flooring, and roofing, will we trust secure for Mr. Stewart's undertaking a liberal encouragement. The specimens we have seen are cut into the form of tiles. The slate appears to resemble the old blue roofing slate, but it wants the metallic kind of polish of that variety; it appears however, as far as we can judge from specimens, to be sufficiently fissile for roofing purposes; and if so, Mr. Stewart will we doubt not find a large demand for it. A white soft earthy limestone or chalk, also occurs, which is the only instance we know of any mineral like chalk having been found in India; this article, as well as the limestone, will be useful in many branches of art, particularly agriculture, building, soap boiling, the reduction of iron ores, &c. The lithographic stones are grey, and reddish yellow, the latter is of course the best, for the nearer these stones approach to the colour of white paper, the better they are; for then the impressions are better seen on them. We hope Mr. Stewart, will be able to render us independent of Europe for an article of such increasing utility in India, for lithography is almost the only kind of printing here practised.

A very excellent black marble has also been found by Mr. Stewart, who, we hope will also succeed in finding quarries of other kinds, which will save us from importing an article at once useful and ornamental for various purposes from Europe, and we believe China. Nothing restricts the demand in India for marble pavements, baths, tables, and other articles of furniture and ornament so much as the exorbitant price attending its importation from distant countries, while India itself abounds in so many varieties of the most beautiful native marbles. To the above list of useful minerals we have to add, red and yellow ochre and coal. The latter is situated at some distance in the interior, near the village of Kotah, and is that which is referred to by Captain Wroughton in the notes from the proceedings of the Coal Committee;* the samples of this coal already furnished are very promising, though quarried by ignorant natives. The specimen contained in Mr. Stewart's collection of useful minerals is, however, a fair sample, of which the following is an analysis:—

Specific gravity, 1.29		
Inflammable matter, ...	54.	
Carbon, ...	32.2	
Earthy matter, ...	13.8	parts in 100.

Mr. Stewart remarks that the Government have already opened a road for a considerable distance into this new and valuable district; we trust the road will be extended not merely into it, but throughout the whole tract, and that it will be rendered fit for wheeled carriages.

* We have been compelled from want of room in our present number to postpone the publication of the paper alluded to, but we shall endeavour to insert it in our next.—Ed. Cal. Jour. Nat. Hist.

“*Official Correspondence on the attaching of Lightning Conductors to Powder Magazines.*”*

[Asiatic Society's Journal, No. 99, 1840.]

The papers under the above title, communicated to the current number of the Asiatic Society's Journal by Dr. O'Shaughnessy, embrace the discussion of a question of so much economical importance, and so vitally connected with the welfare of our community, that we have been induced to examine them in some detail, and under a sense of their general interest, we have ventured to place before our readers the following remarks upon them. The question of the efficiency of Lightning Conductors to afford the requisite protection to Powder Magazines during thunder-storms was brought under the notice of Government in consequence of the explosion of the Magazine at Dum-Dum, in June, 1836, from the effect of a stroke of lightning. The Military Board were accordingly directed to report “on the expediency or otherwise of attaching conductors to Powder Magazines;” and to aid themselves in forming a correct opinion on the point, they applied to Dr. O'Shaughnessy, and in due time received from that gentleman a report unfavorable to the employment of conductors as usually constructed and applied. The Government apparently desirous of obtaining the opinions of some of the eminent Electricians at home, forwarded the whole of the papers connected with the subject to the Court of Directors, by whose instructions they were submitted to Dr. Faraday, and Professor Daniell. The reports of these gentlemen are published in full, and will be found most interesting and valuable, embodying as they do the sentiments of two of the most eminent Electricians of the present age. Their remarks follow generally the course of Dr. O'Shaughnessy's original report (No. 2 of the series), and as this gentleman classes under three heads, his reasons for considering it inexpedient to attach ordinary conductors to Powder Magazines, we will first state these, and then follow Messrs. Faraday and Daniell in their comments upon them.

Dr. O'Shaughnessy's objections to the use of ordinary conductors on Powder Magazines, are,

1. Because being of slight elevation, of rounded surface, and of non-conducting materials, these buildings are scarcely more exposed to lightning, than an equal area of ordinary ground.

* This communication, which is authenticated, was received from a correspondent 17th August, 1840.—Ed.

2. Because a discharge may occur too great for the capacity of a single conductor, in which case the electricity will divide itself to all adjacent objects.

3. Because though the discharge may pass to the ground, the lateral electric disturbance may occasion an explosion within the Magazine.

Dr. Faraday coincides in opinion with Dr. O'Shaughnessy on the first point, remarking, however, that though Powder Magazines are certainly but little liable to be struck, yet if they are struck the consequent destruction and injury would be very great; and that though it is very probable that under certain circumstances a conductor may induce a discharge where no discharge would take place no conductor being present, yet he has the strongest conviction in his own mind that conductors well applied, are perfect defenders of buildings from harm by lightning. This opinion cannot but carry with it the highest authority, and the irresistible evidence of authenticated facts alone could induce us to adopt another.

To the second of Dr. O'Shaughnessy's objections Dr. Faraday scarcely alludes, though we feel warranted to infer from the language he employs in one part of his report that he admits its existence, since he states as one of his reasons for preferring conductors of copper, that "when struck it not only conducts the shock much better (than iron,) "but in the predetermination of the stroke it determines more of the "electricity to itself than would otherwise fall upon it, and therefore "in any case of a divided shock, tends to leave less to fall elsewhere "in the neighbourhood." The possibility of the division of the stroke is fully admitted, but no notice is taken of the opinion involved in Dr. O'Shaughnessy's statement, "that a discharge may occur *too great for the capacity* of the conductor, in which case the electricity will divide itself to all adjacent objects." The possible existence of division is specified, the case or origin of division left unnoticed. Is it established by satisfactory evidence that no such thing as a division of a lightning stroke prior to its impinging on a conductor takes place? Is it not possible that when a rod and an adjacent object are struck by the same discharge that the strokes are independent of each other? For instance, did Dr. Goodeve *see* the conductor on Mr. Trower's house part with its superabundant electricity to strike upon his own, or did the electricity which followed the course of his window bolts impinge directly upon them? It appears to us important to make this distinction, and as we have not yet seen any facts, bearing specifically upon it, we may be permitted to direct attention to it. If Dr. Goodeve did not *see* the electricity leave Mr. Trower's conductor, we scarcely think the conclusion that the electricity passing through it was greater in quantity than it was efficient to discharge, is warranted by the facts stated. Other facts advanced by Dr. O'Shaughnessy in his second report, appear to us decisive as to the possibility of a charge quitting a conductor after it has become engaged in it, but we conceive too much has been based on the solitary case, above alluded to, and there exist imperfections in the details, which it would have been preferable to have avoided. We are ignorant of the dimensions, the material, and the underground arrangements of Mr. Trower's conductors, so that we are at a loss to estimate fully and perfectly its efficiency, and to compare it with the standard conductors recommended by Faraday and Daniell. We feel assured however, we have only to express our sense of the imperfection of Dr. O'Shaughnessy's details, in this instance, to insure his furnishing us many future communications with the fullest information available.

With reference to the third objection specified by Dr. O'Shaughnessy, viz. the danger from the lateral discharge, Dr. Faraday conceives that with a well arranged conductor it would be so slight as scarcely to merit attention. He admits however that the existence of portions of metal, as bolts, bell wires, &c. within a building, may, by establishing imperfect conducting trains from the exterior to the interior, give rise to lateral sparks when the conductor is struck; and Dr. O'Shaughnessy has very correctly pointed to the copper linings of the powder barrels as furnishing such trains. The existence of these appears to us to add much to the force of Dr. O'Shaughnessy's third objection, since in a well stored Magazine, the quantity of copper is very great, and the reciprocal action between it and the charged conductor may certainly be of sufficient intensity to give rise to serious consequences. To do away with these metallic linings, would enable us to fulfil the conditions required by Dr. Faraday for the perfect safety of our Magazines, and we are not aware of their being so absolutely essential to the preservation of the powder from injury or accident, that it would be impracticable to substitute some non-conducting substance for them. Were this to be done, we cannot conceive any danger arising from lateral discharge, since the whole of the materials subjected to the inductive influence of the charged conductor would be non-conducting substances, and a solid mass of masonry, seldom less than four feet in thickness, would be interposed between the inducing agent and the inflammable matter. Having thus shewn that none of the objections stated by Professor O'Shaughnessy have proved sufficiently powerful to induce Dr. Faraday to alter his opinion as to the perfect efficiency of well applied conductors, we would only now record the concluding paragraph of the latter gentleman's report, as it condenses into a single sentence his sentiments on the question at issue. "In my opinion a good conductor, well connected with the earth, cannot do harm to a building, i. e. though it may induce a discharge on the building, the discharge in itself cannot give rise to any secondary effects which are likely to place the building in more danger than it would have been subject to had the conductor not been there."

We now proceed to submit to our readers an abstract of Professor Daniell's opinions on the subject before us, as they are detailed in his report on the papers forwarded to him. We feel ourselves constrained however before entering on this in detail, to notice the most unworthy tone Mr. Daniell has permitted himself to assume in commenting on Dr. O'Shaughnessy's statements. It is calculated to wound the feelings of those who cannot coincide in opinion with Mr. Daniell, and on the whole appears to us unnecessary in the discussion of a physical question. We can only express our hope, that in any future communication on the subject Mr. Daniell will lay aside that spirit of contempt for his opponent which betrays itself so frequently in the report before us. It is our duty however, in all frankness, to bring to Dr. O'Shaughnessy's notice, that while he has recommended Mr. Daniell to avoid Scylla, he has himself fallen into Charybdis, and has laid himself open to the same censure he has passed upon Mr. Daniell, since his reply to that gentleman's remarks gives evidence of an angry state of feeling, which it would have been well had he subdued. Unseemly personalities degrade science and its votaries much more than those who yield to them are aware of, and we notice them with regret.

To leave therefore this painful part of our subject, we find that Professor Daniell is so strongly impressed with the conviction of the protecting power of lightning conductors, that he would rather have them of inferior material, than be without them altogether. He quotes the case of the unprotected Magazine at Dum-Dum, as a proof that Magazines without conductors *may* be blown up by a lightning stroke, while there is no recorded instance of a properly protected building of this description having been struck. Dr. O'Shaughnessy certainly shews that the construction and location of the Magazine at Dum-Dum, were by no means those of a true Magazine, since it was a common square building, having large masses of metal in its vicinity. Such insulation as Dr. O'Shaughnessy claims for a properly constructed Magazine is seldom however, attainable, and we may safely say, that in a Fortress it never is so. Ordnance for the defence, ammunition, as shot and shells, tools, and materials, for the construction of which metal is so largely employed, must always be at hand, and in the case of an actual attack, these are usually concentrated in the immediate neighbourhood of the Magazines, so that *practically*, the Magazine at Dum-Dum, except in its form appears to us a fair representative of the class. That we are not now speaking unadvisably in this respect, the actual circumstances under which the Magazine in Fort William is at this moment placed, will prove. We have examined it with reference to the subject under discussion, and have found that it is closely adjoining to a yard in which upwards of a thousand feet of metallic boring rods with chains, guns, crabs, and large quantities of iron tools, have been constantly kept for the last four or five years. Some little distance in rear of it is another yard with large quantities of metal in it, and again a little way in rear of this is a large assemblage of iron guns. In the exposure to inductive influence Fort William Magazine appears to us not at all inferior to that at Dum-Dum, and though its elevation may be less, and its form more rounded, yet if the explosion in the one case is attributable to the presence of large quantities of metals, it seems not unreasonable to conclude that the safety in the other has been in some degree at least dependent on the presence of the conductor, which we have been informed has been attached to the building for eight years.

Dr. O'Shaughnessy's second objection is based chiefly on the circumstances attendant on the accident to Dr. Goodeve's house, as he states that this case seems to him to prove that occasionally in tropical climates; there is such a vast disproportion between the quantity or intensity of the atmospheric electricity and the conducting "capacity of conductors, that the excess must pass to adjacent bodies." This is a generalisation far too extensive it appears to us to be justified by a solitary fact, even if that fact were more favorable to it in all its attendant circumstances than that before us is; but we coincide in opinion with Mr. Daniell, that the case of Dr. Goodeve's house warrants no inference more extensive than that the excess of electricity quits the main conductor only to impinge on *metallic bodies;* other facts are necessary to warrant the wider conclusion that the excess quits the conductor to impinge on *all* adjacent bodies. The electricity striking Mr. Trower's conductor quitted it---if it quitted it at all (on which point the information afforded appears to us inconclusive)---to strike the window bolts only, and close induction will not admit of our inferring from this circumstance that a like result will happen if no bolts or other metallic fastening are present. Nor is Biot's opinion, that within sixty feet interval between conductors no accident can happen, falsified by the above fact; since the window bolts constituted an imperfect conductor within twenty feet, and no satisfactory conclusion on the point can therefore be drawn.*

* NOTE.—We have taken it for granted above that the distance of Mr. Trower's conductor from Dr. Goodeve's house has been correctly stated by Dr. O'Shaughnessy, but we acknowledge that considerable doubt on this point has been excited in our mind, and as in inquiries like the present, statements cannot be too rigidly scrutinised, we have thought it right to allude to the grounds of this doubt. In its present position Mr. Trower's conductor is we believe not less that 35 feet distant from the nearest part of Dr. Goodeve's house, and we cannot estimate its distance from the window at the corresponding angle on which the discharge struck at less than from 55 to 60 feet. Not having the means of verifying these distances by actual measurement, we regret much that the diagram alluded to by Dr. O'Shaughnessy has not been published, since from that, if it has been drawn to a scale, as every such drawing certainly ought to be, we might have satisfied our doubts immediately. Of course if there is so great a difference between the actual distances and that specified by Dr. O'Shaughnessy, as on good grounds we suspect there is, the whole course of his reasoning on the case of Dr. Goodeve's house is essentially vitiated, and the conclusions he has based upon it necessarily fall to the ground. It would be well if a drawing exhibiting correctly the relative positions of the two houses were to be prepared, as any inferences on the case would then be received with more confidence; but judging from our own acquaintance with the premises, we should be inclined to consider it next to impossible for the lightning to have quitted Mr. Trower's conductor to strike upon the window bolts, without leaving some indications of its course, as it must have traversed the venetians of the verandah part of the angle of Dr. Goodeve's house. And as we believe no such indications were given, we are very doubtful if there is any warrant whatever to be derived from this case for Dr. O'Shaughnessy's opinion, that occasionally "in tropical climates there is such a *vast* disproportion between the *quantity* or *intensity* of *electricity* and *the capacity of conductors*, that this excess of the discharge must pass to adjacent objects." The course of the lightning after impact on Dr. Goodeve's house was to be traced by the fusion of the ends of the window bolts, all of which we presume exhibited appearances like those represented in Dr. O'Shaughnessy's sketch, and some such undoubted evidence as this fusion affords is necessary, we conceive, to establish beyond dispute the true course of the lightning, since the dazzling effect of the accompanying flash, and the natural confusion caused by the discharge, must always tend to incapacitate an eye witness for giving a perfectly trustworthy account of an accident; and if but one individual witnessed the discharge, his opinion as to its having impinged on any particular spot must be received with considerable caution. Unless Mr. Trower's conductor gives some indication of the lightning having passed through it, we conceive Dr. Goodeve's assertion that the lightning struck upon it still requires confirmation.* On farther consideration of the circumstances of the case under discussion, it appears to us that so far from "falsifying" Biot's opinion, it is calculated to afford it signal confirmation. No accident whatever occurred in the interval between the perfect conductor on Mr. Trower's house and the imperfect one formed by the window bolts of Dr. Goodeve's, although the distance of the two was not much less than 60 feet; and as the only damage which happened arose from the want of metallic continuity in the path chosen by the lightning, we cannot but express our strong conviction, that had Dr. Goodeve's house possessed a well constructed conductor it would have escaped uninjured. This impression is strengthened from the efficiency of Mr. Trower's conductor, which though very far from being what we consider faultless in its construction, seeing it is of iron, and only about an inch in diameter at its base, was certainly the means of saving the house under its protection, by opening up a continuous path by which the lightning falling upon it might pass to the earth.

* Note by the EDITOR,—"Can you see lightning strike?" This is one of the questions discussed by M. Arago, who decides in the negative.—ED.

The objection based on the possibility of a lateral discharge, may at all times, Professor Daniell considers, be obviated by providing a conductor sufficiently capacious to carry off all the electricity falling upon it, and the standard size for this when made of copper, he states is one inch in diameter, experience having proved that no rod of this size was ever fused by an electrical discharge. He discusses the question of the attractive power of conductors, and decides, that though "a pointed conductor will draw off silently and safely a considerable portion of electricity from a charged cloud, it can possess no power of determining a disruptive and destructive discharge when it would not otherwise occur." In his comments on this passage, we conceive that Dr. O'Shaughnessy has misapprehended Mr. Daniell's meaning entirely, since this gentleman advances no such assertion as that a pointed bar *must* cause a silent discharge without explosion. He could not but know from historical records, that the whole range of our experience contradicts this, and the indications his report itself gives us of his close reasoning, convince us that Dr. O'Shaughnessy has here misunderstood him.

Mr. Daniell it appears to us means to state that a conductor directly opposed to a charged thunder cloud will draw off silently a portion of that cloud's electricity, but if the line of least resistance between the cloud and the earth does not pass through it, no disruptive charge will there take place. The conductor will diminish the quantity of electricity in the cloud, but it will not of its own attractive power determine the entire charge to itself. In this manner we can account for the circumstance stated by Mr. Faraday, that there is some evidence to shew that the number of discharges in any given locality is diminished by the presence of conductors, since these may often operate on charged clouds so as to diminish their electricity, and keep them under "*the point of discharge*," if we may use such a term for that point in the scale of electrical accumulation at which disruptive discharge takes place. That the conductor is not so completely passive as the water pipe which collects a portion of the falling rain, we think there are grounds for believing, and some attractive influence appears to be involved in the property possessed by copper conductors of "not only conducting the shock better, but in the predetermination of the stroke, or determining more of the electricity to themselves, than would otherwise fall upon them."

We cannot conceive such a property existing independent of some power of attraction resident in the body possessing it, and if copper attracts the electricity in some degree, as the above would imply, so must also iron attract it, though in an inferior degree. On this point however, facts are wanting to guide our opinions, and so much variety of sentiment in regard to it pervades the scientific world, that we would not be considered as expressing any decisive opinion on it. Dr. O'Shaughnessy has proposed iron conductors protected by zinc plates, but Mr. Daniell considers that this arrangement would not by any means be efficient in preserving the conductors from oxidation, and in this opinion we coincide, though we cannot but express a wish, that the suggestion be put to the test of experiment. Conductors are daily being erected in Calcutta; would it not be well to settle the point in question, by applying the zinc plates to them, and observing the result? We have now laid before our readers the sentiments of Mr. Daniell, and as before, would only farther record a single sentence of his report, in which these are condensed. "These two reports (referring to the instructions drawn up by a Commission of the *Academie Royale des Sciences*, and M. Arago's Report *Sur le Tonurre*) have really exhausted the subject, and ought to be sufficient in my opinion to convince the most prejudiced; first, of the impossibility of any additional danger arising from lightning conductors of proper construction; and, secondly, of the protection which they are competent to afford." It is thus apparent that there is an entire coincidence of opinion between Messrs. Faraday and Daniell as to the perfect efficiency of good conductors, when applied to Powder Magazines, and when to their testimony is superadded that of Arago, Harris, and Wheatstone, each a master in electrical science, we conceive our government would incur a fearful amount of responsibility, were it to allow any departure from a plan sanctioned by their favorable estimation, and tested by the experience of nearly half a century. The reasoning of Dr. O'Shaughnessy in favor of his own views, is ingenious, and the facts he has adduced are valuable; but to deprive our Magazines of the protection they now possess, on the authority of these alone, is a step we cannot believe government would ever take. Nor would we recommend the plan proposed by Dr. O'Shaughnessy (although theoretically we see no special objection to it) in supercession of that now in use, till it has experience to the same extent to plead in its favor, and some additional advantages to counterbalance the additional expense it involves. We entreat government to take no hasty steps in the matter, for an amount of human life and property is at stake, which might well make the boldest pause. Dr. O'Shaughnessy's own experience of the consequences of hastily reasoning from the model to the machine, will have prepared him for our caution in taking the minute results of experiments in the laboratory as the true exponents of natural operations. When we recollect that there is not one single recorded case of a properly protected Powder Magazine having been struck, and that the only facts on which our reasonings can be grounded are derived from cases of discharge on common buildings, in which, on Dr. O'Shaughnessy's authority we assert, that "all the circumstances differ so widely, that many of the most important of the facts and arguments which bear on one, are altogether inapplicable to the other;" we cannot be considered unreasonable in urging that no change should be made in the existing system till information more strictly applicable to the question at issue can be furnished us; meanwhile let the search for this be prosecuted with zeal and energy; let a list of the points specially to be observed during thunder storms be printed, and widely circulated over the length and breadth of the land; let a system of concentration for the information thus obtained be established by its being publicly announced that some party will receive all reports connected with the subject, and let government encourage the spirit of inquiry thus excited by instituting some experimental inquiries, on the large scale, so that results may be obtained commensurate with the acknowledged importance of the question; but till all this is done, our parting recommendation to the authorities, is, to leave the existing system in operation, till we have something more than minute experiments, and disputed reasoning to advance in favor of another.

Postscript. In his first report Dr. O'Shaughnessy makes several allusions to the accident which happened to Government House, on the 30th of March 1838, and as the peculiarities of this case give it an additional degree of interest, it is of much importance that all information published concerning it should be carefully authenticated. We have been led to this remark by finding it impossible to reconcile some of the statements made by Dr. O'Shaughnessy in his report with the information relative to the accident now in our possession. We may be permitted we trust to state "*in limine*," that in expressing our doubts of the correctness of the information collected by Dr. O'Shaughnessy we are actuated by no unkind or uncourteous spirit, but simply by a desire to arrive at the actual truth, and if Dr. O'Shaughnessy can satisfactorily authenticate the statements alluded to, we will gladly acknowledge the inferiority of our own information.

Dr. O'Shaughnessy in illustration of his opinion that fusion of conductors takes place generally, (though certainly not universally) only at the point of entrance and exit of the electricity falling upon them, gives a sketch of the appearance exhibited by the spear head of the Britannia on Government House, supposed to have been struck by lightning on the night of the 30th March 1838. Dr. O'Shaughnessy does not inform us of what metal this spear head was composed, but simply states it to have been metallic, and fixed on a wooden shaft. Supposing the spear head to have been struck, it is natural to suppose that as the discharge was sufficiently powerful to fuse the metal at its point of entrance, some similar indication of its intensity would have been given at its point of exit, and we would therefore expect to find this at the junction of metal and wood. We are not aware that Dr. O'Shaughnessy is in possession of any evidence to prove that the metal was there fused, or that the wooden shaft exhibited indications of having been subjected to intense heat, and powerful disruptive force, as it must necessarily have been, had the lightning passed through it in its course to the copper sheeting of the dome, on which it is known to have impinged; but we have reason to believe that neither of these circumstances can be substantiated, we cannot therefore resist the conviction which all our own information tends to support, that the spear head of Britannia was never struck at all. The accident occurred at night, and the sepoys on guard at the time described the effect of the concussion as to them awful in the extreme, so that from the noise and shaking of the chandeliers, the breaking of the windows, and the general confusion, they believed, as they themselves expressed it, that the whole house was coming down. Now taking this testimony as to the intensity of the concussion into consideration, with the imperfect indication, afforded by the spear head and shaft as to their having been struck (the actual fusion of the metallic point being we conceive doubtful) and remembering that parts of the figure itself were in a most insecure state, we cannot but think the fracture of the arm which took place, arose not from the direct impact of the lightning on the spear head, but from the concussion just described. The opinion appears to receive farther confirmation from the circumstance that although the head of the Britannia was studded with iron spikes, having their points upwards, no discharge, either direct or lateral, took place to it---a result certainly unconformable to common experience in such cases, since the lightning impinging on a conductor deficient in capacity for carrying it off, generally passes to the nearest metallic body. Experience it is true supports the idea of the spear head having been struck, in so far as it shews that lightning usually strikes the highest point first; but in this case when we remember that this spear head was no more than a small piece of insulated metal, and that the entire dome around it was covered with copper, which independent of its high conducting power possesses the singular property of determining to itself a larger portion of a charge of electricity than any other metal, we cannot but feel the opinion that the lightning impinged directly upon it, without touching the Britannia in any way, notwithstanding its presenting the most elevated points, to be better calculated to explain the circumstances of the case than any other. Of course we state this as our opinion, with the qualification that if Dr. O'Shaughnessy can assure us that besides "knowing" of this case, he actually saw the spear head after it had been fused, we can consider it no longer tenable, as such testimony would be fatal to it; but until some such unexceptionable testimony can be produced as to the fusion, we must, on the grounds above specified, continue to maintain our doubts as to the charge having ever impinged on the spear head at all. The necessity for having undoubted facts on which to base conclusions which involve interests so varied and extensive as those linked with the present discussion, will, we feel assured, plead our excuse for dwelling at so much length on some of the details of a single case. We may state, that it would be well if authenticated information relative to the accident to St. Andrew's Church could be collected and made public. From the little we know of it, we believe a more striking instance of the beneficial effects of conductors, could scarcely be cited, but as our information is but meagre, we do not at present feel warranted in attempting to discuss it.

Note by the Editor.—Regarding one point brought forward by our correspondent, namely, the distance from that part of Dr. R. O'Shaughnessy's house which (while in the occupation of Dr. Goodeve) in 1837 was struck by lightning, from the conductor attached to the house of the Secretary of the Asiatic Society, then in the possession of Mr. Trower, Professor O'Shaughnessy has since (10th September, 1840,) acknowledged his error, nearly one month after it had become generally known to others. Thus we ourselves on 13th of August, the very day the error was published, measured the distance, and found it to be above 60 feet instead of 20, and three days after we received the communication which we have given at length from another party who had also it would seem been measuring.

The discrepancy between the actual condition of the spear and the representation of it by Professor O'Shaughnessy is another point upon which we think the Professor is called to explain.

Are the dangers which arise from Lightning so considerable as to merit consideration?

Is the danger of being struck with lightning so great, that we ought reasonably to attach importance to the means of guarding against it? This question has different aspects, and it may be regarded in reference to individuals, to dwellings, and to ships.

In the centre of the great towns of Europe, mankind, it would at first glance appear, are but little exposed. Lichtenberg says that he had satisfied himself that during *half a century*, *five men* only were seriously struck with lightning in the town of Göttingen; of these five, three only died. It it stated, with regard to Halle, that a *single individual* had been killed by lightning in the interval between the years 1609 and 1825, that is to say in more than two centuries. At Paris, where tables concerning the metropolitan welfare are kept with such regularity, the chief officer of the Statistics of the *Préfecture* assured me that during a great number of years not a single death had been notified as produced by lightning. Notwithstanding this, however, there were not wanting instances during the same period, and in the department of the Seine, of individuals who had been so destroyed; thus there was the workman of whom we have recently spoken at page 112, in connection with ascending lightning; there was also an husbandman killed in the fields in the *commune* of Champigny, on the 26th June 1807; and likewise a mower killed at Romainville, on the 3d of August 1811, when he was running for shelter with a pitchfork in this hand. Hence it must have happened that the deaths from lightning were designated and registered as deaths from accidents; hence, too, we should probably be much mistaken were we to receive as accurate, and true to the letter, the number of deaths which Lichtenberg reports for Göttingen and Halle. Nor would the risk of error be less were we to generalize these results, by applying to all countries over the globe what had been observed in one only, and in wishing to deduce from the experience of a village what ought to be dreaded in a great city. Göttingen, Halle, and Paris, it is said, scarcely reckon a single accident in a century! True; but let us notice what a little more accurate investigation declares; and for this end, I open very much at hazard, a few volumes in which I read such particulars as the following:—

On the night between the 26th and 27th of July 1759, a flash of lightning struck the theatre of the town of Feltre. IT KILLED A GREAT NUMBER *of those present, and more or less wounded all the others.** On the 18th of February 1770, a single thunderbolt threw to the ground, without their knowledge, ALL *the inhabitants of Keverne* in Cornwall, who were assembled in their parish church during their Sunday service. In the year 1808, the lightning fell twice in rapid succession upon the inn of the town of Capelle, in Breisgau, and *killed four persons* and wounded a great many more. On the 20th of March 1784, the lightning struck the theatre at Mantua; of 400 people who were present IT KILLED TWO *and wounded ten.*† On the 11th of July 1819, the lightning fell during the service, upon the *Church of Châteauneuf-les-Moutiers,* in the neighbourhood of Digne, Department of the Lower Alps, and killed *nine individuals* on the spot, and more or less wounded *eighty-two.* The same flash killed in the middle of a stable, close to the building, five sheep and a mare.

In spite of these citations, no one will doubt me when I affirm that to each of the inhabitants of Paris, or any other city, the danger of being struck with lightning is less than that of being killed in the street by the fall of a workman from a roof, or of a chimney-can, or flower-pot. There is no one, I believe, who, in starting in the morning, dwells upon the idea that a workman, or chimney, or flower-pot, will fall on his head. If, then, fear reasoned, we should not be more uneasy during a thunder-storm which lasted for a whole day. For the acquittal of our understandings, however, it ought to be added that the vivid and sudden flashes which announce the lightning, and its resounding thunders, produce involuntary nervous effects which the strongest organizations cannot always resist. It ought also to be stated, that if the descent of true thunderbolts is but rare, the total number of strokes of lightning of one kind and another, throughout the year is, on the contrary, very great; that nothing distinguishes the harmless flashes from the others; and that however insignificant in reality the danger may truly be, it seems to be increased by the considerable number of its apparent renewals. This consideration will appear clearer if, returning to our term of comparison, I suppose that at the moment when a workman, or chimney, or flower-pot *was about to fall* from a roof or a window, a very loud detonation were to announce the event throughout the whole extent of the city; every one might then conceive, many times a-day,

* Lightning often occasions extensive fires; on this occasion it was the reverse, for it put out all the lights.

† On this occasion, the lightning also melted ear-rings and watch-keys; it likewise cleaved diamonds, and this without wounding in the slightest degree those who wore these several articles.

that he was precisely in the street where the accident was to happen; and his alarm, without being at all better founded, would become conceivable.

I have been treating above of the accidents which occur in the middle of *great towns.* Were we to rely upon general belief, there is much greater danger in villages, and in the open country. Theoretical considerations to which the review I am now taking forbids me to advert, would tend to confirm this opinion. As for facts again, I see not how it is possible to invoke their aid, since they have been so very partially collected. To this must be added that no accurate account has been preserved of the differences which exist as to the frequency and the intensity of thunder-storms, or to their occurrence in different countries, or even in different circumscribed spaces.

No one in the *Republic of New Grenada* willingly inhabits *El Sitio de Tumba barreto* near the golden mine of *Vega de Supia,* on account of the frequency of thunderbolts. The people have preserved the recollection of a great number of miners who had been killed by lightning. While M. Boussingault traversed *El Sitio* during the prevalence of a storm, a flash of lightning struck to the ground a negro who was acting as his guide. The *Loma de Pitago* in the environs of Popayan, possesses the same melancholy celebrity. A young Swedish botanist, *M. Plancheman,* obstinately persisting, notwithstanding the advice of the inhabitants, to cross the *Loma,* when the sky was covered with stormy looking clouds, there met his death. Finally, in considering great countries only, it appears that in some, entire years occasionally elapse without a word being said of the tragical events occasioned by lightning, whilst in others, on the contrary, in certain seasons they seem to happen almost daily. For example, I find that in the summer of 1797, from the month of June till the 18th of August, Volney counted in the newspapers of the United States, *eighty-four* serious accidents, and *seventeen deaths;* whilst in *France,* the newspapers of the year 1805, if I am rightly informed, only announce one thunder-storm which was productive of the death of one individual. In the year 1806, again, they recount only the death of two children who were struck upon their mother's knee at *Aubagne,* Department *des Bouches du Rhone:* in the year 1807, the same journals mention the case only of two young peasants of the *Commune de St. Geniez* who were struck with lightning when engaged in harvest-work; and in 1808 they allude only to a waterman who was killed on the banks of the river at *Angers.* Notwithstanding all this, the years are very far, even in France, from resembling each other, in respect of the number of deaths from lightning. In one year, 1819, the reported victims are the following:---On the 28th of June, *three* horses, near to *Vitry-le-Français;* on the 11th of July, as already stated, *nine* individuals in the church of *Châteauneuf;* on the 26th of the same month, a *man* killed in the open fields at *Maxey sur Vaize (Meurthe);* on the 27th, a *husbandman, his wife, and son,* who had taken refuge in the portico of a chapel near *Chatillon sur Seine;* on the 1st of August *forty-four* sheep, near *Beaumout-le-Roger (Eure);* on the 2d of the same month, a labourer who had taken refuge under a tree at *Bourdeaux;* on the same day, a husbandman of *Vigneux,* near Savenay, who was killed in his chamber; and, still under the same date, two young students and two girls, between ten and twelve years of age, in the house of M. l'Abbé Coyrier, at . . . . *Department du Cantal;* and, finally, on the 27th of September, at five in the morning, a female domestic servant, who was killed in her bed, at *Confolens,* Charente.

But if few persons perish from thunder-storms in the heart of our towns, the number of houses and edifices which are struck, and seriously injured, is, on the contrary, very considerable. During the single night from the 14th to the 15th of April 1718, the lightning struck twenty-four steeples in the space comprehended along the coast of Brittany, between *Landernau* and *St. Pol-de-Leon.* During the night between the 25th and 26th of April 1760, the lightning fell three times, in the short interval of twenty minutes, upon the chapel and other buildings of the Abbey of the *Notre-Dame-de-Ham.* On the morning of the 17th of September 1772, the lightning injured *four* different buildings at *Padua.* A memoir of *Henley,* which is dated December 1773, informs us that the same day, nay, that nearly at the same moment, the lightning over London struck the steeple of St. Michael's, the obelisk in St. George's Fields, the New Bridewell, a house in Lambeth, another house near Vauxhall, and a great number of other places very distant from each other, not omitting a Dutch vessel which was lying at anchor near the Tower.

A learned German found in the year 1783, that within the space of thirty-three years, lightning had struck 386 steeples, and had killed 121 ringers*---the number of the wounded being of course much more considerable. In December 1806, during a single storm, the lightning destroyed, in whole or in part, the steeples of *St. Martin* at *Vitré,* of *Erbré,* of *Croiselles,* and of *Etrelles.* On the 11th of July 1807, the

* These numbers will not astonish any one, if I mention that, on the 11th of June 1775, lightning fell upon the steeple of the village of Aubigny, and killed at the same instant *three men,* who were ringing the bells, and four children who had taken refuge under the tower of the same steeple.

steeple of *St. Martin*, was again struck, and five days before the lightning had fallen at *la Guerche*, and around that city, within the space of a league in different directions, upon ten chapels and other edifices. At *Paris*, on the night between the 7th and 8th of August 1807, the lightning fell upon the sign-post of a shop in the *Rue de Thionville*, upon a house near *la Halle*, upon a reflector of a lamp of the *Rue de Perpignan* in the *Rue aux Féves* at *Vaugirard*, and at *Passy*. On the 14th May 1806, we find it damaging a joiner's workshop in the *Rue Caumartin;* on the 26th June 1807, it injured nine portions of a house at Aubervilliers; on the 29th of August 1808, it struck a public-house near the *Barrière des Gobelins*, and killed and wounded many; near the *Barrière Mont-martre*, it fell upon another public-house filled with people, many of whom were knocked down in a state of insensibility; on the 14th of February 1809, it knocked to pieces a wind-mill, situated on the road to St. Denis; on the 29th of June 1810, it did much damage to a house in the *Rue Aumaire;* next day it broke and scattered about whatever it encountered in a house in the *Rue Popelenière;* and on the 3d of August 1811, it fell upon a house at the *Barrière de Pantin*, and wounded many individuals.

On the 11th of January 1815, during a thunder-storm which embraced the space comprehended between the Northern Ocean and the Rhenish provinces, the lightning fell upon *twelve* steeples dispersed over this great extent of country, set fire to many, and greatly injured others. In leaving this recapitulation of recorded facts, it is scarcely necessary, I imagine, to remark that I believe it very far indeed from being complete, every one indeed will recognise that it reaches only the minimum limits of the subject.

The necessity there is for protecting buildings against lightning, should be measured by the *number* of those which are annually struck by it, and also by the extent and importance of the damage which it carries in its train. Three or four citations will shew the importance of this last-mentioned consideration. In the year 1417, lightning set fire to the woodwork which terminated the steeple of *St. Mark at Venice*, and the whole was consumed. This pyramid was reconstructed, but another thunder-storm reduced it to ashes on the 12th of August 1489. On the 20th of May 1711, a single thunderbolt not only did very great damage, both to the interior and the exterior of the principal tower of the town of *Berne*, but it also devastated *nine houses* in its immediate neighbourhood. The pyramid of St. Mark (on this occasion it was built of stone) received a violent stroke of lightning on the 23d of April 1745. The repairs of the damage cost more than 8000 ducats. On the

27th of July 1759, the lightning burned all the wood-work of the roof of the Cathedral of Strasburg. In the month of October following, this meteor struck the upper part of the magnificent tower of this same town, and so completely divided one of the pillars which supported the lantern, that it was discussed at the time, whether it should be taken down. The reparation of the damage cost more than *three hundred thousand francs.* The three strokes of lightning which, in the night from the 25th to the 26th of April 1760, struck the church of Notre-dame of Ham, led to the burning and complete ruin of this great and beautiful building.

In speaking of damage, I should not forget that which lightning sometimes occasions when it strikes *powder magazines.* On the morning of the 18th of August 1769, lightning fell upon the tower *St. Nazaire* at *Brescia.* This tower stood upon a subterranean magazine, which contained 2,076,000 pounds of powder belonging to the Republic of *Venice.* This immense mass of powder ignited in a moment. The sixth part of the edifices in the great and beautiful town of *Brescia* were overturned, and the rest were much shaken, and threatened with destruction. Three thousand persons perished. The tower of *St. Nazaire* was projected entire into the air, and fell down again a shower of stones. Fragments of it were found at enormous distances. The destruction of materials was rated at *two millions of ducats.*

On the 18th of August, lightning set fire to the powder which was at the time in the magazine of Malaga. The building was overturned; and the whole town would assuredly have shared the same fate, had they not, some time previously, transported the greatest part of the powder into more distant magazines. On the 4th of May 1785, a thunderbolt set fire to the powder magazine at Tangier. The magazine and most of the houses in the neighbourhood were blown up. On the 26th June 1807, at half past eleven in the forenoon, lightning blew up a powder-magazine at Luxemburg, which was very solid, and long before built upon a rock by the Spaniards; it contained upwards of 28,000 pounds of powder. Thirty persons perished; more than 200 were mutilated or grievously wounded. The lower town was a heap of ruins. At nearly the distance of a league, very large stones of the magazine were found conveyed thither by the explosion. On the 9th of September 1808, lightning fell upon a magazine of military stores at the fort of *St. Andrea-del-Lido* at Venice, and blew it up. The explosion completely destroyed a barrack, a neighbouring chapel, the wall of a half-moon battery, greatly damaging, at the same time, the barracks of the artillery.

I have multiplied these citations regarding the explosions of powder-magazines, because, by a succession of qualifications, some have been led to conclude, that even although lightning penetrates these buildings, yet it *never sets on fire* the ammunition they contain. Having shewn how completely untenable such a proposition is, I am free to avow that *in certain instances* the meteor has presented anomalies which would warrant almost any hypothesis. Thus on the 15th of November 1755, lightning descended near Rouen, upon the powder-magazine of *Maromme*, broke one of the rafters of the roof, and shattered to pieces two casks which *were full of powder* without igniting it. The magazine at the time contained 800 of these casks. Again, at day-light, on the 11th of June 1775, the lightning struck the tower of *Saint Second* at Venice, entered the magazine, threw down the shelves, overturned the powder-casks and, what appeared quite miraculous at the time, set fire to none of it.

A list of a number of vessels, amounting to forty-two, which have been struck with lightning, has been prepared, and is printed in another part of this essay. At present we shall only remark that after examining it, it seems quite superfluous to insist upon the utility of the means which have been made available for the protection of ships against these dangers. This list, however, which was prepared with a particular object, contains only a small proportion of the names of the vessels it might have included, if I had enumerated them without a statement of their date and geographical position. Hence, in the very restricted circle of my own information, I might add to the list above alluded to, the following :—

The (name unknown) an English merchant ship, was struck with lightning in the year 1675, near Bermuda.

The (idem) a merchant ship, was struck at Bencoolen, in the year 1741.

The (idem) a Dutch ship, was completely burned by lightning in 1746, in the Roads of Batavia. When the fire reached the powder, the ship blew up.

The (idem) a Dutch ship, was struck and much damaged in 1750, near Malacca

The *Harriet*, English packet, in sailing to New York in 1762. The whole three masts were entirely destroyed.

La Modeste, French frigate, completely burned, in 1766, from lightning.

Captain Cook's vessel, and a Dutch ship, were both struck with lightning in Batavia Roads.

La Zephir, French frigate, struck at Port-au-Prince, St. Domingo, 23d September 1772; the top-mast was destroyed.

La Meilleur Ami, of Bourdeaux, struck, same place, 25th May 1785; the mizen and two top-masts shattered to pieces.

La Prévost de Lingristin, of Rochelle, struck, same place, 29th July 1785; two of the top-masts required to be replaced.

Le (name unknown), French schooner, struck, same place and day; main-mast destroyed.

The *Duke*, British 90 gun ship, struck, 1793, off Martinico; one of its masts shattered.
The *Gibraltar*, British-ship-of-the-line, struck, 1801, and much damaged immediately over the powder-room.
The *Persius*, British vessel, struck at Port-Jackson, in October 1802; the accident led to the loss of the vessel.
The *Desire*, British frigate, struck at Jamaica, in 1803; one of the masts much injured.
The *Theseus*, British vessel, struck, at St. Domingo, 1804.
The *Favourite*, British corvette, struck, at Jamaica, June 1804; *three sailors killed, nine wounded*, main-mast much damaged.
The *Desire*, British frigate, struck, near Jamaica, 20th August 1804; many parts of the ship burned by the lightning.
The *Glory*, ship-of-the-line, in Admiral Calder's squadron, off Cape St. Finisterre; the three masts were made useless.
The *Repulse*, British vessel, struck in the Bay of the Rosas, in 1809.
The *Dœdalus*, British frigate, at Jamaica, in 1809; some of the crew struck down, the lightning fired the powder.
The *Hebe*, British frigate, at Jamaica, in 1809; one of the masts destroyed.
The (name unknown), British schooner, Jamaica, in 1809; sunk by the same thunder-bolt as the two last.
The *Glory*, British ship-of the-line, off Cape Finisterre, 1811; had all its masts cleft.
The *Norge*, British ship-of-war, and a merchant vessel, Jamaica, June 1813; the *Norge* was dismasted.
The *Palma*, British frigate, Harbour of Carthagena, S. A., in 1814; one of its masts destroyed.
The *Medusa*, British brig, in its voyage from Guayra to Liverpool.
The *Amphion*, American vessel, sailing from New York to Rio Janeiro, 21st September 1822; much damaged, all its compasses destroyed.
The *Jessy*, of London, abandoned in 45° N. L. and 16° W. L., in November 1833, from the injury by lightning.
The *Carron*, British steamer, in passage from Greece to Malta, struck in 1834.

In running over such catalogues as these with attention, it is remarkable, and such statements are truly striking, that in fifteen months of the years 1829 and 1830, there were in the Mediterranean alone, five ships of the British Royal Navy struck with lightning. These were the *Mosquito* of 10 guns, the *Madagascar* of 50, and the *Ocean*, *Melville*, and *Gloucester* ships-of-the line. All these vessels suffered considerably in the rigging. I will add, for the benefit of those who imagine that the damage arising from lightning is of small importance as a pecuniary matter, that a large lower mast of a frigate costs about £200, and the great lower mast of a ship-of-the-line costs as much as £400.

To all these authentic examples of the effects of lightning it must be added, that the British ship *Resistance* of 44 guns, and the *Lynx*, completely disappeared during a severe thunder-storm, in a convoy of which they formed a part; that the ship *York* of 64 guns, which was never heard of after its entrance into the Mediterranean, was probably blown up or sunk by this same meteor; and that the instances of burnings in the preceding list, are by no means the only ones which might be enumerated. Thus, for example, the *Logan* of New York, of 420 tons and of £20,000 value, was entirely consumed; the *Hannibal* of Boston shared the same fate in 1824. Moreover, the crews do not suffer less than the masts, the cordage, and the hulks of ships. Thus there were *two men* killed, and *twenty-two* wounded by the thunderbolt, which, in the year 1799, struck the *Cambrian* at Plymouth; under the same circumstances, the *Sultan*, at Mahon, lost *five men* killed on the spot, *two* thrown into the sea and drowned, and *three* more, severely burned; *nine men* perished on board the *Repulse*, by the flash which struck that vessel in the Bay of Rosas in 1809; and there were *three* seamen killed, and *five* wounded on board the Austrian frigate *Leipsig*, when she was struck on the coast of Cephalonia.

The facts, however which I have already reported, ought to be sufficient. They have been cited without exaggeration, and without concealment. Every one, therefore, may appreciate at its true value the importance of the various methods which have been proposed for preservation against lightning. It is now time, then, to submit these to serious consideration.*

Remarks by the Editor.

It is due to the non-scientific portion of our readers to offer a few remarks in explanation of papers, devoted strictly to pure science. Such communications are essentially the most important that could occupy our pages, as their object is usually directed to clear up or establish some fundamental principle on which the extension of science depends. Mr. Jameson's paper, in our present number, on the natural classification of *Falconidæ*, which we hope to continue, though relating to the highest objects of science, would afford but little interest to those who do not know what the natural system is. We might quote very beautiful illustrations of the importance of system or method in the study of nature, by which all objects of the creation are classed in groups

* From M. Arago's essay on Thunder.

according to such of their characters and properties as may appear to be most obvious. As the properties of natural bodies are infinite, so our knowledge of them depends on the progress of science, and as this is now continually advancing, old systems founded on a more limited state of knowledge are daily crumbling to pieces. Some great men perceiving the disadvantage of this, have devoted their minds to the investigation of natural laws throughout the creation, with the view of deducing from these a natural system, which the improvements of science will tend rather to complete than to destroy. The design is one that cannot like former systems, be accomplished by any single individual. One of the great difficulties to overcome at the commencement was, therefore, to devise a plan on which all might labour towards the accomplishment of the one great end. Although a thorough knowledge of the system of nature is probably more than it was ever intended the human mind should accomplish, yet it is something to know that we are on a right path, and that we may hope to attain at least a general insight to the mysteries and beauties of the creation; and although some happy observation or general remark may be found in various authors tending to shew that they were not insensible of what should constitute the true path, yet it was reserved for Mr. W. S. MacLeay, in a series of essays specially devoted to the subject, not only to point it out, but also to illustrate by his own profound researches, many of the primary laws on which a natural method should be formed. Mr. Jameson's paper, as its title indicates, is devoted to an investigation of the first order of birds, with a view to discover the true relations which the members of that group bear to each other in the order of their mutual affinities. The subject is one of great philosophical interest, as those who have leisure will find on the perusal of Mr. Swainson's popular treatise on the geography and classification of animals.

The second paper, by Mr. Jameson, in our present number, is one of great economical interest, and requires no observations from us to point out its importance.

In India, where so vague a notion seems to be entertained of the legitimate objects of physical science, we trust the translation of Schouw's Popular Sketch of the Physical Geography of Europe, will be useful, particularly to the Education Committee. Dr. Cantor indeed remarks that he does not know who the members of that Committee are, otherwise he would supply them with a series of elementary treatises, but whether for the special instruction of the members themselves, or for that of their pupils, he does not mention. Be this as it may, Dr. Cantor is now we are happy to say, much better employed in China, in possession of all those facilities, we trust, which are indispensable to the successful results of his researches. His translations from Schouw, amounting to above two hundred pages, were written between Calcutta and Penang, at the commencement of the voyage, while passing over that part of the sea with the productions of which his former services on the Survey with Capt. Lloyd had made him familiar.

Remarks on the Deposits of the Calcutta basin.—We should have thought it unnecessary to offer any remarks on Lieut. Smith's paper, which places the late operations in search of an artesian spring in Fort William very clearly before the public, together with some excellent observations of his own on the formation of Kunkar, had we not been requested by the author himself to offer such further views on the subject as our experience, or rather he should have said, his own observations, might suggest.

Lieut. Smith's report on the work in question places one of the most interesting operations of the kind that ever have been undertaken in India in so clear a light before our readers, that any one on perusal of the details he has collected and illustrated, may form as accurate opinions on the subject, as if he had been engaged in the tedious and difficult operation itself, during the five or six years which this work has been in progress.

The sections of deltas can only become known by works of this nature, which from the expense and difficulty attending them, must always be extremely rare. When they are undertaken and carried on with so much spirit as in the present case, it is due to the liberality of the Government, as well as to those intrusted with their management, to make the scientific world acquainted with the result, and this duty could not have fallen into better hands than those of Lieut. Smith, who has left nothing undone but what others may accomplish from the details he has laid before them. The first question that occurs after the perusal of Mr. Smith's paper is, whether the deposits beneath Calcutta have been formed from Gangetic sediments similar to those now forming at the head of the Bay? So great is the quantity of mud and sand poured out by the Ganges into the Gulph at flood season, says Mr. Lyell on the authority of Major Rennell, that the sea only recovers its transparence at a distance of sixty miles from the coast. The general slope therefore of the strata must be extremely gradual. By charts recently published, it appears that there is a gradual deepening from four to about sixty fathoms, as we proceed from the base of the delta to the distance of about 100 miles into the Bay of Bengal. If we suppose the deposits beneath Calcutta to have the same inclination as those now forming at the head of the Bay, and to have been formed by the same tranquil causes that are now producing new lands from the deposits of the Ganges, the sea face of the delta would necessarily have been situated 125 miles north of Calcutta, or half way between Morshedabad and Malda, at a time when the coarse conglomerate 580 feet below Fort William was deposited. Mr. Lyell, from data furnished by Mr. Everest, calculated the annual deposit of mud discharged at the mouths of the

Ganges to be about 6,368,077,440 cubic feet, which, supposing it to be deposited on a surface as much below the level of the sea as the depth attained in the Fort, would be sufficient annually to raise 6 square miles of dry land; and if we suppose the Bramaputra to contribute equally with the Ganges, these two rivers would require a period of 3,333 years, to extend their delta to its present position from the point it would have occupied (according to the present state of things) at the period when the lower beds penetrated in the Fort were deposited. Mr. Lyell remarked, that the Ganges and Burrampooter have probably become confluent within the historical era, and the foregoing observation rather tends to confirm the conjecture. We have also to remark in the consideration of this question, that the bones brought up from a depth of 350 to 430 feet had not lost all their animal matter; that is to say, they retained the character of grave bones, and could not therefore be regarded as perfectly fossilized, and the wood which was found at a depth of 390 feet retained its recent appearance. When we say 3,333 years as the probable period since the deposits penetrated in Fort William were forming, of course we only mean this as an approximation to the truth. The accuracy of the calculation will, however, depend on the estimate we have formed of the depth of the delta, and the quantity of mud annually discharged, as well as on the question whether the sedimentary deposits were the same at the early period alluded to as now, and whether they have been accelerated or interrupted during the interval.*

Taking the two first of these elements to be nearly as accurate as the present state of our knowledge admits, we

* We have just perused an interesting paper by Sir J. G. Wilkinson on the deposits of the Nile, which may lead to some modification of the present views of geologists regarding the growth of Deltas. We shall take an early opportunity of laying the result of Sir J. G. Wilkinson's observations before our readers.---Ed. Cal. Jour. Nat. Hist.

will now consider whether the deposits took place during the interval alluded to, as they do at present.

A submarine basin, or a lake filled up by the uniform discharge of sediment from a great river, will exhibit in its lower parts a deposit of water-worn fragments, more or less coarse, according to the velocity of the current, and the distance the transported matter has been carried forward. As the cavity of the basin becomes obliterated, the velocity of the currents entering it will also proportionally diminish, and the sediment from being coarse gravel, will gradually pass into fine sand, and this last into clay and mud. So far from the section afforded by Lieut. Smith of the boring operations in Fort William presenting this uniform gradation, we find various beds of fine clay and sand alternating with beds of gravel, several of these different beds being nearly 100 feet in thickness.

Thus proving considerable variation in the velocity of the currents from which they were derived, and the lapse of a considerable period of time in some cases from the termination of one change to the introduction of another.

The coarse conglomerate from 392 feet down to 480, where the work terminated, corresponds with that which is rolled forward, as Mr. Smith has remarked, by mountain streams. The large branch of the Bramaputra which falls into Assam from the Eastward, is the greatest and most rapid torrent we have seen in India, and yet its power of transporting gravel is lost at some distance above Suddyah, or within about 30 miles of the Mishmee mountains, from which the river falls. In the lesser, but equally rapid streams in Assam we find the distance to which gravel is transported to vary from five to twenty miles, and on the surface of these coarse gravels we often see occasional fragments of bones of various animals, pieces of coal, and trunks of trees, the latter often changed to lignite, especially when buried in the hot sands, which during the dry season are exposed to a parching sun.

Lieut. Smith remarks that from the lower surface of the black peat clay, which rests on the lower conglomerate at a depth of 390 feet, fragments of coal were found, and beneath these, at some distance in the midst of the conglomerate or gravel, bones of a kind of lizard or crocodile were found, and still lower down, at a depth of $464\frac{1}{2}$ feet, fragments of lignite.

These remains, as well as the nature of the gravel in which they are found, unquestionably indicate the close vicinity of bold rocky mountains at no greater distance than 20 or 30 miles, and from which similar torrents descended to those which now fall into the valley of Assam.

Reposing on the coarse conglomerate, above alluded to, there is a series of layers, twelve feet deep, consisting of calcareous clay and decayed wood, which from their nature could not have been deposited at any depth beneath water. We must conclude, in fact, that these beds were formed on dry land, which afterwards by series of movements indicated by the beds of gravel, sunk down bodily to their present depth of 390 feet below the level of the sea, as it is quite impossible to understand how drift wood could be separately deposited at such a depth. The lower conglomerate therefore affords all the proofs of having been derived from mountain rocks of sufficient altitude, within 30 miles of Calcutta, to render the river currents as rapid as the falls of upper Assam, and this would seem to have continued during a period required to deposit a depth of at least 60 feet of gravel, when the transporting power of the currents became suddenly arrested; for we have reposing on the gravel a bed of drift wood and lacustrine clay containing fragments of a very soft friable shell, of which we find no example in superincumbent beds, or in the recent deposits now forming at the head of the Bay.* This last change clearly indicates a

* We are indebted to Capt. Lloyd Marine Surveyor General, for a series of deposits from the head of the Bay, taken at various depths from 2, to 200 fathoms.

depression of the land in the interior before the bed of the basin itself began to sink, for the carbonaceous bed, now at a depth of 385 feet, bears evidence of having been slowly formed on a marshy surface covered with vegetation, on this a thin bed of fine lacustrine clay rests, containing the peculiar shell already alluded to.

After the shelly calcareous bed of two feet which rests on the dark clay and drift wood above noticed was deposited, a gradual subsidence of the basin appears to have succeeded, when a sediment consisting of 60 feet of sand intermixed with the bones of land animals took place. The period occupied in this last change may be estimated by the time required for a deposit of sand of equal depth to take place below Saugor island. This bed of sand is now converted into a slightly adherent sandstone by the impervious nature of the fine calcareous clay on which it rests. It is succeeded by a bed of loose sand, intermixed with fragments of quartz, felspar, and granite, 25 feet deep, indicating a more rapid change in the relative levels of the land, by which the currents entering the basin became again accelerated. This seems to have been succeeded by a long period of repose, during which a depression of 100 feet occasioned by the last movement became gradually obliterated by the deposition of 90 feet of fine *ferruginous sand intermixed with clay*, the upper stratum of which is now converted into soft sandstone, and lies 205 feet below the present surface. Towards the close of this long period of repose the currents again became disturbed, and so continued while a coarse quartzose conglomerate, ten feet in depth, took place. This is situated at a depth of 175 feet from the present surface, and is followed by a bed of fine calcareous clay, five feet in thickness, and corresponding in its characters with the lower calcareous clay at a depth of 380 feet, and which we supposed to have been a lacustrine deposit. This is succeeded by a bed of sandy clay 30 feet deep, with fragments of mica-slate, &c. 150 feet below the present surface, and which indicates the latest general change of importance to which the interior of the land and the rivers passing over its surface have been subject. From this to within 45 feet of the surface the changes in the character of the deposits are slight, and indicate a gradual filling up of a basin which had suddenly sunk down to a depth of 75 feet when the coarse quartzose conglomerate was formed.

The Kankur appears to occur in siliceous clay at a depth of 70 feet, and continues to within 50 feet of the surface, where the matrix becomes calcareous. This is succeeded by dark clay with decayed wood to within 45 feet of the surface. Adhesive blue clay, a deposit from marshes, continues to within ten feet of the surface.

Thermometrical Register at Neemuch, from 29th March 1840, to 31st June 1840, taken daily between the hours of 9 and 10 A. M., from self-registering Day and Night. By CAPT. JACK, *30th Regiment Native Infantry.*

Month.	Date.	Night. ° ′	Day. ° ′	Winds.
March.	29	49 10	81 30	W. Cloudy.
	30	48 5	80 40	W. Cloudy.
	31	64 0	84 25	SW. Clear.
April.	1	78 0	85 8	WNW. Clear.
	2	77 30	86 40	W. Clear.
	3	79 0	87 0	W. Clear.
	4	78 30	85 5	W. Clear.
	5	80 0	86 0	WSW. Clear.
	6	77 50	86 0	Ditto Clear.
	7	78 40	88 0	Ditto Cloudy.
	8	78 20	85 20	Ditto Cloudy.
	9	79 40	85 0	WNW. Clear.
	10	80 30	87 30	WSW. Clear.
	11	80 40	87 10	SSW. Clear.
	12	81 40	89 0	SSW. Cloudy.
	13	80 0	87 20	Ditto Cloudy.
	14	77 0	89 5	Ditto Cloudy.
	15	77 40	84 40	Ditto Clear.
	16	78 40	90 10	W. Clear.
	17	80 40	88 0	W. Clear.
	18	81 0	81 0	W. Clear.
	19	83 30	91 0	E. variable.
	20	84 30	91 0	N. variable.
	21	86 0	91 30	NE. variable.
	22	85 0	91 0	NW. Clear.
	23	84 40	94 30	Ditto Clear.
	24	84 30	95 40	NE. Clear.
	25	85 40	93 0	NE. Cloudy.
	26	84 30	92 10	SW. variable.
	27	85 0	91 0	SW. variable.
	28	86 0	93 0	S. variable.
	29	82 0	90 40	SW. Cloudy.
	30	77 40	87 40	NW. Cloudy.
	33	81 7 18 (° ′ ″)	85 3 37 (° ′ ″)	Mean.

Month.	Date.	Night. ° ′	Day. ° ′	Winds.
May.	1	79 0	90 0	WNW.
	2	80 40	90 0	NW.
	3	80 40	91 0	NNW.
	4	84 30	94 0	S. variable.
	5	84 0	93 40	S. variable Cloudy.
	6	83 40	90 40	SW. Cloudy.
	7	84 40	90 40	SW. Cloudy.
	8	84 0	91 30	SW. rainy.
	9	79 40	90 0	W. Lightning rain.
	10	80 0	89 10	W. Cloudy.
	11	83 30	90 0	W. Cloudy.
	12	83 40	92 0	S. Clear.
	13	84 0	90 40	SW. Clear.
	14	84 0	90 45	SW. Clear.
	15	82 0	92 0	SW. Clear.
	16	86 0	92 40	SW. Clear.
	17	84 0	92 0	SW. Clear.
	18	85 0	91 20	SW. Clear.
	19	86 0	92 0	SW. Clear.
	20	84 40	91 30	WSW. Clear.
	21	85 0	93 0	SW. Clear.
	22	87 0	92 0	SW. Clear.
	23	86 0	94 0	SW. Clear.
	24	86 0	94 10	SW. Clear.
	25	85 10	93 0	SW. Clear.
	26	86 30	95 0	S. variable.
	27	86 30	93 40	S. variable.
	28	85 0	94 0	SW. variable.
	29	85 0	93 0	SW. variable.
	30	85 0	92 30	SW. variable.
	31	86 0	92 0	SW. variable.
		84 5 33 (° ′ ″)	92 0 29	88 3 1 (° ′ ″)
		33 5 27½ (° ′)		

Month.	Date.	Night. ° ′	Day. ° ′	Winds, &c.
June.	1	85 0	93 0	SW. and SE.
	2	85 30	93 10	SW. variable,
	3	86 0	92 0	SW. rain.
	4	88 20	93 10	SW rain.
	5	88 30	93 30	SW. variable.
	6	89 0	95 0	SW. variable.
	7	90 5	96 30	SW.
	8	90 30	98 30	SW.
	9	90 0	99 0	SSW. rainy.
	10	84 40	95 10	N. Squally.
	11	81 40	93 50	SW. Heavy rain.
	12	82 0	89 40	SW. variable, rainy.
	13	83 30	90 10	SW. variable, rainy.
	14	84 0	90 20	SW. variable, rainy.
	15	83 20	89 30	SW. variable, rainy.
	16	82 30	90 40	SW. variable, rainy.
	17	81 0	89 20	Heavy rain
	18	80 30	86 30	Showery.
	19	80 0	86 20	SSW.
	20	81 0	36 0	SSW.
	21	82 40	89 0	S.
	22	82 30	88 0	S. Strong gale.
	23	82 0	88 40	SW Stiff.
	24	82 20	88 0	SW. increasing.
	25	81 40	88 10	SW. moderate.
	26	80 10	88 0	SW. little.
	27	81 0	89 0	SW. Clear.
	28	81 30	89 0	SW. Clear.
	29	83 0	90 40	SW. Clear.
	30	83 0	91 30	SW. Clear.
	31			
		81 33 50 (° ′ ″)	91 2 40 (° ′ ″)	

		°	′	″
By which we have the mean from 29th March 1840, to 1st May,		83	5	27½
from 1st May to 1st June,	......	88	3	1
from 1st June to 1st July,	......	86	18	15
Mean Temperature from 29th March to 1st July,	......	85	48	54½

NOTE.—The cantonment is very dry, there is from 8 to 15 feet of red indurated clay, lying on clay slate, water goes from 30 to 40 feet, when you generally come upo geologically (though not chemic·lly) what is called trap But I hope to communicate further particulars on this subject.

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OF

NATURAL HISTORY.

On the Creation, Diffusion, and Extinction, of Organic Beings. By CAPT. THOS. HUTTON, *Bengal Army.*

It has been a matter of doubt and contention as to whether the days of creation are to be considered merely of the same duration as these of our present computation, or indefinite periods of years.

It has been asserted, that like the human race, the plants and animals have sprung from a single pair of each species, and diffused themselves from a common focus or centre of creation. With regard to the actual duration of the day, facts will hereafter be adduced to prove it of the same length as these of the present time, and therefore let us now inquire what proofs can be found in support of the other views, or whether they cannot be shown to be altogether untenable.

First, then, it has been asserted that all animals have proceeded from a single pair of each kind.

There would appear to be no better reason for this belief, than the assertion that mankind originally sprung from one pair, for with regard to the numbers of the animal and vegetable races, the Bible is altogether silent.

Now if we take the Mosaic account in a literal sense, and believe them all to have been created on the fifth and sixth days, as stated in Genesis, and that those days were natural days of twenty-four hours duration, and that the habits, instincts, and propensities of species were the same then as now, it is evident that many would never have multiplied at all; because eagles, hawks, owls, and others of the raptorial order, as well as the carnivorous mammalia, would have destroyed them in the very outset of their career, and the loss of either a male or a female would at once have crushed the species.

This view then is evidently incorrect.

Secondly;—If we suppose that the creation and diffusion of organic beings has been progressive,—each being called into existence, as its services were required—we shall first have the vegetable kingdom diffusing itself gradually through a number of years, over the earth; and then, as some plants became so numerous as to require a check upon their increase, various species of the animate classes would be called into being, and commissioned to restrain the vegetation within certain limits. In like manner as these multiplied, it would be found necessary to create other animals, until at length after a lapse of many years, the whole animal kingdom would have been successively supplied, and the earth rendered fit for the reception of the human race.

In this view we must not suppose that *the whole* of any class of animals, whether of insects, birds, mammalia, or others, was at once called into existence, but that different genera, or rather a few species of several genera, were from time to time supplied as they became necessary; and for this reason, that as some plants and animals increase and diffuse themselves more rapidly than others, they would consequently need restraining long before those of a slower growth.

In supposing the creation of animals to have been progressive, we may also allow that they sprung from a single pair of each, because, each would have had time to propagate and multiply itself, before the species destined to prey upon it, would be called into existence.

But it may simply be objected in this case, that had creation been thus gradual and progressive, the Mosaic record must necessarily be incorrect, for it states, not that a *few genera* or *species*, but *whole classes* of animals had their peculiar and simultaneous periods of creation; or in other words, that on the third day "The earth brought forth grass and herb, yielding seed after his kind, and the tree yielding fruit whose seed was in itself after his kind;" that on the fifth day, the *waters* and the *air together* were stocked with every species peculiar to themselves; and on the sixth, and last period, "the earth brought forth the living creature after his kind, *cattle* and *creeping thing*, and *beast* of the earth after his kind; and God saw that it was good."

Here then we have two conflicting statements, or rather be it said, a modern theory, endeavouring to overthrow an ancient and insured record of events; and either must we believe that "Heaven and earth and all that in them is," were created by an Almighty fiat on the several days, as related by Moses, or we must reject his account, as narrating what did not occur.

I shall endeavour to show that these modern theories, and not the Sacred Record, must be rejected.

But if, in the meantime, for the sake of argument, we allow that the six Mosaic days of creation were as many periods of years, and that the different classes of animals were being progressively called into existence during each of those periods, we shall nevertheless overthrow the very theory of progression which we are so anxious to establish; for we shall find that the vegetable kingdom would be gradually increasing and diffusing itself over the earth, *without a check*, not only throughout its own indefinite and peculiar period of years, but also through the *fourth* and *fifth*, with the exception of the slight check some species might receive, during the latter period from birds, and not until the *sixth,* and last period, when man himself was created, and by which time the earth would have become a perfect wilderness, would the vegetable world have been restrained by the ravages of mammalia, insects, and all the other terrestrial classes.

It is evident also that if such were the order of creation, those members of the feathered tribe whose food consists of insects alone could not have had existence at all, for the insects which constitute their food were *not created* until the *succeeding* period of years, or sixth day; so that supposing, with some theorists, that each day was an indefinite period of thousands of years, we shall perceive that if the insectivorous species of the present time were then in existence, we are reduced to the absurdity of believing that they must have been constituted to endure the pangs of hunger, and *to live without food for thousands of years.*

It would seem therefore from the above line of reasoning, that if creation occupied only six periods, each of the same duration as one of our present days, and each of those periods produced its peculiar events,—a single pair, or even several pairs of each species of animals would have been insufficient to stock the earth, because many, both among birds and mammalia, being carnivorous, would have destroyed the weaker to satisfy the cravings of their appetites, and in like manner the large herbivora would have destroyed the vegetation.

On the other hand, if we admit the six days of creation were so many period of years, and that according to the Sacred Records one period produced *vegetables,* another *birds* and *aquatic animals,* and a third, *mammalia* and *other terrestrial creatures,*—we shall still overthrow the doctrine of progressive creation and diffusion; because the lapse of years between the creation of the vegetable and animal kingdoms would be so great, that the former being empowered to "increase and multiply," without a check to preserve a due equilibrium of species, would in the warm and probably humid climates of the infant world, have choked and destroyed each other;—so that by the time a check was furnished by the creation of some animate beings, many of the original and more tender plants would have already become extinct.

"All the plants of a given country," says Decandolle, "are at war one with another;—the first which establish themselves by chance in a particular spot, tend by the mere occupancy of space, to exclude other species;—the greater choke the smaller;—the longest lives replace those which last for a shorter period;—the more prolific gradually make themselves masters of the ground, which species multiplying more slowly would otherwise fill."*

"Every plant," observes Wilcke, "has its proper insect allotted to it, to curb its luxuriancy and to prevent it from multiplying to the exclusion of others.—Thus grass in meadows sometimes flourishes so as to exclude all other plants; here the *Phalæna graminis* with her numerous progeny find a well spread table; they multiply in immense numbers, and the farmer for some years laments the failure of his hay crops; but the grass being consumed, the moths die of hunger, or remove to another place. Now the quantity of grass being greatly diminished, the other plants which were before choked by it spring up, and the ground becomes variegated with a multitude of different species of flowers. Had not nature given a commission to this minister for that purpose, the grass would destroy a great number of species of vegetables of which the equilibrium is now kept up."†

From these facts, therefore, it is easily perceptible that if the plants were diffusing themselves for thousands of years over the earth, before the creation of the insect tribes, as

* Lyell's Principles of Geology, vol. ii. pp. 131 and 132.

† Ibid.

the above theory supposes, many of them would shortly have been exterminated, and the earth abandoned to those of hardier and ranker growth. Thus we are led to acknowledge the importance of the insect tribes in keeping in check those plants which would otherwise soon cause the extinction of the weaker and less hardy species; and we are therefore unhesitatingly led to reject the doctrine which would teach us, that the days of creation may be construed into indefinite periods of thousands of years.

It has already been shewn, that if the Mosaic days were the same as these of our present time; and if a single pair only of each species was created, and that these species were constituted as at present,—that many of them could never have propagated or diffused themselves at all, but would have fallen a prey to the fiercer tribes on the very threshold or outset of their existence.

It may however be strongly urged as an objection to this line of argument, and with every probability of truth, that death and decay came into the world as a consequence to man's transgression, and therefore as they did not visit the organic creation until after the Fall, no destruction of species could take place at the outset.

This point being ceded, as it necessarily must, and as we know that the carnivorous races could not have subsisted upon vegetable diet alone, unless their natures and habits have undergone a total and radical change since then, it reduces us to the necessity of believing, that *none* of the *purely carnivorous* animals of our time could have existed till subsequent to the fall of man; for had they been created previous to that event, they must have been *herbivorous*, and not, as now, *carnivorous;* nor need this reasoning in any way perplex or surprise us, for it is in strict accordance with the doctrines of the Bible, as set forth in the twenty-ninth and thirtieth verses of the very first chapter of Genesis, wherein it is clearly stated, that to man was "given for meat," "every herb *bearing seed,* and every tree in the which is the *fruit* of a tree *yielding seed;*" while to the brute creation it is as distinctly declared, that to "*every beast of the earth,* and to *every fowl* of the air; and to *every thing that creepeth* upon the earth, *wherein there is life,*" was given "*every green herb for meat.*" Here is the line as clearly drawn as can be required; there is no mention whatever of carnivora, or animals of prey, even in allusion, but the food allotted to the animal world is solely that of the *herbivora.* Between man and the brutes there is this distinction made, namely, to the one the *fruits* of the earth, and to the other its *herbs* are given; but between the animal classes no line whatever is drawn.

In this view we are also supported by the testimony derived from the fossil flora of the secondary strata, which is precisely of that character which the above doctrine of the sacred historian would lead us to expect.

"The antediluvian vegetation was very different from the present." This is the statement of the most eminent of the modern geologists, and the phenomena in the fossil matters of the earth have suggested, and justify the supposition. The difference was of two kinds; it was that of a tropical character, implying a temperature like that of the torrid zone or equatorial regions, and displaying that largeness of size which is only now found in regions where that degree of heat prevails; and it was also not of the leguminous species—not the *corn plants* or the *vegetables* which now constitute the food of man, but it was of the *reedy, fern-like, grassy, more aquatic* and puny kinds, such as are adapted for the nutrition of brute animals, and obviously by its nature indicating that these were then living or predominating in those regions where the imbedded remains of this character appear."*

* Sharon Turner's Sacred History of the World.

It may again be urged, that having shown the carnivora to be posterior to the fall of man, the objection to the animals having sprung from a single pair of each, is at once removed; not so, however,—for the argument cannot be maintained with regard to the animals alone, but to all organised nature, and therefore it is still impossible that the furnishing the earth with plants and animals could have proceeded from single pairs of each species, because the first pair of elephants, of oxen, or of hares, (if then in existence) having exterminated in a few days the greater portion of the vegetation within the limits of their haunts, would then in turn have become extinct from sheer starvation.

With regard to the creation of some animals and plants, subsequent to the recorded days of Scripture, I shall again take occasion to speak in the sequel, when I trust sufficient proofs of the fact may be adduced, from the phenomena observable in the strata of the earth.

In the meantime, let us proceed to inquire into the tenability of the arguments adopted by former theorists, to account for the diffusion of plants and animals.

It has been suggested by Linnæus that the portion of the earth which was first destined to be the abode of man, contained climates suited to all classes of beings, as well vegetable as animal; and that from this nursery or focus, a gradual diffusion of species over the face of the earth took place.

The various degrees of climate were produced by supposing this region to possess some lofty mountain ranges, on which, at various elevations, were to be found the plants and animals destined for cool climates.

Now, this region must necessarily have contained *all* the plants and animals of the world, as it was before the Fall;—some of these were fitted for a residence in hot climates, and could not live in a cold one; others, destined to inhabit cold regions, could not survive in tropical countries. From this focus, as it were, the various genera and species were to multiply and spread themselves.

Now various objections might be raised against this hypothesis; and first, it may be asked, were these mountains *isolated*, or connected by other chains or ranges with various regions of the earth?

Isolated they could not have been; for if they had, then must the animals which delighted in cold climates have been merely *local*, and without the power of dispersing their species over other parts, for being unsuited by reason of their constitutions to undergo the heats of the plains below, and their proper food also failing them, they would undoubtedly have perished in attempting to find other countries adapted to them.

Thus for instance, the yâk of Tartary and Thibet,(1) the wild Himalyan sheep,(2) the musk deer,(3) sikeen,(4) jahral,(5) and various other animals peculiar to the higher and colder regions of the mountains, will not live in the scorching plains of India, and degenerate and die even in the lower ranges. Again, the monaul,(6) the golden-breasted tragopan,(7) and others of the feathered tribes, whose natures fit them for a residence in a cold climate, would all have perished in seeking new countries adapted to their wants and constitutions.

How then could such species have been spread from their *isolated cradle?*

I am aware it may be objected in this case, that if these animals could not have spread themselves over the earth *before*, so neither could they have done so *since* the Deluge, for as they were taken into the ark, they must necessarily have diffused themselves from a common centre or focus,

(1) Bos poëphagus.
(2) Ovis nahoor.
(3) Moschus moshciferus?
(4) Capra jaela.
(5) Capra jahral.
(6) Lophophorus Impeyanus.
(7) Tragopan Hastingsii.

namely, from the spot where the ark rested on the subsidence of the flood. I am however by no means prepared to admit that these species did necessarily exist previous to that event, and I have instanced them merely as illustrating my argument; neither am I willing to admit that individuals of every species which lived before the flood were taken into the ark, for I shall take occasion hereafter to prove the contrary.

But an argument might with a trifling degree of ingenuity be brought forward, to show that in the primitive epoch spoken of, *no animals or plants* of *a cold or* northern clime were then in being. This argument indeed would find ample support from the fossil phenomena of the secondary strata, the whole of which can be referred only to a climate analogous to the tropics of our present time. If then, the plants and animals of that golden era in the history of our planet are found to be such, as, reasoning analogically, could only flourish beneath the smile of warm and sunny skies, we are naturally lead to conclude that climates and their productions were mutually adapted to each other; and in consequence, that the primeval condition of the temperature of the earth's climates, was wholly that of a tropical character.

If such reasoning be admissible, and the fossil phenomena of our strata are allowed to furnish data by which we may satisfactorily determine this point, then can we have no hesitation in declaring that previous to the fall of man, or the first geological revolution, the climates of the earth were wholly tropical, and no animals or plants *now* peculiar to the colder regions were then in existence.

Such reasoning too will show us that *no mountain station* in the primitive focus, as suggested by Linnæus, was necessary, since there were neither animals nor plants adapted to such a situation.

On this subject, however, I shall have occasion to speak again hereafter, and shall therefore for the present proceed to examine farther into the tenability of Linnæus' theory of central *foci.*

It is evident then that the mountains of the imaginary focus of creation could not have been isolated; nor indeed is there greater reason to believe that they were connected with various regions of the earth.

Let us however suppose that they were so, and it will follow, that as the races multiplied, they would extend along those ranges to various countries whose temperatures were adapted to their comfort and well being, and thus in the lapse of years be found in different and widely distant regions of the earth.

From Lyell's Principles of Geology, may be derived an apt illustration of the absurdity of supposing that the vegetable and animal kingdoms were originally diffused from a common centre.

In speaking of the supposed foci of creation, he says,—"let us imagine that about three centuries before the discovery of St. Helena (itself of submarine volcanic origin) a multitude of new isles had been thrown up in the surrounding sea, and that these had each become clothed with plants emigrating from St. Helena, in the same manner as the wild plants of Campania have diffused themselves over Monte Nuovo. Whenever the first botanist investigated the new archipelago, he would meet with individuals of every species belonging to all parts of the archipelago, and some in addition peculiar to itself, namely, those which had not been able to obtain a passage into any one of the surrounding new formed lands. In this case, it might be truly said that the original isle was the primitive focus or centre of a certain type of vegetation, whereas in the surrounding isles, there would be a smaller number of species, yet all belonging to the same group."*

* Lyell's Principles of Geology.

Now if we apply this reasoning to the primitive focus from which all organic nature was diffused, it will follow that the productions of its various climates are not only to be expected partially in surrounding and similar temperatures, but that *species of every kind* are to be found in *one particular country*, in that region from whence each originally sprung, while at the same time it will probably contain some peculiar to itself, " naturally those which had not been able to obtain a passage into any one of the surrounding countries."

Yet this is not found to be a fact, for although widely separated regions may produce some apparently similar climates, still few of the organic productions are the same. In the mountain tracts of tropical regions whose climates are modified by the various degrees of elevation, animals common to the cooler and temperate lowland countries of other regions may be found, but the great proportion of their products, both vegetable and animal, are quite distinct. Besides this, many species and some genera are decidedly local, and only to be met with in one peculiar region. Thus while the Toucans (Ramphastus) inhabit South America, the Hornbills (Buceros) are confined to the east;—while the Jaguar and Puma are peculiar to the New, the Lions and Tigers are peculiar to the Old World;—the Kangaroo and Ornithorynchus of New Holland, the Birds of Paradise, and the extinct Dodo are only a few, among many instances of this predilection for peculiar and widely separated climates. Thus too does D'Aubnisson truly remark, that of organic beings—" some can only live in the bosom of the *sea,*—others, in *fresh waters;* some are only to be found within the *torrid zone*, while there are others which would perish the moment they should be removed from the *frigid zone;* in a word, *each species* appears as if it were fixed to an *element* or *climate proper and peculiar to it.*"

It might perhaps be more truly said, that *apparently* similar climates seem in most cases to produce rather a strong similarity, than an absolute identity of species. Thus in the lofty ranges of the Himalaya, some climates may be found (at least if we may judge of climates by their products) approaching to those of the lowland tracts of Europe. Here ranging through the hills from an elevation of three thousand feet to that of twelve, and probably thirteen thousand feet above the sea, are found in numbers, the Tortoise-shell,[1] Brimstone,[2] and Swallow-tail[3] Butterflies, identical with those of Europe; the larva of the former still feeding on a species of nettle (Urtica.)

In company with these may also be seen various species of the white butterflies found in Europe, as well as the "painted lady," (Cynthia cardui); the last named species is likewise found at Candahar, in company with *Pieris cratægi*, or the black-veined white butterfly, and *Pontia rapæ*, the small cabbage butterfly.

These species are all identical with those of Europe, and doubtless there are many more besides, but still this does not by any means prove that the *climates are identical* with those of Europe, but only that these species are so constituted as to be able to live and thrive in various temperatures; for if the climates were the *same*, then might we seek in Europe for the many species which are now apparently peculiar to the Himalaya.

The animals *common to both regions* therefore, are *few* in comparison of those which are *peculiar* to either; and thus, although at first the identity of some species, and the strong similarity of others, might lead one to agree with some writers that species have no real existence in nature, but have descended from a common source, and become modified by climate, yet the absolute distinctness of others peculiar only to certain regions, and often even to particular

(1) Vanessa urticæ. (2) Gonepteryx rhamni.
(3) Papilio machaon.

localities in those regions, must at once upset the theory; for it is evident that such alleged modifications must have been the work of ages, that is, since the first creation of the species from which they are descended, and therefore that on the first extending or migrating of the original stock into other climates than that of its creation or focus, it remained for a few years perhaps in statu quo, and afterwards, as the difference of climate told upon its constitution, it gradually assumed different colours, or modifications of its original colours. But as we find from the difference of their general products that climates of Europe, of the Himalaya, and of the Indian lowland provinces, are *distinct,*—how comes it that the species of Lepidoptera, above enumerated, have lived for ages in the two former dissimilar climates, *without having undergone any change or modification?* Or, how again, is it, that we find in the three regions just mentioned, that is, in Europe, in the Himalaya, and at Neemuch in the Western Provinces, species which are common to them all, namely the "painted lady,"(1) the "death's hawk moth,"(2) the "humming-bird hawk moth,"(3) and others?—or how is it that the "Oleander hawk moth,"(4) found in the latter, is identical with that of the former region?

In the case of man, or of the higher animal classes in general, it might be said that change of food, together with that of climate, is instrumental to this modification; though even this is far from being proved to be the case:—"a fair haired" native of Europe migrates with his family and settles among the woolly haired and swarthy inhabitants of Africa. Do his descendants in the lapse of a century, born under a scorching sun, begin to assume any of the characteristics of the races that surround them? Do their lips gradually become thick, their nose flattened, and their complexion black?

(1) Cynthia cardui. (2) Acherontia atropos.
(3) Macroglossa stellatarum. (4) Sphinx oleandri.

Assuredly not; the supposition is refuted by actual experience to the contrary. Again, does an African diet, or a change of costume, create any change in their form, or their mental perceptions? Are their natural characteristics, in short, in any degree lost so long as their race is preserved pure? Let the Spaniards settled for more than two centuries among the copper coloured Indians of Mexico and New Spain,—the Dutch Boors of Southern Africa,—the descendants of the whites who first settled in the West Indies,—above all the Jews, now scattered "among every nation under heaven:"—let these, we repeat, tacitly reply to these questions. Such living testimonies, known to all, should at once have dispelled the illusion which many writers, and some of them able ones, have indulged in,—that temperature, food, clothing, and other secondary influences were the *chief* causes of that extraordinary variation in the aspect of the human species which the different nations of the earth exhibit, and which, so long as each race is preserved pure, is unchanging, and unchanged. Upon such a subject the modest and ingenuous mind may indulge conjecture; but when we attempt to penetrate the darkness of primitive ages, and pretend to trace the first causes of such things, we wander in regions from which human knowledge is excluded. HE alone, that great First Cause, "by whom all things were made," that are made, "is alone master of this impenetrable secret."*

To the insect tribes this theory of change by food and climate, is still less applicable, since we know that larvæ of many species will feed on one plant alone, and when that fails them they must perish, so that climate alone must be the cause of change in them. We see however from the examples above given, that climate alone is *not sufficient* to effect this change, and therefore we are forced to conclude that genera and species have not diffused themselves

* Geography of Animals by Swainson, Lardner's Cyclopædia, p. 23.

from any central focus, but were placed "ab initio," in those countries which were best adapted to them; and also that species have a real existence in nature, independent of the fact, that however much a change of temperature might be instrumental in changing or modifying the *colours* of a species, it could never alter its actual *form,*—so that we know that the Comma, and large tortoise-shell butterflies, although of the *same genus,* could never have descended the one from the other.

But there is yet another class of beings to which the remarks already applied to the insect world, may be still better adapted, namely the terrestrial and fluviatile Mollusca.

Species occur apparently in every country, however widely they may be separated from each other, yet at the same time many are extremely local, even in their respective countries, while others again have a wider range, and appear to defy alike both heat and cold.

Numerous species, for the most part peculiar to the Gangetic provinces of India, have of late years been brought to notice by the researches of naturalists, while others again have been discovered in the Sylhet and Himalayan mountain ranges, with one or two exceptions quite distinct from the lowland forms, and extending upwards to an elevation of nearly fourteen thousand feet above the sea, upon the borders of eternal snows.

It is interesting to observe the wide distribution of these tender beings, and to trace the gradual, and almost imperceptible yielding of one species to another, as the elevation, or the climate varies.

The shells of the lowland provinces give place in the Himalaya, as the temperature becomes cooler, to forms more nearly resembling those of Europe, some, still advancing a short way into the hills, but as if impatient of the chills of a mountain winter, confining themselves to the valleys of the lower ranges.

One species, however, the "Nanina vesicula," found by myself between Neemuch and Mhow, and subsequently discovered by my friend Mr. W. H. Benson in the Rajmahl range, seems alike to defy the heats of the provinces and the winter of the hills, ascending even beyond the height of ten thousand feet above the sea. It ranges therefore over the central and western tracts of the Bengal Presidency, and occurring in profusion along the verge of the hills at Mansir Debi, mounts to Subathoo, Simla, and Huttoo mountain, preserving everywhere precisely the same habits.

Another species, the "Nanina vitrinöides" of Deshayes, inhabiting the Rajmahl range, and extending also to the western frontier, advances upwards only to Subathoo and its neighbouring valleys, passing at Simla into a strong variety, possessing the same form, and partaking of the same habits and general economy.

"Succinea crassiuscula" of Benson has also a wide range, and is apparently to be met with throughout the provinces, occurring abundantly, according to the above gentleman's observations, in the compound of the Asiatic Society's rooms in Calcutta, extending through Bahar and Allahabad to the western frontier, and advancing to the hills as high as Subathoo.

Yet although we find some species common to the plains extending far into the hills, there is nevertheless a well marked line of elevation beyond, which the welfare of the general number forbids them to pass.

Thus while "Nanina vesicula" is found roaming through the hills apparently at all elevations up to 10,500 feet, other species which in the plains of India are found in company with it, and at the same seasons, never mount beyond a third of that height, confining themselves to the warmer valleys at about three to four thousand feet above the sea.

Among these are "Nanina vitrinöides" and "Succinea crassiuscula," which around Subathoo are found in company with species peculiar to the hills, such as "Helicarion cassida," (Nob.) and "Pupa pulchella," (Nob.) neither of which are found in the plains, while the former are not met with in the higher and colder hills. To this region also "Pupa pulchella" would seem more properly to belong.

Here then we have a well marked frontier line of elevation, separating, as it were, on either hand, the animals of the highlands from the lowlands.

"When temperature," observes Lyell, "is the barrier which arrests the progress of an animal or plant in a particular direction, the individuals are fewer and less vigorous as they approach the extreme confines of the geographical range of the species. In almost every district, especially if it be mountainous, there are a variety of species, the limits of whose habitations are conterminous, some being unable to proceed farther without encountering too much heat, others too much cold. Individuals which are thus on the borders of the regions proper to their respective species, are like the outposts of hostile armies, ready to profit by every slight change of circumstances in their favour, and to advance upon the ground occupied by their neighbours and opponents."*

With respect to the Mollusca of these regions, it will be found, and indeed the remark is generally applicable to all classes of animate beings, that although the *same genera* may occur in widely separated countries, *the species* are with few exceptions, entirely distinct.

Thus, although in the Himalaya genera, *Pupa, Bulimus, Helix, Carychium,* and *Vertigo* occur, yet the species are distinct from those of Europe, and with the exception of one or two species common to both regions, they are totally distinct also from those of the plains of India.

If climate, therefore, is instrumental in gradually chang-

* Lyell's Principles of Geology.

ing or modifying a species, how is it that "Nanina vesicula," so widely distributed through the provinces, still remains precisely the same in habits, form, and economy, even on a mountain rising to the height of nearly eleven thousand feet above the sea, and where snow lies early in autumn, and continues throughout the winter season, even till the end of May?

Or, why, since the rigours of a cold climate are known to be instrumental in clothing the animals of warmer regions with a thicker and more woolly covering, has it not altered the habits and economy of these fragile beings; for we find *Nanina vesicula* using the same thin vicid operculum, and in every respect preserving the same habits on Huttoo mountain, in the Himalaya, as it does in the hot plains of the Gangetic provinces; and two other species, the "*Nanina monticola*," (Nob.) and "*Pupa sylvatica*," (Nob.) which I discovered among juniper bushes at the Burrenda Pass, on the Snowy range, make use, at the height of between thirteen and fourteen thousand feet, on the verge of never melting snows, of the same means to secure the aperture of their shells, as their congeners which inhabit the lower and warmer ranges near Simla?

It is obviously because a merciful Creator *originally endowed these species with constitutions to set the effects of climate at defiance, and to preserve themselves distinct and free from change or modification*, alike among the snows of a mountain winter, or the burning heats of a tropical summer.

But again, if we wander with these several species from the original focus of creation, how shall we cross the many streams and rapid rivers (to say nothing of the sea) which intersect and divide the various countries in which they are found?

Or, how, since rivers in different quarters of the world are stocked with species peculiar to themselves, could they have wandered to their respective localities?

Their distribution evinces too much design to admit, for an instant, of the idea that their *ova* were diffused through the agency of winds or aquatic birds, independent of the fact, that there is no one region or focus which contains all the species, and that the suddenness of such a transportation or diffusion would have tended rather to *exterminate*, than to *disseminate* the species!

Nor could they have wandered from a common centre in the sea, for they are adapted solely for a residence on the land, or in fresh waters, and perish instantly in salt waters.

These latter speculations then, like the former, must be abandoned; for as the diffusion of the various races could not have taken place from an isolated mountain, so neither is there any country in which all animals are found; nor a mountain range connecting all the portions of the earth; and farthermore, if there had been, it would have formed, as indeed mountains are often found to be, an insuperable barrier to the diffusion of those species which, delighting in warm and humid climes, were placed in the plains below them.

The only rational answer then must be, that each was created for specific purposes, and adapted at once to those situations in which they were to perform their parts; and being so adapted, they were placed each and all in such numbers and proportions as an infinitely wise Creator saw good, at once in the countries where their several services were alone required.

It is now necessary that we should more particularly touch upon a point to which we have already made allusion, namely, to the fact of fresh creations of animals and plants having taken place subsequent to the six recorded creative days of Genesis.

This position, which derives ample support from the phenomena actually existant and observable in nature, may be still farther substantiated by the the following passage of Genesis, wherein it is declared that after the subsidence of the deluge, " God spake unto Noah and to his sons with him, saying, and I, behold I establish my covenant with you, and with your seed after you; and with every living creature that is with you, of the fowl, of the cattle, and of every beast of the earth with you; *from all that go out of the ark, to every beast of the earth!*"

Is it not evident from this latter passage that a marked distinction is made between the beasts that *went out of the ark*,—and some other *beasts of the earth?* And what others can we refer to, save to those which God had seen fitting to create, in order that the *new climates* which the late revolution had produced, might be stocked and replenished in common with all other quarters and portions of the globe? The passage, in short, clearly declares that God had established his covenant not only with the human race, but likewise with all organised nature, *as well* the beasts which were already *in the earth.*

We have a still more convincing proof, if indeed such be required, in the mention of an *olive tree* springing up immediately on the retirement of the waters; for as land trees and plants could not survive beneath the deep waves of the deluge, during a period of ten months, especially since the surface of the former earth was swept off and " obliterated" by the Almighty fiat on account of man's transgressions,—so it is evident that the olive tree (which Professor Jameson has incautiously cited as a proof that no change took place between land and sea*) must either have been an entirely new creation, or what will answer fully as well,—a recently created individual of a species formerly existing. We derive indeed from this circumstance a positive and undeniable proof, that fresh creations took place after the deluge, because we know by the destruction of the earth's soils, that

* Jameson's notes to Cuvier's Theory of the Earth.

the vegetation which grew in those soils must also have been destroyed with them; and we know likewise, that the olive tree from which the dove plucked a leaf, was neither planted nor sown by Noah, and consequently, that it was of spontaneous and immediate growth, or an especial creation after the deluge.

Now it has already been shown in a former essay,* and that strictly in accordance with the rules of geological reasoning, that the vast mountains of the Himalaya were not in existence previous to the visitation of the Mosaic deluge. It will follow therefore, as a matter of course, that the climates and stations *now produced* by the various elevations and local peculiarities of those regions, were likewise not in existence previous to that grand catastrophe; and it moreover follows, that as some plants and animals are found to be peculiar to those new climates and stations, *they too must date their origin subsequent to the* event which called the hills and climates into existence.

Thus it is evident that when our first parents were driven out of Eden, and vast mountains were upheaved, the cold summits of those ranges produced stations for which as yet no proper or peculiar vegetation or animals existed.

Again, after the deluge, when the vast mountains which now adorn the earth were first upheaved, they likewise towered to a height which was unknown in the warmer antediluvian era, and consequently again formed climates and stations for which few, if any, of the already created beings were adapted. Fresh creations were therefore indispensably necessary, unless those regions were intended to be left barren and untenanted.

As we perceive, however, that those elevated tracts produce some species *peculiar* to themselves, we are led at once to acknowledge that fresh creations must positively have taken place.

* J. A. Society, Geology of the Western Himalaya.

Among other examples of new climates and new creations of animal and vegetable species, may be cited the continent of New Holland, whose productions in many instances are apparently peculiar to itself, and are not found in any other country of the known world. It cannot be argued that these animals were part of the stock preserved by Noah, because the isolated situation of that continent, so completely separated from that region from whence the antediluvian species were again to diffuse themselves, at once forbids the supposition, and proves beyond a doubt, that a new creation was absolutely required to replenish those regions.

With regard to the natives of that continent, the same argument, however, is by no means necessary; since we know in the case of man, that storms and shipwreck have often landed him on shores previously unknown and uninhabited;* and even animals have been so wafted; but in such cases they have still left species living in the countries from whence they emigrated. To some of the animals of New Holland we at once perceive that this reasoning will not apply, since they have no living prototypes in any other portion of the known world.

As we know therefore that the elevated regions of the Himalaya, the Andes, the continent of New Holland, Eastern Isles, and indeed every quarter of the globe, produce some species, and even genera *peculiar* to themselves,† we are lead at once to perceive that in these instances no diffusion from a central focus could have placed them in their isolated situations, and consequently we are again obliged to acknowledge that fresh creations must have occurred.

From these clear and incontrovertible facts, we arrive at the conclusion that new creations have invariably followed the revolutions which the earth has undergone; for it is evi-

* See Lyell's Geology, passim.

† See J. A. S. Himalayan Geology.

dent that the plants and animals now peculiar to certain regions could not have existed *previous* to the formation of those stations in which alone they are fitted to reside, and that if the mountains of the Himalaya were not in existence before the flood, so neither were their peculiar climates and productions.

The proof already furnished of the truth of our position,* must necessarily therefore prove the truth of all; and thus we establish the fact, that *many creations have taken place since the six recorded days of Holy Writ.*

But again, as we perceive that *fresh creations* of organic beings have necessarily been attendant on the production of *new climates,* so, by a parity of reasoning, since all things tend to show that a reduction of temperature has taken place, shall we be permitted to declare that many of the *former genera and species* must have become *extinct,* when those revolutions, by reducing the temperature, *destroyed the climates in which alone they were able to exist;* and thus we are brought to *substantiate* and *explain* the doctrines of the progressive theorists, and to show how nearly they have approached the truth without being aware of it; and we may therefore assert, in accordance with those doctrines, "that the creatures were constructed with a view to the conditions of the surface of the earth;" "that repeated changes in species both of animals and vegetables in succeeding members of different formations give further evidence of important changes in the physical condition and climate of the ancient earth;" and that one race of beings has become *extinct* at a period when another *sprung into existence* to supply its place.†

The various opinions or theories of a successive creation and gradual diffusion of the animal and vegetable kingdoms

* See J. A. S. for an excellent paper on Zoological Provinces, by W. Jameson, Esq.

† Buckland's Bridgewater Treatise.

have arisen from the unwillingness of geologists to admit that the six creative days of the Mosaic record were of no longer duration than these natural days of our common computation; and truly if we are to measure the operations of infinite and almighty Power, solely by such effects as are clearly comprehensible to our weak and finite capacities, we may be excused for so theorising; but it behoves us while endeavouring to trace out the means by which the primeval operations of nature were effected, to be careful, lest over-stepping the bounds of prudence and sound reason, we launch into the dangerous paths of scepticism and infidelity.

In all cases, therefore, where we cannot clearly reconcile existing effects to the causes assigned by sacred history, it will be but in accordance with sound philosophy and true religion, to suppose that our inability to fathom those causes, proceeds from our as yet imperfect knowledge of the subject, and not from ignorance of the facts, or a disregard for truth in the inspired historian; and we shall therefore pause ere we reject his narrative, for our own wild fancies.

Having now, I trust, satisfactorily shown the untenability of the various theories and opinions regarding the creation and diffusion of species, it only remains ere bringing the subject to a close, to take a summary view of the facts we consider to have been established;—namely, that proof has already been given of the tropical character of the climates with which the infant world was blest; and that we have also gathered from the recorded facts of Holy Writ, and from the nature of the fossil flora of those early times, that the animals which then inhabited the earth, were solely of the herbivorous kinds, and that no carnivora, properly so called, existed.

The dawn of our human existence was therefore ushered in, in peace and gentleness; there was no strife, no thirst for blood, but all was quiet and serene, and aptly termed in the figurative style of scripture language, a garden or paradise. Such term must be taken as applying to no one particular spot or garden, but to the earth at large, which then enjoyed, during the short reign of innocence, a state of calm repose and happiness, to which the appellation of paradise was well suited.

But, alas! this smiling scene was not destined to be of long duration;—man fell,—and in his fall involved the ruin of a world.

This, as we have already stated, was the period of the first great geological revolution, by which the hitherto tropical character of the climates was reduced to one of more moderate temperature.

How this was effected, we may take occasion to treat of hereafter, but at present it is enough for us to state, that such is recorded in the pages of Scripture, in the declaration that the earth was cursed for man's sake, and would henceforward produce nought but weeds, unless tilled and subdued by the sweat of man's brow. How true that declaration is, we may see by every day's experience, for to this hour we eat our bread by "the toil and labour of our hands."

Supposing then that one great means of bringing about a reduction of temperature consisted in the upheavement of far loftier mountains than had hitherto adorned the surface of the earth, it is evident that the cold currents sweeping downwards from the snow-clad heights, would not only have reduced the temperature, and checked the luxuriance of the vegetation, but that it would also have caused the death and extinction of the less hardy races, both vegetable and animal, whose constitutions were such as to render them unable to bear any other temperature than that which had just been reduced. Such, we are inclined to consider, the plants and animal exuviæ of the secondary strata.

At this period it may be that the carnivora were first called into being, and commissioned to restrain the other animal races which were now, be it remembered, to multiply their species through a far longer term of years than had been accorded to the herbivorous classes before the fall, and which would consequently require those checks upon their increase which during the shortness of the first epoch was not at all necessary. This at least is but acknowledging the foresight, and in accordance with the wisdom, of the Almighty, so conspicuously displayed in all His works.

Here then was a Creation subsequent to the recorded days of Scripture; nor need we suppose that this creation of the carnivora was the only addition to the fauna of the earth, for we have seen that the reduction of temperature may in some measure have been occasioned by the upheavement of vast mountains, whose snow-clad summits furnished climates and stations hitherto unknown, and for which perhaps a peculiar fauna was required; fresh plants and animals of various kinds were therefore the natural consequence of the late revolution, and new species came into existence, as the more tender beings of the former epoch became extinct.

At a subsequent period the second geological revolution, or Mosaic deluge, occurred, and here again the same operations were repeated, but only far more extensively; and, whereas the first epoch affected almost exclusively the marine,—so the second acted most severely on the terrestrial classes.

This difference may have been a natural consequence, arising from the diversity of the destructive agents, for as the first revolution gave birth to a wider tract of dry land, the inhabitants of the sea were necessarily those which suffered,—while the second revolution, being accompanied by a flood of waters, would most seriously affect the inhabitants of the land.

In this last catastrophe perished the entire produce of the land, both animal and vegetable, with the slight exception of a few genera and species saved with Noah in the ark, and which were, in all probability, such as the Almighty foresaw would be of service to mankind, and fitting to reside in the altered temperatures of the postdiluvian era.

As the waters again subsided therefore from the face of the earth, a fresh vegetation every where sprung up, adapted to the climates in which it was to flourish, and for which alone it was proper. Animals, too, of various kinds, with constitutions adapted to the varied temperature and circumstances of the earth, were again created to supply the place of those which had again become extinct, and to tenant those new climates which the revolution had produced.

Of this fact, too, proof may be gathered as well from the doctrines of Holy Writ, as from the phenomena unfolded to our view in the rich pages of Nature's book.

Thus we perceive truly, that "the creatures have been formed with a view to the varying conditions of the earth's surface," and that each has been placed in those countries and climates where its services were alone required, and for which its constitution was peculiarly and particularly adapted, and we reject, therefore, as contrary to nature and recorded facts, the theory of progressive diffusions from a central focus.

To enter farther at present into the causes and effects of these geological revolutions, and the phenomena they have given origin to, would be foreign to our purpose; but should the farther elucidation of this important and interesting subject be desired, we shall have pleasure in recording our opinions in some future essay.

CANDAHAR,
16*th September,* 1840.

Official Correspondence on the attaching of Lightning Conductors to Powder Magazines.

[From a Correspondent.]

II.

It has afforded us much pleasure to find that our remarks on the Conductor question, published in the last number of this Journal, have been so generally, we might almost say universally, assented to; and we return to the subject for the purpose of noticing briefly the reply Dr. O'Shaughnessy has published to certain passages of our paper, and also of substantiating more fully some of the statements we therein ventured to make.

A regard for the simple courtesies of science, were there no higher actuating motive, would induce us to pass over in silence Dr. O'Shaughnessy's misrepresentations of our intentions in taking the part we have done in this discussion, and we the more readily follow this course, as we are well assured that unprejudiced readers have attempted in vain to discover in our paper the grounds of his complaint. We may however remark, that when any scientific man comes forward and lays before the public, statements which are intended to furnish materials for some important generalisation, he ought to be prepared to submit them to the most careful and rigid scrutiny, and he has no right to feel offended if others demand an amount of evidence for their substantiation greater than that which has satisfied his own mind. An immunity from this process of verification would only be productive of unmixed evil to science, and it consequently never has been, nor ever will be, accorded to any one, however high may be our confidence in his habits of careful observation, or strict honesty of scientific character.

We have no hesitation whatever in acknowledging that the detection of one important error of measurement in Dr. O'Shaughnessy's papers shook our confidence in the other statements associated with it, and we considered it right to express our doubts, and thus afford an opportunity to Dr. O'Shaughnessy to furnish further evidence by which we and others might be satisfied; this is no proper ground of complaint, and Dr. O'Shaughnessy is doubtless too well acquainted with the history of science in general, and of electricity in particular, to require to be more than reminded that it is the course which under analogous circumstances has invariably been followed, and that he by no means stands alone in having to conform to it. We need only instance the case of Dr. Wollaston, the whole of whose experiments on the identity of common and voltaic electricity have been called in question, because he mingled with his proofs an experiment which had a resemblance, and nothing more, to a case of decomposition by ordinary electricity; nor were they admitted among scientific facts till Faraday's recent researches confirmed their general correctness. Dr. O'Shaughnessy will also recollect the case of M. Colladon of Geneva, whose conclusions as to the identity of magnetism and common electricity were doubted, or totally denied, although he asserted the experiments on which they were founded had been witnessed by MM. Arago, Ampere, and Savary, because these gentlemen did not publish their admission of the results. We have briefly adverted to these instances, taken from the history of electricity, to convince our readers that the expression of doubt, when the evidence of a scientific statement is not complete, does not merit the title of "carping," and that Dr. O'Shaughnessy in being required to substantiate his assertions in greater detail than he had done, has not been unfairly dealt with.

In our former paper we were under the necessity of pointing out an instance in which Dr. O'Shaughnessy had entirely misapprehended his opponent's meaning, and consequently misrepresented his statements; and we are now compelled to point out a similar instance in which we have been the sufferer. Dr. O'Shaughnessy states, that admitting the danger from the lateral spark in a well stored Magazine, we propose to do away entirely with the copper linings of the powder barrels; but he neglects to add, that this *proposal was made dependant on the* POSSIBILITY *of* SUBSTITUTING *some* NON-CONDUCTING substance for them. Cheerfully acquitting Dr. O'Shaughnessy, as we do, of wilful misrepresentation either in Mr. Daniell's case or our own, his failure in apprehending our meaning, and his entirely erroneous statement of the nature of our suggestion (for it merits no higher title in its present state) are matters not so much of complaint as of surprise, since they indicate on his part a deficiency of that perceptive power which is an element of primary importance in the constitution of a scientific mind. The trifling in which Dr. O'Shaughnessy has indulged on this point, is unworthy at once of its author, and the subject under discussion; and having shewn it to be based on a mistake, we may consign it to that oblivion which best befits it.

Having read both of Dr. O'Shaughnessy's papers with the utmost attention we could command, we are at a loss to understand what he means by saying, that the case of Dr. Goodeve's house is therein referred to, especially in the second paper, more for *illustration* than for *proof*. The opposite inference, we confess, would have suggested itself to us, since we find it appealed to as a species of "crucial instance" between his opinions and those of Mr. Daniell; as however Dr. O'Shaughnessy appears now inclined to estimate the support to his opinions afforded by this case at its true value, we do not consider it necessary to dwell further upon it.

The information relative to the effect of the lightning on Mr. Trower's conductor, contained in Dr. O'Shaughnessy's reply to our remarks, removes satisfactorily our doubts as to its having been struck at all; and had it been furnished us in the first instance, these doubts would never have been expressed. The mere testimony of eye-witnesses as to the points of impact or course of an electric discharge we consider of the least possible value; and while the only proof of impact on Mr. Trower's conductor was such testimony, and from a solitary individual, it was impossible for us to express ourselves satisfied. Our opinion as to the value of ocular testimony was expressed in entire ignorance of M. Arago's sentiments on the point, as we have not yet had an opportunity of seeing his celebrated essay; and since Dr. O'Shaughnessy disputes the translation Dr. McClelland has given of the question, which would prove he agreed with us, we cannot yet appeal to his authority in support of our views.*

Imperfect as are the details connected with the accident to the Purfleet magazine, with which Dr. O'Shaughnessy has furnished us, they yet involve sufficient to shew that this case forms no exception to Mr. Daniell's assertion, "that there is no case on record of a properly protected magazine having been struck by lightning." We are informed that the discharge impinged on an *iron cramp* in the roof of the magazine, the presence of which *of itself* is sufficient to shew that the building was not properly constructed, nor could its conductor act efficiently with metal in its immediate vicinity.

We considered Dr. O'Shaughnessy pledged to the accuracy of every fact he had admitted into his papers, and finding it there stated as a fact, that the spear head of the Britannia on Government House was fused by the discharge on the 30th March, 1838, while we had good reason to doubt it, we could not avoid allusion to the circumstance. Had the spear point really been fused, the fact would have been fatal to our preconceived opinion as to the course of the lightning on that occasion, and we therefore felt an additional interest in having the truth discovered.

* See Note p. 501.

From Dr. O'Shaughnessy's published explanation, it appears that he stated the circumstance entirely from memory, and so imperfect does his recollection appear to be, that he cannot say whether the iron was shewn him by Capt. FitzGerald or Mr. Barnes. He *understood* one of these individuals to state, that this piece of iron was the spear head of Britannia, and he himself asserts that it certainly was fused. So treacherous is the memory, as a sole record of such facts, and so probable do we consider it that some mistake has been made by Dr. O'Shaughnessy, that we still hesitate in receiving his explanation as satisfactory. To convince him that we are not now evincing a spirit of unfounded or obstinate incredulity, we will state fully, and in detail, our grounds for this continued doubt.

Firstly.—We have personally examined with the utmost care *the identical piece of iron* alluded to by Dr. O'Shaughnessy, and failed in detecting the slightest indication of its having been subjected to fusion. This iron forms now the point of the spear of Britannia on Government House, and we have no doubt that Dr. O'Shaughnessy, by application to the proper authorities, could satisfy himself of the correctness of our statement. It appeared to us however more than probable that had indications of fusion originally existed, they would have been obliterated before the iron was replaced in its former position, and we therefore obtained—

Secondly,—The testimony of the individual by whom the repairs were executed. In obtaining this, the precaution of not giving him the slightest indication of the object of our inquiries was observed, and he was simply requested to specify the nature and extent of the repairs he had made to the spear head then before him. He assured us that no change whatever had been made, with the exception of the repair of a thin metallic strap by which the spear point was attached to the wooden shaft, and which had been broken by the fall of the arm of the figure; he pointed out to us the rivets he had made, and repeatedly assured us nothing else had been done. We then asked him if he had altered the *point*, and he replied in the *negative*.

Thirdly.—Dr. O'Shaughnessy erroneously speaks of the iron as if it had constituted the spear head, whereas it formed only the spear *point*. Its entire length is not above 4½ inches, and at its thicker extremity two thin straps are fixed to admit of its being fastened to the wooden shaft. The head of the spear is formed of wood covered with thin sheet copper. On this no alteration whatever was made by the discharge, although from its being in contact with the iron point it formed the natural path of issue for the lightning in its way to the sheeting of the dome. This is only negative evidence, but it has weight notwithstanding, since, if the discharge could fuse a thick point of iron, it must, we are warranted to conclude, have had some effect on thin sheet copper.

Fourthly.—Dr. O'Shaughnessy being acquainted with the extent of the damage done to the furniture, &c. &c. of Government House by the discharge, will admit that its disruptive force must have been very great, at least *so great* as to have shivered to pieces the wooden shaft of Britannia's spear, had that proved an obstacle to its course; yet we have carefully examined the lower portion of this shaft, and have not detected the slightest indication of its having been subjected to intense heat or disruptive force. This may be considered further negative evidence against the lightning having ever impinged on the spear head.*

Fifthly.—The entire absence of any indications of the discharge having impinged either directly or laterally on the iron spikes of the head of the figure, although these constituted a mass adjoining to the spear head.

* M. Arago proves, "that lightning cleaves wood in the direction of its length into thin laths, or still smaller fragments,"—Ed. Cal. Journ. Nat. Hist.

Lastly.—The negative evidence against the fusion, afforded by the fact, that neither Capt. Fitz-Gerald nor Mr. Barnes have in any way publicly confirmed Dr. O'Shaughnessy's statement, though they are both in Calcutta, and could have been appealed to.

The object which Dr. O'Shaughnessy had in view in stating that the spear head of Britannia was fused, cannot of course in any way affect the fact itself; and although we were fully aware that fusion of conductors takes place generally only at the points of entrance or issue of the electric discharge, that formed no just reason why we should pass over in silence a statement brought forward by him for our acceptance as a scientific fact in the electrical history of Calcutta, while we had the strong grounds, just detailed, for doubting its correctness. Dr. O'Shaughnessy is urging on Government the adoption of a plan, *the expediency* of which is denied by nearly every one—*the efficiency* of which is doubted by most; it is therefore of the utmost importance that its claims should be sifted and discussed, and that the true value of the foundation on which his plan has been constructed should be ascertained. A regard for the interests of science, for the good of the community, demands that this should be done, and we consider the determination of the correctness of his observations to be a most essential step in the process. For this reason, as we originally stated, we have dwelt longer on the case of the Government House, than we otherwise would have done. Our intention is not "to carp" at Dr. O'Shaughnessy's statements, but to ascertain their scientific value; and if in our manner of doing so there has been any thing uncourteous, we regret it sincerely, and will gladly correct it to the utmost of our power, provided only no sacrifice of impartiality be required of us.

We dissent entirely from the concluding paragraph of Dr. O'Shaughnessy's reply, and instead of joining with him in recommending the adoption of his plan, either in the case of the Fort William Magazine, or the others throughout the country, we cannot too strongly urge upon those with whom the decision rests, to have nothing to do with it in its present state. We cannot pronounce "a priori" that it can do no harm, for although theoretically we may not be able to detect any source of danger from its employment, yet this is a very questionable ground for adopting it in preference to another plan, to whose efficiency every master in electrical science bears willing and decided testimony, and which has a century of European, and many years of Indian experience to plead in its favour. The latter is estimated as of small value by Dr. O'Shaughnessy, and without disputing the point, we may simply state, that small as it is, it would be sufficient, were there not other considerations, to turn the balance against his plan, unsupported as that is *by even the experience of an hour.* Our recommendation (if we may venture to make one) would be, that no time should be lost in erecting over every Magazine in the British dominions a conductor, or when the extent requires it, conductors, of the material, the dimensions, and underground arrangements specified by Messrs. Faraday and Daniell in their respective reports; and in the event of any accident occurring subsequently, Government would have the satisfaction of knowing that the very highest authorities in the whole scientific world would justify the course it had adopted, as being that most consonant to the extent of our knowledge on a still mysterious subject, most conformable to the opinions of those best qualified to decide, and analogous to that which every other government, under similar circumstances, has followed. No government, however intense its anxiety for the welfare of its subjects, could do more; and we must say we conceive that none would be justified in doing less, or doing differently.

Having now noticed all that appears to us to require notice in Dr. O'Shaughnessy's reply to our papers, we trust he will allow us, without offence, to urge upon him in conclusion, the propriety of conducting this discussion temperately, and of refraining from the indulgence of that spirit of injustice which prominently characterises his remarks both upon ourselves and upon Mr. McClelland, for no other reason that we can see, than that we question the correctness of some of his statements, and refuse our assent to some of his reasonings, on what we believe to be good and solid grounds. We borrow the words of Sir John Herschell, in his elegant discourse on the study of Natural Philosophy, to embody what we look for from Dr. O'Shaughnessy:—"We are not so unreasonable as to demand of him an instant and peremptory dismission of all his former opinions and judgments; all we require, is that he will hold them without bigotry, retain till he shall see reason to question them, be ready to resign them when fairly proved untenable, and *to doubt them when the weight of probability is shewn to be against them.* IF HE REFUSE THIS, HE IS INCAPABLE OF SCIENCE."

POINTS FOR DETERMINATION IN ACCIDENTS FROM LIGHTNING.

With a view to obtain increased and trustworthy information relative to the various circumstances connected with accidents from lightning in this country, the following list of points for determination has been prepared. It is very far from being perfect, but it may still serve in some degree to guide the inquiries of observers, and to direct their attention to those leading points on which information is most desirable, as well as to form a ground-work on which each can rear his own superstructure.

1. *The Date of the Accident.*

This should be specified with as much minuteness as circumstances will admit of, as much interesting information relative to the course and effects of thunder storms may be developed by the correct identification of the time. The period of the commencement of the storm during which the accident occurred, as well as that of its termination, should also be noted; and if any remarkable circumstances should have been observed during its progress, the periods of these should further be recorded.

2. *The Locality of the Accident.*

It is of the utmost importance that every circumstance connected with this should be carefully recorded and duly substantiated. When it is possible, plans of the locality, drawn to a scale sufficiently large to admit of the details being distinctly represented, should be prepared. On these every dimension, verified directly by the observer himself, should be laid down in one colour, while those derived from others should be laid down in a different one. A memorandum should be attached, specifying the authorities for the latter, and furnishing an estimate of the value attached to them by the observer. In the case of buildings being struck, their general form and dimensions, both absolutely and with relation to surrounding objects, should be detailed, the nature of their fittings, the quantity of metal they contain, the protection furnished to them by the attachment of conductors, and any other circumstances of a like nature should all be carefully specified. In the event of conductors having been attached to the building, they should be examined with the greatest care. The metal of which they were composed, their dimensions, both as regards their thickness and height, the degree to which they were oxidised, their distance from each other, their height above the highest point of the building, their mode of attachment to the building, and their distance from the walls of the building, the state of their points, and the nature of their underground arrangements should all be recorded, and the authority for each statement specified. The vicinity of metallic masses to the conductors should be noted, and generally any circumstance which may appear to affect the action of the conductors, should be recorded.

3. *Details of the effects of the Discharge.*

Under this head should be included all the consequences of the discharge, and every effect which can be traced to it should be recorded and substantiated.

4. *Determination of the course of the Lightning.*

On this point mere ocular testimony must be received with the utmost caution, and the true course of the discharge from the moment of its original impact on the building to that of its quitting it, can only be indisputably established by its effects detailed in the preceding section. By these, whether they have been due to the intense heat or disruptive force which almost invariably accompany discharges of lightning, the course of the fluid will be indicated, and much care ought to be taken to trace its various steps. Sometimes the discharge becomes subdivided, and follows different lines; the determining causes of such separations should if possible be established. The vicinity of metal to the original point of impact, and its relations to the course pursued by the lightning, should be most carefully noted. All the information obtained relative to the course of the lightning should be laid down on the plan previously alluded to, but prior to doing so the observer ought to scrutinize most rigidly every point brought under his notice, estimating the value of the statements he has received, verifying them where they can admit of verification, and whenever doubts are excited in his own mind on any point, they should be openly and fully expressed by him.

5. *Meteorological and General Observations.*

The state of the Barometer, Thermometer, Hygrometer, and such other meteorological instruments as the observer may have access to should be carefully noted, and also the direction, or changes of direction, of the wind, with the disposition of the clouds during the continuance of the storm. The *kind* of the light observed, whether it was like a sheet of flame, a darting spark, or a broken zigzag. The character of the accompanying thunder-claps, whether explosive like the discharge of a large cannon, dull and rolling, or sharp and rattling; their duration, and its characteristics, whether they succeeded each other rapidly, of the same intensity, or gradually increased, or faded away, are all important points for determination. The perception on the discharge of lightning taking place of any shock, stroke, or peculiar sensation of any kind, or of any strange taste in the mouths of observers should be recorded, and the exact time of the observation remarked.

6. *Summary and Concluding Remarks.*

In conclusion, the observer should give a general summary of the case, of the inference it warrants, of its relations to recorded opinions, with such other remarks as many present themselves in connexion with the information he has collected. It is impossible to be more specific on this point, as each observer will discuss the instance he details with more or less precision, according to the state of his own knowledge of the general principles of electrical science. The chief object, however, to be kept in view, is the collection of carefully authenticated facts, minutely and faithfully detailed, and there will never be wanting those by whom such facts will be rendered subservient to the true progress of our knowledge on this most important branch of physical science.

October 26th, 1840.

Note.

Dr. O'Shaughnessy, who saw the lightning strike repeatedly not a hundred yards from his house, objects to our note, page 436, and says, M. Arago's words are, "Can you see the lightning strike *you?*" As the Doctor states that he is engaged in translating M. Arago's essay, he is probably in possession of the only French copy of the work in Calcutta, and ought to know best. The following however is a translation of M. Arago's words from the " Edinburgh New Philosophical Journal."

" *Does the Lightning strike before it becomes visible ?*

" I much question if any natural philosopher has, for some years, hazarded publicly to propose the question at the head of this section. During this period it has been supposed that nothing could, by possibility, be more rapid than lightning. A well determined velocity of eighty thousand leagues a second, appeared so astonishing, that the imagination never ventured to think of going further. The experiments, however, of Mr. Wheatstone will probably effect a change upon this point. These have, in truth, I will not say demonstrated, but they have at least led us to conceive the possibility of even greater velocities than that of light; and that, in a substance whose identity with lightning, a hundred comparisons tend to establish. The suspicion then announced at the head of this chapter, merits investigation in a theoretical point of view. Meteorology must gain by the inquiry; and I imagine the problem has a relation, on some points, to physiology. Finally, it appears to me that many timid individuals will be spared many poignant moments during thunder-storms, were it proved that nothing is to be apprehended when the flash has been seen."---*Edinb. New Phil. Journal, No.* li. *p.* 143.

Indication of a Nondescript Species of Deer. By John M'Clelland.

Captain Guthrie, of the Bengal Engineers, employed in the construction of a road from the valley of Katchar to Moneypore, procured the horns of a Deer whose lower or *basal* antler descends in the axis of the beam, rather as an extension of the horn itself than as a mere shoot. The horn may be compared to the segment of a circle, the burr, or root from which both limbs extend being placed on the outer circumference. The beam is round, and terminates by a fork, as in the Russa Deer. The lower prolongation of the horn beneath the burr may also be said to terminate in a fork, for on the left horn, about two inches below the root there is a small snag directed forward. We have represented the horns with a portion of the occipital and frontal bones adhering to them, (Plate xii. figs. 1 a. b.)

We trust Captain Guthrie will endeavour to procure more complete examples of this interesting species; and if possible, a living male and female for the Zoological Society's Menagerie in Regent's Park. This is one of the numerous examples of interesting animals which are still to be found in the forests of India, unknown and undescribed, although many of them are doubtless calculated to confer important benefits on society.

It is singular that although the vast range of climate which India affords renders it suitable to almost every kind of animal, from the polar bear to the most tropical form, yet that it should have afforded fewer species to European collections than the islands of the Straits, or the small settlement at the Cape of Good Hope.

Of 77 species of *Quadrumana* in the Museum of the Zoological Society, nearly all from British colonies, only 5 are from continental India. Of 25 species of *Lemuridæ* in the same collection, there is but *one* from India. Of 47 species of *Cheiroptera* there are but 6 from India. Of 176 species of *Feræ*, only 30 are from India. Of 16 species of *Cetacea* and *Pachydermata*, there is not one from India. Of 16 species of *Ruminantia*, only 15 are from India. Of 184 species of *Rodentia*, only 12 are from India. Of 18 *Edentata*, there is but *one* from India. Thus if we take the Museum of the Zoological Society as exhibiting the proportion in which different colonial possessions have contributed to the present stock of known Mammalia up to 1839, the ratio will be—Africa 141; South America 115; Indian archipelago 75; Continental India 66; New Holland 50. Were we to take any other class of animals than the most conspicuous, or any other Museum than the principal Zoological collection in Great Britain as the means of comparison, the result would be still less favourable to Indian Zoology. We are happy however to perceive that the Zoological Society and other public bodies in England have at length begun to adopt measures for the removal of this reproach; as a first step, the Zoological Society have authorised Messrs. Cantor and Co. to ship at their expense such animals as residents in India may feel desirous to present to their collection, and Lord Auckland has offered the Barrackpore Menagerie for the temporary reception of such as may arrive in Calcutta, pending the necessary arrangements for their dispatch to England. Other measures we believe are in contemplation, which in the course of a few years will be attended with the most favourable results.

Synopsis of Mahomedan Science, derived from the Preface to the " Jama Buhadur Khanee," *a Persian work on Mathematics; to which is added explanations of some of the scientific terms that occur in the same work. Communicated by* D. LISTON, ESQ.

Mathematics belonging to the division of science known as حکمت نظري *hikmut nuzuree,* which we may translate *speculative science,* the author of the work (the Buhadur,) Khanee, as a preliminary gives a general view of the knowledge so denominated.

Hikmut nuzuree is defined to be the knowledge of entitie موجودات *moujoodat,* with the right apprehension of them, and demonstration of their properties, so far as appreciable by human faculties.

The First Division of Hikmut nuzuree is threefold, viz.

I. Metaphysics, علم ما بعد الطبيعه *ilm ma bad ultubeeuh; lit.* μετὰ τὰ φυσικὰ; also علم اعلي *ilm aulee,* transcendental science; علم ماقبل الطبيعه *ilm ma-qub-ul ul-tu-beeuh,* q. d. Metaphysics.

II. Mathematics, علم تعلمي *ilm talumee,* called also علم رياضي *ilm reazee,* abstract science; علم اوسط *ilm woosat*

*

q. d. mean science, probably as holding a place between the preceding and the next mentioned.

III. Physical science, علم طبيعي *ilm tubeeaee;* and each of these three kinds of science is divided into several parts, of which some are in the rank of stems or roots, اصول *usool,* and some in the rank of branches, فروع *furooa.*

I. The stems of the first, or metaphysics, are two :—

1st. امور كليه نامه *umoor kooleeuh namuh,* universals (?) احوال موجودات *uhwal moujoodat,* ontology; with the understanding that the subjects have being, as *one and many, necessary and possible, new and old, preceding and following, cause and effect;* علت و معلول *ulut o malool,* with their parts, and that science is called the science of the first philosophy.

2nd. The study of the Divinity, and of the spirits and intelligences نفوس و عقول *nufoos o uqoul,* who under him are ruling powers; and they call that science theology, and the branches are various, as *prophecy, priesthood, sanctification of spirit, divination, power over true dreams, knowledge of a future state,* and such like.

II. *Mathematics.* The STEMS of this are four; viz. *geometry, arithmetic, music, astronomy.* Of the branches, four are also enumerated, viz. *dioptrics, cetoptrics, algebra, mechanics.*

III. *Physics.* The *stems* are eight; viz. 1. *physics of the heavens; 2. the science of simple and compound bodies, or the science of the earthly or lower heavens,* (i. e., of the four elements of *earth, water, air,* and *fire,* simple and compounded); 3. the science of *growth and decay,* كون و فساد *koon o fusad;* 4. *meteorology,* or science of the appearance of the sky, اثار علوي *usar ulovee;* 5. *mineralogy,* or the *science of mines rather;* 6. *botany;* 7. *zoology;* 8. *psychology.*

The branches are, 1. *medicine;* 2. *analysis?* حل *hul;* 3. *synthesis? composition of medicines?* عقد *uqud;* 4. *distilla-*

tion; 5. calcining of metals تكليس *tuklees; 6. husbandry; 7. astrology.*

In the above paragraphs I have given the original words, in cases where I have been doubtful of the translation, or where the meaning ascribed might not be found readily in Richardson's Dictionary (edit. 1806). The following are a few words in the condition last mentioned, and to which I have endeavoured to assign a correct interpretation. New inquirers into Arabic philosophy may perhaps find the list, though small, of use; or the attempt may call the attention of qualified individuals to supply effectually explanations of scientific terms, in which respect it has been considered by competent judges that there is room for improvement in Arabic Dictionaries.

احكام *uhukam*, laws, properties.

اصول موضوعه *usool mouzoouh*, axioms or postulates.

اعراض لازمه *auraz lazumuh*, essential properties, predicamental accidents (?)

ارقام هندي *urqam hindee*, Indian notation in arithmetic.

ارقام ستيني *urqam suteenee*, is the literal notations employed by the Greek geometricians in arithmetical operations, or the لنقيو *abjed*, notations of the Arabians الا *ila*, besides except is employed for the negative sign in algebra.

اوج *aouj*, apogee.

اختلاف منظر *ikhtulaf munzur*, parallax.

بيضوي *byzooee*, an ellipsis, l. an oval.

تصديق *tusdeeq*, demonstration.

تجذير طلب *tujuzeer tulub*, investigation of the square-root.

تدوير *tudweer*, epicycle.

تقويم *tuqween*, right ascension.

تجاوز *tujaooz*, optical refraction.

ذات الثقبتين *zat ul suqbutyn*, name of a sort of micrometer.

جيب *jyb*, a sine, جيب اعظم *jyb auzum*, is used for radius in trigonometry.

جوزهر *jozuher*, sphere of the moon, the poles of which coincide with those of the ecliptic.

حادح *haduh*, acute as an angle.

حضيض *huzeez*, perigee.

حامل *hamul*, deferent in the old astronomy.

حلقهٔ شاملهٔ افقي *hulquh shamil oofuqee*, name of a sort of altitude and azimuth instrument.

ذات الحلق *zat ul hulaq*, name of a sort of armillary sphere.

خارج قسمت *kharij qusmut*, quotient.

خارج المركز *kharij ul murkuz*, the eccentric in which the sun or a planet is supposed to move round the centre of the world.

دايرهٔ معدل النهار, *daeruh madul ul nihur*, equinoctial circle.

دايرهٔ منطقه البرج, *daeruh muntuq ul burooj*, ecliptic.

دايرهٔ مارهٔ باقطاب اربعه *daeruh maruh baquteb urubuh*, solstitial colure.

دايرهٔ ميل, *daeruh myl*, circles of declinations are so named.

دايره عرض *daeruh uruz*, latitude.

افق *oofuq*, horizon.

نصف النهار *nisf ul nihar*, meridians.

اول السموت *awul oos sumoot*, prime vertical.

ارتفاع *irtif au*, elevations.

راس *ras*, is used for node, perhaps for a quadrant beyond it.

زائد *zaed,* is used for a positive quantity; ناقص *naqus* is a minus, or negative quantity.

سمک *sumuk,* height or thickness.

سهم *suhum,* an arrow, is used for an axis, as of a cone.

سطح *sutuh,* a plane; سطوح متکافیه *sutooh mut kafeeah,* reciprocal figures.

سدس *sudus,* a sextant; سدس انکاس *sudus anakas* is the term employed for a reflecting sextant.

شي *shee,* the unknown quantity in an equation.

ذات الشعبتين *zat oos shabutyn,* an instrument fitted to mark chords of elevations.

ظل *zul,* tangent in trigonometry; ظل دوم *zul doam,* ظل مستوي *zul mustooee,* and ظل ثاني *zul sanee,* cotangent; ظل ستيني *zul suteenee,* and ظل اصابا *zul usaba,* (quere) لدا صابع digits, applied to the tangent according as the radius is supposed divided into 60 or into 12 parts; ظل اقدام *zul uqudam* if radius is supposed, divided into seven parts. A tangent to a curve is مماس *mumas.*

علم الهي *ilm iluhee,* divine science; the term is also employed for intuitive knowledge in the preface to the Buhadur Khanee.

علوم متعرفه *iloom muturufuh,* axioms.

علم الابصار *ilm ulabusar,* optics.

علم المرايا *ilm ulmuraeea,* catoptrics; *ilm ulanakas* is also used for this branch of science, see above.

عقدتين *uqudutyn,* nodes.

فصل مشترک *fuzul mushturuk,* line of common sections of two planes.

قوس *qbus,* an arc; قس and مقايس pl.

كره *kuruh,* a sphere; كره مصنوعه *kuruh musnooah,* an artificial globe.

لبنه *lubnuh,* an astronomical instrument, being a semicircle for observing altitudes of heavenly bodies.

مواليد *mooaleed* (l) productions; مواليد ثلثه *mooaleed sulusuh,* the three kingdoms of nature.

معين *mueen,* a rhombus; شبيه بالمعين *shubeeuh bilmueen* a parallelogram.

مسدس *musudus,* a hexagon.

معشر *mushur,* a decagon.

مجسم متوازي السطوح, *mujusum mutooazee us sutooh,* a paralleopiped.

مخروط *mukhrot,* cone; راس مخروط *ras mukhrot,* apex of a cone.

مخروط مضلع *mukhro muzlu,* a pyramid.

متفرجه *mutfurjuh,* obtuse as an angle.

محور *muhoor,* axis as of a sphere.

مري *muree,* an object of sight.

مال *mal,* a square in arithmetic and algebra, as is also مجذور *mujuzoor.*

مقسوم *muqusoom,* dividend مقسوم عليه *muqusoom uleeh,* divisor.

معرفت مقادير اضلاع و زوايا مثلث *murfut muqudeer izlau o zoaeea musulus,* means plane trigonometry.

معرفت مقادير اضلاع و زوايا مثلث قوس كه برسطح كره وقع شود *murfut muqadeer izlau o zoaeea musulus qous kuh bur sutuhi kuruh wuqu shownd,* is spherical trigonometry.

متمم حادي *mutumum hadee* is used for the maximum distance of a planet from the supposed centre of the world.

متمم محوي *mutumum mahovee* is the minimum distance of a planet from the centre.

فلک ممثل *fuluk mumsul,* corresponds to the *primum mobile* of the old astronomy, its poles are those of the ecliptic.

مربع مجيب *murubu mujyb,* an astronomical quadrant.

نقطة تقاطع *nuqtuh tuqutu,* nodes.

وتر *wutur,* a chord ; pl. اوتار *uwutar.*

EUROPE:—*a popular Physical Sketch. By Professor* SCHOUW. *Translated from the second edition, by Dr.* CANTOR, *Assistant Surgeon, Bengal Medical Service, doing duty with H. M's.* 26*th Regt. on expedition to China.*[1]

Central European mountains. These mountains, bounded by the last mentioned plain on the one side and the Alps and Pyrenees on the other, form nearly a semicircular belt (broadest north of the Alps, and narrower to the east and west) round the Alps, the highest mountains in Europe. Traversing from W. to E. a flat district on the west coast of France, the traveller is stopped by the Auvergne mountains, an oblong chain, eighty miles N. to S. between the rivers Allier, Dordogne, and Lot, flat above, interrupted by loftier, mostly conical peaks, many of which are exhausted volcanoes.

The chain attains an elevation of 3733 feet, and Mont d' Or is 6192, Cantal 5700 feet high. The *Cevennes* form a long chain E. and W. of the Auvergnes, about 180 miles long, commencing in a direction from SW. to NE. and then changing from S. to N. They are separated from the Pyrenees by a deep ditch, in which is cut the Languedoc canal, which, 533 to 640 feet above the level of the sea, unites the Mediterranean with the Atlantic ocean. Towards

[1] Continued from page 419.

the east is the river Rhone, towards the west Tarn and Allier. The northern part is called Montagne Forez. The mean altitude is computed to be 3733 feet; Pierre sur Haut is 6400, Mont Mezin 5653, La Lozère 5653 feet.

Jura, an elongated chain, runs from SW. to NE. between the rivers Saone and Doubs on the one, and the Rhine and the NW. part of Switzerland on the other side. Rauhe Alp continuing this direction on the opposite side of the Rhine, and consists of a similar kind of limestone, is properly regarded as a continuation. The length of Jura is 140 miles, or 240 including Rauhe Alp. The chain consists of several longitudinal valleys, whereas the transversal valleys are remarkably small and few. The side facing Switzerland is full of precipices, whereas it slopes with terraces towards France. The mean altitude is about 3733 feet, and the highest peaks are pretty uniform, viz. Pré de Marmiers 5653 feet, Réculet 5653, Mt. Tendre 5546, and Dôle 5546 feet. The mean elevation of Rauhe Alp between the rivers Necker and Danube (Donau) is only 1706 feet, and Hohenberg reaches to 3413 feet.

On either side of the Rhine, N. of Jura, appear several mountains, which might be collected under the common name of the *Rhenish mountains.* To the W. of the Rhine the *Vosges* are situated, a longitudinal mass, extending 120 miles from S. to N., bounded on the W. and N. by the river Moselle, of 2666 feet mean elevation, and with numerous cupola-shaped rocks, of which Ballon de Sulz is 4586, Ballon d' Alsace 4160 feet in height. East of the Rhine is the *Schwarzwald,* bounded by the river Necker and the chain of *Odenwald,* which again is surrounded by the Mayn. Schwarzwald is 2666 feet (Feldberg the highest peak is 4800 feet); Odenwald has a mean elevation of 1066 feet (Malchen is 1706 feet). Lower still, and less connected, are the mountains to the north of the Odenwald, on the eastern bank of the Rhine, viz. *Spessart, Taunus, Vogelgebirge, Westerwald,* which also is the case with *Hundsrück*, *Eifel*, &c. on the western bank of the Rhine; which of course receives their rivers.

The following mountains, which as they send their rivers to the Weser river might be denominated the *Weser mountains*, viz., *Harz*, a somewhat isolated chain flattened above, of 2133 feet mean elevation (Brocken, Blocksberg, 3733 feet) which is rich in minerals, chiefly iron, lead, silver, and copper, also arsenic, zinc, and cobalt. Clausthal and Andreasberg, two mountain towns, are built 2133 feet above the level of the sea. The *Weser mountains*, properly so called, are much lower, of 440 feet mean elevation, with the highest peaks about 1280 feet, also *Das Rhöngebirge*, and several exhausted volcanoes belong to those low mountains. *Thüringerwald* and *Frankenwald*, 1500 feet mean elevation, (Grosser Beerberg 3413 feet) form a transition to those mountains, which contain the sources of the river Elbe.

The centre of Bohemia is a basin-shaped depression, surrounded by mountains, *Elbe-mountains* as they might be termed, which are generally speaking flattened above, and therefore approach to what is commonly called land ridges, although loftier mountains rise from these. The surrounding mountains are *Titchtelgebirge*, NW. of Bohemia, 1708 feet (Schneeberg 3413); *Erzgebirge* in the north, steep towards Bohemia, sloping towards Saxony, 1600 feet (Schwarzwald 4053), *Böhmerwald* in the W. and S., a kind of mountain-plain 2666 feet, Heidelberg 4160, Arber 4053 feet, *Sudetes* (the northern extremity of which is called Riesengebirge) towards NE. 2666 feet, Schneekoppe 4213 feet, Glatzer Schneeberg 4586 feet. Of those the Erzgebirge are particularly rich in ores (silver, copper, iron, lead, cobalt, nickel.) In the Fichtelgebirge the remarkable limestone caves contain bones of fossil mammalia, particularly bears.

In like manner as Bohemia, the large Hungarian plain is also surrounded by mountains; in the W. and SW. by the eastern part of the Alps, in the S. by the Dinarian Alps; but nearly one-third of this almost circular plain is bounded by a kind of flat rampart of 2133 to 3200 feet in height, extending about 560 miles, from which rise several considerable heights. This rampart is usually called the *Carpathians,* the loftiest group of which is *Tatra,* in the north-western part, the greatest elevations of which are Eisthalerspitze 8533 feet, Lomnitzerspitze 8479, and Hundsdorfferspitze 8320 feet, also the south-eastern Carpathians attain a considerable elevation.

In all the central European mountains are found several *plains* and extensive *valleys.* West of the Auvergnes and Cevennes, the country slopes into a flat coast land, and considerable heath districts (Les Landes). Between the Cevennes and Côte d'Or on the one side, and the Alps and Jura on the other, is situated the Rhone and Saone valley. The country between the Mediterranean and the British Channel has here an elevation of 1491 feet, and here is a canal communication. From this point the Rhone and Saone valley slope by degrees towards the Mediterranean. The Rhine passes through a valley which from Schwarzwald and the Vosges declines from 853 feet to a still lower level. Between Rauhe Alp, Schwarzwald, Odenwald, Thüringerwald, Fichtelgebirge, and Böhmerwald, the Franconian plain is situated 965 feet above the level of the sea. That of the Bohemian basin is 533 feet, that of the plain of Mährn, between the Sudetes and the Carpathian mountains, 640 feet. Between Böhmerwald and the Alps appears the broad Danube valley, or the lower Austrian plain, 533 feet, which is continued by the much more extensive circular Hungarian plain, elevated from 213 to 320 feet above the sea.

The most important rivers whose sources either are in the central European mountains, or turn their course between them and receive branch rivers, are the *Garonne* from the Pyrenees, Cevennes, and Auvergnes to the Atlantic; *Loire* and *Seine* from the two latter mountains and the northern hilly country to the Atlantic and the British Channel; *Rhone* from the Cevennes, the western face of Jura and the Alps, to the Mediterranean; *Rhine* from the Alps, receiving branch rivers from Jura, the Vosges, Schwarzwald, Odenwald, and some smaller mountains; *Weser,* from the above-mentioned Weser mountains; the *Elbe,* from the Elbe mountains, (the three last rivers send their waters into the North sea); *Oder* from the east side of the Sudetes to the Baltic; *Weichsel* (Vistula) from the north side of the Carpathians, also to the Baltic; *Dnister* from the east side of the Carpathians to the Black Sea; and, lastly, the *Danube* (Donau) from Schwarzwald and Rauhe Alp, receiving a number of large branch rivers from the north and east side of the Alps, and some from Böhmerwald and the Carpathians, whose mouth is also in the Black sea.

Geat lakes are only found on the Hungarian plain; viz. Plàtten, and Newsiedler lake.

		Annual,	Winter,	Summer.
Bordeaux,	45° N. L.	56·75	43	71·4
Carlsruke,	49°	51·12	34·2	65·75
Prag, ...	50°	50	30·88	66·9
Vienna, ...	48°	51·12	32	69·12
Ofen,......	47°30′	51·12	30·88	70·2
Clermont,*	46°	51·12	36·5	36.5

From this it will be perceived that the mean temperature somewhat decreases toward the east, and particularly that the winter becomes severer, the summer warmer: the Rhenish valley (Carlsruke) and the Bohemian basin (Prag) have a remarkably high mean temperature. The winter in Prag is about equal to Copenhagen, but the summer nearly 3·37° warmer. At Ofen the difference between summer and winter

* In Auvergne.

is 39·32°, in Vienna 37·12°, at Bourdeaux 28·4°. In the plateau of Auvergne, the town of Clermont (1349 feet above the sea) has a mean temperature equal to that of Paris, which is situated 3° more to the northward. Clermont, compared to Bourdeaux, proves that a height of 1349 feet lowers the mean temperature 5·62°, which is at the rate of 2·25° per 537·8 feet.

The annual quantity of rain on the west coast of France is 24½ inches, consequently little less than in Holland, and a good deal less than in the west of England. Towards the mountains the quantity increases; in the Rhine valley, for instance, from Coblentz to Mühlhaunsen from 21 to 28½ inches. On the eastern plains the quantity appears to become less, more so even than on the north European plain; thus the quantity of rain in Prag is 18 inches, in Ofen 16.

Notwithstanding the Carpathians attain an elevation of 8533 feet, yet the snow on them is not perpetual; and on the Eisthalerspitze but a little snow remains during summer in the clefts, and there forms a small glacier; nor do the rest of the central European mountains, of which none is higher than 6400 feet, reach the snow-line. The higher mountains of the Carpathians are of course covered with snow during the greater part of the year, which some of their names indicate, as Schneekopf,* Schneeberg.†

The western coast of France consists in a great measure of *heaths* (Les Landes), but is also covered in some places by forests, consisting of *coast-fir*, a species quite different from the northern. The French mountains (Jura, Cevennes, Auvergnes,) present chiefly *beech* and *oak* in the higher, *chestnut* in the lower regions. The German mountains are covered partly by *pines* and (hence the names of Schwarzwald, Tichtelgebirge, &c.) partly by *beech* and *oak*, and in the Rhine, Mayence, and Neckar valley is also found the

* i. e. Snow-head. † i. e. Snow-mountain.

chestnut. In the Carpathians, '*Krumholz*' (a kind of low fir) and another kind of *pine,* form the upper forests; *beech* the lower.

The *cultivated vegetation* is in a great measure the same as that of the North European plain; yet some additional plants appear in the valleys, on the plains, and on the sides of the central European mountains. Thus the *vine* on the west coast of France as far as the city of Nantes, in the Rhone valley, in the Rhine valley and its lateral branches, on the Austrian and Hungarian plain. The north frontier of the vine is more dependent on the temperature of the summer than of the mean temperature of the year round. On the west coast of France the north frontier is 47°, in Champagne 49° to 50°, where the Rhine and Moselle unite 50° to 51°, at Dresden 51°, and in Hungary 48° to 49°. The almond and fig thrive in the open air in the warmer parts of the Rhine valley (Pfalz to 50°). In the lowest part of the Rhone valley, and on the south side of the Cevennes mountains, the olive is found, with other trees peculiar to the vegetation of the countries bordering the Mediterranean. *The domesticated animals* are the same as those of the North European plain, with the addition of the *ass.* The boundary of this animal, as domesticated, is 50° N. L. In Hungary *buffalos* are found. *East European plain.* The largest in Europe, is bounded on the E. by the Ural mountains (running from S. to N.) and the Caspian sea; but between these, the plain blends into the basin surrounding the Caspian sea; in the S. the Caucasus (the direction of which is nearly E. to W.) the Black sea, and lastly the Balkan, form the natural frontiers. In the W. the plain is bounded by the Carpathians, to the northward of which it blends into the North European plain, and the Baltic; but towards Finland, no well defined line of demarcation appears, whereas the Arctic sea and its gulph, the White sea, form the northern frontier. The situation is between the 43° and 70° N. L., thus occupying 27 degrees from N. to S., it extends about 1600 miles from E. to W., 800 between the gulphs of Finland and Ural, 1200 from Grodno to Ural, and 500 from the Carpathians to Astrakan on the Caspian sea. The sea, viz. the Arctic ocean and the White sea, the Baltic, with the gulph of Finland, the Black sea and the gulph of Asov, touch a small part only of this immense plain, the most part of which is continent, and far distant from the ocean.

The entire plain is indeed not quite level, for the NW. part presents some uneven tracts, which however either form undulated plains, or plateau, or high banks of rivers, scarcely exceeding 853 to 1066 feet, and consequently do not deserve the name of mountains. Such, for instance, is the case with the tracts of country called the Waldai and the Wolchonsky mountains, the sources of the rivers Volga and Dnipr (E. and S.), Duna and Volkoo (NW. and N.). The country between Dnipr on the one, Düna and Niemen on the other side, consists of marshes, and there is a canal communication between these three rivers, and between Dnipr and the Vistula, and those rivers, although taking different directions, occasionally communicate after heavy rains. The NW. parts appear to be the highest, and from those the plain slopes partly towards the White, partly towards the Caspian sea, the surrounding countries of which (in NW. and E.) form a basin; thus Saratov and Orenburg, situated in opposite directions some 280 miles distant from the Caspian sea, are only 320 feet, Burzuk, on the lake Aral, 130 feet, above the level of the Caspian. Gaisekaln, in Livonia, a short distance from the Baltic, has an elevation of nearly 1024 feet above the level of the ocean.

Some of the largest rivers in Europe, most of which have their sources here, water the plain; thus the gigantic *Volga*, whose mouth is in the Caspian sea, *Don*, *Dnipr*, *Dnister*, and the *Danube* terminating in the Black sea, *Niemen* and *Düna* in the Baltic, *Dvina* and *Petschora* in the Arctic ocean.

The northern part of Russia has greater *lakes* than any other country in Europe, among which Ladoga, Onega, and Peipus are the most remarkable Towards the south and east the lakes become more and more rare; to the westward many considerable marshes are found.

The greater part of the plain is covered with those more recent strata of earth commonly called alluvium, containing boulders; the south of Russia, however, presents in many places granite, chalk, and other kinds of limestone. The *climate* may be understood by the following table.

		Annual,	Winter,	Summer,
St. Petersburg,...	60° N. L.	37·6	16·13	62·37
Moscow, ...	56	38·70	10·63	65·75
Kasan, ...	56	36·5	10·63	62·37

On comparing these cities with others of a more westerly locality, we find that the temperature in Europe decreases considerably towards the east. The mean temperature of St. Petersburg is 4·5 less than that of Stockholm, and 6·25 less than that of Ullensvang; that of Moscow is 7·87 less than that of Copenhagen, and 9 less than that of Edinburgh. The winter is extremely severe, whereas the summer is comparatively warm. The summer in St. Petersburg is warmer than in Stockholm and Ullensvang, but the winter is 9·17 colder than in Stockholm, and 13·67 colder than in Ullensvang. The winter in Moscow is 21·27 colder than in Copenhagen, 28·12 colder than in Edinburgh, nay, even severer than at the North Cape, or the northern part of Iceland. The summer temperature, on the other hand, is 2·2 above Copenhagen, 7·87 above Edinburgh, and an equal mean summer temperarture is not met with till we reach Paris or Carlsruhe. Thus the climate of Copenhagen when compared to Moscow, becomes a coast climate, whereas compared to Edinburgh it is a perfect continental climate.

At Kasan, on the latitude of Copenhagen, mercury freezes occasionally, which in western Europe only happens in Lapland. Also in the south of Russia the winter is proportionally severe; the sea of Asov is frozen every year along the coast, and so is the mouth of the Volga in the Caspian sea.

Too few observations exist upon the annual quantity of rain, which, on a plain, generally at a great distance from the sea, may be supposed to be trifling. At St. Petersburg it amounts to 21 inches. Snow is much more common, and remains much longer on the ground, than in the same latitude in western Europe, and the thus protracted sledge communication increases the inland trade. From observations during one century, the river Neva freezes across at St. Petersburg on the 11th of November, and is freed from ice on the 9th of April. The river Volga at Kasan (on the latitude of Copenhagen) is frozen from the end of October till the commencement of April.

In St. Petersburg westerly *winds* prevail, (yet not to such a degree as in western Europe,) so also at Moscow and Kasan. Whether this also be the case on the southern part of the plain, is not known, for want of observations upon the subject.

The northern and central part of the east European plain possesses many *forests,* whereas the southern part has none. These barren districts are, as far as they are uncultivated, called 'steppes,' the soil of which towards the Caspian sea contains salt ('salt-steppes'). The predominant forms of trees are, *fir, pine, larch, birch, oak, lime, and elm.* The *larch,* which does not appear in a wild state in Scandinavia or the North European plain, is common in the northern and north-eastern part of Russia. The *lime* tree is more common on the east European plain than in any other part of Europe. The north frontier of these trees may thus be fixed :—

Birch,	69° N. L.
Larch,	68°
Pine,	68°
Fir,	67°
Lime,	63°
Elm,	62°
Oak,	60°

From which it will be perceived that these trees, notwithstanding the severer climate in Russia, extend nearly as far north as in Scandinavia, and even more to the northward than on the islands of the Atlantic. The beech does not thrive in this severe climate, and is found only in Volhynia, and some other south-western provinces. The chestnut does not appear in a wild state.

Except in the northernmost part, and in some districts where the soil proves an obstacle, this plain is well adapted for agriculture. The exportation of grain from the ports in the Baltic and from Odessa is very important, and the sorts exported are *rye, wheat, oats,* and in the central provinces millet, and in the southern also maize. Rye is the common bread from 65° to 48° N. L., below which wheat. The north frontier of these kinds of grain may be fixed thus:—

Barley,	67° N. L.
Rye,	65°
Oats,	63°
Wheat,	60°
Millet,	55°
Maize,	48°

Compared to the agricultural frontiers in the western part of the European continent, the difference will not be found considerable, and even on the islands of the Atlantic, grain extends not so far north as on the North European plain; another proof that grain cultivation depends more upon the summer temperature than upon the annual temperature.

Our northern fruit trees succeed but with difficulty at St. Petersburg, which arises not so much from want of summer-heat (there nearly equal to that of Copenhagen), as in consequence of the winter and spring cold, which injures the stems, and nips the trees in the bud. At St. Petersburg experiments have been made to draw the stems along the ground, thus affording them a cover under the winter snow, and the results have turned out favourably, and fruit has thus been produced even in less favourable years. As commonly cultivated, the fruit trees extend no farther than the 56° N. L. The apple stands the climate best, next to that the cherry; pears and plum trees find more difficulty.

The most northerly *vineyards* occur at Zarizyn and Sarepta on the river Volga (48° N. L.), at Astrakan (46°); in the western parts small plantations are found as far as 49° to 50° N. L.; from which it will be perceived that the cultivation of the vine extends as far north in eastern Europe as it does in the western. *Hemp* and *flax* are much cultivated in Russia, and thrive well up to 64° N. L.

The *domesticated animals* are the same as in central Europe; though the ass is found in the southernmost parts only. *Camels* are met with in Wallachy, Moldow, and some of the southern Russian provinces, where these animals however require during winter to be sewed up in blankets in order to stand the cold.

In the eastern parts of the Russian plain are found people of the Kalmukian (Scythian) race, materially distinguished from the Europeans; they are short, with broad faces, with protruding jaws, and small half-shut eyes; their skin is of a yellow colour. The rest of the inhabitants belong to the European (Caucasian) race.

Crimea. This peninsula is united with the Eastern European plain by a narrow isthmus; its northern part is a perfect plain; in the southern is situated a small, but proportionally lofty mass of mountains, very steep toward the north, but gently sloping to the south, and chiefly consisting of limestone. The highest peaks are Tschadyrdagh 5058, and Babugan-Jaila 5038 feet. The summit is partly covered with pines, farther down with beech and oak forests. In the valleys inclined towards the south, which are flanked by the mountains toward the north, the climate is very mild, and here are found the *laurel*, the *wild olive-tree*, the *fig-tree*, the *manna ash*, and other plants belonging to the southern countries of Europe, and not only the *vine* is cultivated, yielding excellent wine, but also *figs*, *almonds*, and even the cotton plant and the olive thrive, although the latter produces but an inferior description of oil. In Crimea also the camel is kept as a domesticated animal. By a number of mountain chains, pursuing a serpentine line from E. to W. and interrupted in one place only, the southern Europe is separated from the northern: *Balkan*, the *Alps*, and *Pyrenees* form this line.

Balkan and the Dinarian mountains. Of the former our information is very imperfect; it is only known as a huge and lofty chain between the Danube plain and the Grecian Peninsula, following a course from E. to W. from the Black sea to the Adriatic, a distance of about 320 miles. Orbelos, the highest elevation, is computed to be 9600 feet.

[To be continued.]

Self-Calculating Sextant. By Alexander Jack, *30th Regiment Bengal Native Infantry.*

The attention of the scientific portion of the public is solicited to the validity of the principles on which the Self-calculating* Sextant is constructed.

* The name requires explanation. A common Sextant affords data for calculation. So also does our proposed instrument; at the same time making, we trust, a step in advance, it saves the trouble of calculation, announcing, in the plainest terms, the elevation and distance, with promptitude and fidelity.

They appear to be new in practice, certain to demonstration, and promise to become useful.

1*st.* Reflex vision, which diminishes the scale on the circular arc to half its natural dimensions, enlarges the scale on the line of cotangents to double its natural dimensions; thus creating a difference of four to one in favour of the accuracy of the latter.

2*d.* Besides the advantage of reading from a larger scale, a farther benefit we think of importance, is obtained by the introduction of a line of cotangents. Our knowledge is thus advanced a step without trouble or thought, being told directly, or by inspection, the relative proportions of two sides of a right-angled triangle, which otherwise could only be made by indirect means, or calculations founded on a measurement of the arc.

The instrument proposed, besides other advantages, possesses all the properties of a good Sextant.

Its form is convenient for ascertaining angles, whether vertical or horizontal. Thence it is adequate to every purpose for which a Sextant is wanted.

Its chief peculiarity consists in the introduction of a lineal scale, by the inspection of which, many important and frequently recurring problems may be solved on the spot, without a reference to books, or any calculation beyond the most simple; thus saving much time, while we are made independent of foreign aid, and obtain results we think more satisfactory and accurate than can be had by instruments in common use.

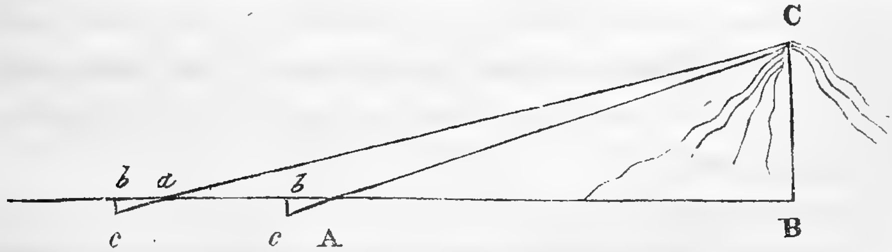
In a right-angled plain triangle, if one side be made radius, the other side becomes the tangent of the angle opposite to it, and the hypothenuse the secant of the same angle. The scale in question is a line of cotangents, the several divisions of which are noted by the index converted into a hypothenuse or secant.

Every movement of the index announces two things ;—on the limb (as in other instruments), the measure of an angle;—on the line of cotangents, the relative proportion of two sides of a right-angled triangle. This last is a piece of information which no other instrument gives direct.

This additional information gives a command over the quantities concerned much greater than otherwise could be had.

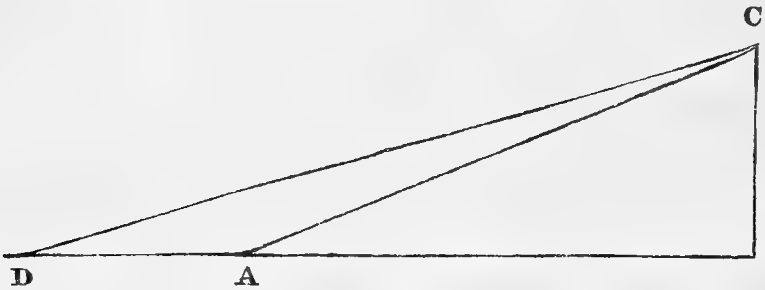
Availing ourselves of the lineal scale, our first aim will be to reduce the problem to a case of right-angled triangles. In all that respects heights and distances on the vertical or horizontal planes, this may, in general, be done with the utmost ease.

On the vertical plane, every altitude may be viewed as a perpendicular to the horizontal line passing through the eye of the observer, and since the instrument affords the means of ascertaining that line, and also the proportion which the height bears to the distance, it is evident that we are put in possession of considerable information on the subject. If we wish farther to know the actual measurement of parts, set the instrument a division backward or forward on the line of cotangents, and advance or retreat. By measuring the intervening space you may then proceed with facility and certainty.



Let BC be a mountain whose height and distance are unknown; occupying the station A, apply the instrument vertically to your eye, and having ascertained the horizontal line AB, look steadily along it by direct vision, and move the index A*c* until you see the top of the object C by reflex vision correspond with the horizontal line at B; fix the index and the observation is complete. If you now consult the instrument, as a common sextant, you will learn from it the measure of the angle BAC. If, as a Self-calculating Sextant, you will further learn the proportion which BC bears to AB. Referring to the figure, the triangle A*bc* on the instrument is similar to the triangle ABC in the field, consequently, *bc* to A*b* on the one, as BC to AB in the other; thence, if you know the height you learn the distance, and *vice versa:* if you know neither, move the index one full division forward on the line of cotangents, and retreat until the top and bottom again become coincident; you then have the perpendicular projected on the ground, and by actual measurement thereof, obtain the height, and thence the distance.

It is not pretended that a like result may not be obtained by a common Sextant, but perhaps neither with the same certainty nor equal dispatch. Take, for example, the present most simple of all cases, to ascertain the height of an inaccessible object above the horizontal plane. After



two observations and one measurement backwards, as before, the trigonometrical calculations wanted in the latter case are as follow:—

Sin $\angle$ ACD : Sin $\angle$ D : : AD : AC;

B : Sin $\angle$ CAB : : AC : BC the height;

and R : Tan $\angle$ BCA : : BC : AB the distance.

Now, the purpose of all this apparatus of tables of Sines, Tangents, and Secants, is learned from our instrument by simple inspection, and more accurately, we think, by it than by any circuitous process.* To say nothing of the pleasure of being informed on the spot, which in many cases may be most important, as in the vicinity of a hostile fortress, when a person with this instrument in his hand, might in a few minutes furnish information which could not otherwise be had in as many hours; superseding at once the necessity for books and tables.

We are also of opinion that the method now recommended is more scientific, and accurate in its results, than the former circuitous one. The reasons of which are—

1st. That, in respect of science, it is surely more scientific in design to ascertain the cotangent directly by inspection, than directly by reference to the arc.

2d. That, on the circular limb, half the arc (by reason of reflex vision) measures the whole angle; on the line of cotangents (by reason of the same), double the radius becomes the measure of the cotangent; in other words, reflex vision, which reduces the scale on the limb one-half, doubles that on the line of cotangents, and thus creates a difference as four to one in favour of the accuracy of the latter.

3d. That all tables of Logarithms, Sines, Tangents, and Secants give interminate decimals, or mere approximations, which cannot vie in accuracy with direct results.

It may be objected to the instrument, that, taking cognizance only of right-angled triangles, the cases to which the cotangent scale is applicable must be few. On the contrary, it is surprising the number of important problems to which it may be applied, whether on the vertical or horizontal plane. Besides, it affords a fine exercise of ingenuity to

* The process of observation, in this case, is nearly identical with the former, the only difference is that, referring to the line of cotangents, we have a direct answer on a scale of four times the relative dimensions.

bring all problems, as far as may be, under the influence of this most simple rule.

Were the uncommon accuracy in detail, and facility in practice attainable by this instrument generally known, we think that it would supersede many of the contrivances at present in use for purposes of surveying. For example, it would prevent the necessity of dragging a chain for the measurement of distances, thus removing at once the most laborious, unpleasant, and painful duty connected with the profession.

To measure a distance not exceeding four chains, nothing more is wanted than a pole, with cross projections at top and bottom, ten links apart. Erect the pole where you please; by a single observation (making the projections at top and bottom coincide) you may at once tell your distance in chains and links. Or sending a bearer off in any direction, with the pole erect, you may tell him to stop at any predetermined distance, ascertained by the coincidence of the crosses.

For greater distances (even of miles) similar means are resorted to, on the ground plane. From one extremity of the line to be measured, set off a perpendicular (which the instrument readily enables you to do), measure on this line a convenient distance, not less than one-fortieth part of the whole distance to be measured; then proceed to the other extremity of the original line, and using the instrument horizontally, bring the two former stations into contact. By a single inspection you ascertain the distance required.

The economy of time and labour, which this method appears likely to effect, is obvious; it is independent of temperature, seasons, crops on the ground, intervening obstacles, and all the contingencies to which measurements by the chain are liable. But what is more deserving of notice is, that its accuracy seems to be superior to that of the ordinary means now in use, which may, at any time, be ascertained by the test of experiment.

It has been objected to Hadley's Sextant, that, by reason of reflex vision, the scale on the circular arc is reduced one-half. In the proposed Sextant, from the same cause, the scale on the line of cotangents is doubled; for whatever halves the arc, doubles the cotangent; hence the latter not only remedies the objection, but, doubling the original scale, quadruples the chance of accuracy in a comparison with the former.

Farther, by substituting the measurement of a right line for that of a circular arc, the calculation necessary for a mere transference of terms, is saved.

The Silurian System. *By* R. I. Murchison, Esq., F.R.S., F.L.S.[1]

In our first notice we reviewed that part of Mr. Murchison's work which treated of those deposits which pass from the oolitic beds down to the coal measures. In our second notice we endeavoured to lay before our readers the chief peculiarities of the coal measures, in all cases pointing out any points of coincidence between Indian and English formations that our experience may have suggested, thus rendering our notice of Mr. Murchison's work of more interest, we trust, than a dry barren criticism. The small coal-field of Newcut, in Gloucestershire, is alluded to by Mr. Murchison to show how the regular series of formations may be interrupted, and how the new red sandstone may rest on the old red without the intervention of the coal measures; and in some cases where even the old red sandstone itself is absent, and the new red thus brought into contact with

[1] Continued from p. 236.

Silurian rocks. "It was a very interesting task," observes Mr. Murchison, "to trace the same strata from this narrow wedge near Gamage Hall, through all their contractions and expansions between the new red sandstone and the old, to their full development in the trough-shaped land to the west of Newcut, and again to follow them till they finally disappeared upon the sides of May Hill, where the new red sandstone reposes at once on the old red sandstone and Silurian rocks." Nor is this information without its economical importance. Attempts to raise coal at Newcut by speculators, who were ignorant of the peculiar structure of the district, ended in the ruin of all concerned. Nevertheless a joint stock company was formed for renewing the attempts, but without success. If coal works are ever to be renewed, says Mr. Murchison, with any prospect of success, the trials should be made to the east of Newcut, by sinking through a thicker cover of new red sandstone than any hitherto penetrated; "for as it appears that the most important seams on the west dipped to the east and south-east, so it is possible that the measures may be found to have expanded when followed upon their dip, &c." Mr. Murchison next describes the north-western and eastern edges of the great coal-basin of South Wales, and the parts of the basin more immediately connected with the more ancient rocks, to which his work is particularly devoted.*

The rocks forming the northern and north-western escarpments of this coal-basin are, Mr. M. remarks, of much consequence in explaining the regular order and succession of the strata between the carboniferous and Silurian systems; for these sections exhibit a full and unbroken sequence of

* Mr. Murchison remarks, that the Rev. W. Conybeare is engaged in the investigation of the great coal basin of South Wales, and therefore he has not himself attempted various descriptions of the members of this coal-field in detail.

all the intermediate strata, nothing being left to hypothesis or the imagination.

The carboniferous limestone forming the lowest member of the coal measures, is a "strong regularly bedded mass, partly light coloured, rarely oolitic, and occasionally of so dark a tint as to be termed black marble. It is overlaid by the conglomerates and sandstones of the millstone grit, or base of the coal-field, and rests upon another conglomerate very similar to the millstone grit, but generally of a redder colour, which constitutes the uppermost stratum of the old red sandstone. The limestone in its course through Brecon, Monmouth, and Cærmarthen, forms a tortuous girdle conforming to the shattered outline of the coal measures.

The thickness of the limestone varies from a mere band to a thousand feet, and it is in those situations where it is most expanded, as in the eastern division of Monmouthshire and adjacent parts of Gloucestershire that the beds of passage are best seen. The passage from the lower beds of this limestone to the old red sandstone is analogous to that previously pointed out between the *uppermost* part of the coal measures and the new red sandstone, the phenomena being always best displayed in those districts where the respective portions of these systems are most developed. The limestone shale, by which the lower limestone is accompanied, is another peculiar character of this member of the coal series, and the course of these shales may be discerned even when covered by herbage and detritus, by the surface consisting of boggy ground interspersed with rivulets and springs, the waters of which having been absorbed by the pervious strata of the overlying coal grit and limestones, are thrown out by this argillaceous sand, and fall in rills over the scarped and lofty edges of the old red sandstone. A peculiar glazed appearance of the surface of the limestone, was pointed out to Mr. Murchison by the Rev. H. Lloyd, on detached fragments which appeared to have been subjected to fire. Mr. Murchison traced these glazed or varnished fragments to a great escarpment, which having been subjected to a downcast, is for the space of a mile submerged in a turf bog, the ends of the strata alone appearing in the banks of the stream. This glazed appearance Mr. Murchison ascribes to long continued immersion in the bog water, which is impregnated slightly with a vegetable acid. The course and flexures of the carboniferous limestone is delineated on the map, which forms an important part of Mr. Murchison's work, together with its various elevations and subsidencies. At the Ferns of Cærmarthenshire, where the rock is a thousand feet in thickness, it is thrown up so as to form the highest point of land in South Wales; and in other situations it dwindles in thickness to the size of a mere bed, and disappears at the mouth of the Towy river, and is no further traceable on the Sea cliffs.*

* The following is a list of the organic remains found in the carboniferous limestone by Mr. Murchison.

	Chief Localities.
" Productus hemisphæricus, M. C. t. 238.	Coal Brook Dale, and Oswestry.
——— Martini, M. C. t. 318 f. 2. 3 & 4.	Clee Hills, &c.
——— comoïdes, M. C. t. 239.	Salop and South Wales.
——— costatus Phill, pl. 7. f. 2.	Oswestry, &c.
——— margaritaceus Phill, pl. 8. f. 8.	
——— sotossus, pl. 8. f. 9.	
——— punctatus, Phill Phill, pl. 8. f. 10.	
Spirifer attenuatus Phill, pl. 9. f. 13.	Pembrokeshire.
——— connivens Phill, pl. 11. f. 2.	
——— imbricatus Phill, pl. 10. f. 20.	
——— filiarus Phill, pl. 11. f. 3.	
——— papilionaceus Phill, pl. 11. f. 6.	
——— radialis Phill, pl. 11. f. 5.	Pembrokeshire.
——— resupinatus Phill pl. 11. f. 1.	
——— semicircularis Phill, pl. 9. f. 15 & 16.	Littleton on Severn.
——— bisulcatus, M C. t. 494. f. 1 & 2.	
——— cuspidatus, M. C. t. 120.	Clee Hills, Shropshire.
——— distans, M. C. t. 494. f. 3	
——— octoplicatus, M. C. t. 562. f. 2. 3 & 4.	
Terebratula fungites, M. SS. Phill.	
——— ambigua, Phill, pl. 11. f. 21.	Pembrokeshire.
——— radiculis Phill, pl. 12. f. 40 & 41.	

Crinoidea occur in vast profusion, including genera and species described by Miller from the limestone of Bristol. Corals also are in parts very abundant, Orthocerata are very rare, and I never found one with well-marked characters. *Trilobites* are also scarce, but a few

The dislocations of the carboniferous limestone along the margin of the South Wales coal-basin are next pointed out, and illustrated by many natural sections, afforded by the rich mountain scenery of South Wales. "The western end of that portion of the escarpment of the South Wales coal-field, which is occupied by the Cærmarthen Ferns, exhibits a very powerful transverse fault, by which the upper strata of the old red sandstone have been so thrown up, as to occupy the summit of Fan-sirgaer, 2200 feet above the sea; while in the contiguous mountain of Carreg-o-gof, the same beds, covered by carboniferous limestone and millstone grit, lie at the height of not more than 1500 feet; and hence

examples of them have been detected by the Earl of Cawdor in the coast cliffs near Stackpole, Pembrokeshire, among which are caudal portions of *Asuphus seminiferus* and *A. granuliferus* of Phillips. The *Icthyodorulites* of this formation are of peculiar forms, and have been described by *M. Agassiz*; among them is the *Cotenacanthus tenuistriatus* of the Clee Hill limestone; other species occur near Bristol.

Considering this formation to be well known, I did not collect many organic remains, so that after all the list is very incomplete. We may however consider it as a sample of specimens taken from various localities; and viewing them in this light, it is worthy of remark, that every species above enumerated has been previously described by Professor Phillips as occurring in the limestone of this age in other and distant tracts. On the southern edge of the South Welsh coal-field, particularly between the Mumbles and Pennard, west of Swansea, the carboniferous limestone has been diligently explored by my friend Mr. Dilhwyn, M. P., whose skill in conchology has enabled him to detect many species in addition to those commonly observed in the formation. In his list, which has not yet been published, he enumerates---

Ammonites? and *Goniatites* 2; *Bellerophon,* several species; *Cirrus?* several; *Dentaleum* 1; Euomphalus several; Eulima? 1; *Littorina,* 3; *Lutraria* 1; *Melania,* 3; *Natica,* 1; *Orthocera,* several; *Turbo,* 1; *Trochus,* 3; *Turritella,* 4; *Rotella* 1; &c.; among these also Professor Phillips has also recognised many published in his work, while Mr. J. de C. Sowerby coincides with me in opinion *that not one of these species has yet been found in the old red or silurian systems.*"

the old red sandstone of the Ferns is proved to have been upcast to an extent of at least 700 feet. The direction of this transverse fault is nearly from north to south, as marked by the fissure in which the rivulet Twrch-fechan flows in its descent from the edge of the escarpment toward the centre of the coal basin. On the left bank of this rivulet all is old red sandstone, while a little to the right is the millstone grit of Carreg-las, the limestone being entirely lost for the space of nearly two miles. The elevated mass of old red sandstone dips ten to twelve degrees SSE., the limestone and millstone grit being inclined twenty degrees to the south. This inclination of the limestone accounts for its rapid disappearance beneath the millstone grit of Carreg-las, and connected with the great upcast of the Ferns, explains how the latter rock has been thrown into juxtaposition with the old red sandstone.

Immediately to the west of the great limeworks of Clogan-maur, there is another considerable fault. After occupying the terrace-formed ridge, on which the kilns are situated, the limestone is abruptly snapped off, and thrown down about 200 feet beneath its usual level into a morass, the ends of the lower strata only being visible on the side of the mountain rill. This is the spot above Blaeu-Cennen, where the limestone presents the peculiar glazed surface before described. The strike of this dislocated mass is 10° to the north of west, and the inclination, differing from that of the adjoining lime quarries, is 25° south by west. This downcast, though not exhibiting so great an amount of disturbance as that of the upcast of the old red sandstone in Fan-sirgaror, exhibits in one respect analogous phænomena. In both cases large portions of the lip of the coal-field present the appearance of having been extruded from their regular line of bearing, and forced into the area of the old red sandstone by movements which miners would call "lateral shifts;" an explanation which would naturally suggest itself by inspection of the relative position of the masses on the map. These appearances can, however, be more simply explained by the upward and downward movement of the faults in question, and by the different angles at which the separate masses are inclined.

The limestone emerging from this morass at Paut-y-gwasted, where the strike is true south-westerly, is well exhibited in low parallel ridges crowned by high ridges of millstone grit. The strata dip SE. and SSE. at angles of about 30°. These calcareous terraces diminish successively in height, and terminate near the cavern from which the river Lwehwr bursts forth. Between this point and the house of Cwrt-a-bard'dh the limestone is wanting, and the distance is occupied by the old red sandstone or its detritus.

The surface of the ground near the source of the Swehwr is singularly marked by several funnel-shaped cavities, which are not peculiar to the limestone of this spot, but are also observable along the lines of greatest dislocation around the promontory of Carreg-o-gof, and beneath the northern face of Carreg-las. They seldom exceed 60 to 70 feet in their diameter at the surface, tapering downwards to depths of 30 to 40 feet, and apparently terminating in vertical tubes. As they occur at or near points of the greatest dislocation of the strata, may we not be allowed to speculate upon their having formerly been the spiracles by which certain gases were evolved, during those periods when earthquakes produced the adjoining elevations and depressions of the strata?

I invite special attention to the locality of Cwrt-a bard'dh, because this portion of the margin of the coal basin is directly opposite to the remarkable outline of carboniferous limestone called Castell-cerrig-ceunen, with the position of which I shall now attempt to prove that the break in the escarpment is directly connected.

The picturesque limestone rock on which Castle-ceunen is erected, from its isolated position in the centre of a valley formed by old red sandstone, might at first be supposed to have been torn from a gap with which it corresponds at Cwrt-a-bard'dh, and precipitated down the shelving escarpment upon the surface of the old red sandstone; an inference, Mr. Murchison remarks, that would not appear extravagant in this region of violent disturbance. Mr. Murchison however offers another explanation. It is evident, he says, from the beds on either side of the valley, as well as from those on which the castle stands, that the whole of the district has been violently broken up by those movements of elevation to which the coal basin of South Wales was subject. Earthquakes and subterranean forces sufficient to raise the circular escarpment of this coal field could not have acted, Mr. Murchison thinks, on such large accumulations of sedimentary matter without occasioning immense transverse openings or channels. On the supposition that such operations were going on for a long time before the deposits in question were raised above the waters, powerful must have been the submarine currents set in action by these changes of level! How must they have affected the bottom of the sea, and how deeply must such currents have channelled out the hollows into which they were deflected? By all these operations Mr. Murchison conceives the vallies of denudation on the skirts of the South Wales coal field have been determined, deepened, and increased; and we may here remark, that the explanation applies equally to the dry sinuous vallies in all lofty regions, as the Alps, and the Himalaya, and the Khasya mountains.

We have dwelt longer on the details given by Mr. Murchison regarding the different members of the coal formation, from the very great importance of the subject in India. It is however difficult for the student to acquire a knowledge of any branch of natural science by reading alone; all that the best books can do, is to put him in the way of recording the results of his own observation whenever he may be placed in circumstances favourable for prosecuting inquiry.

Old Red System.

Having followed Mr. Murchison through the coal measures, as well as the rocks which repose upon them, we shall now endeavour to afford a view of the results of his observations on the more ancient rocks. The old red sandstone consists of various strata, of conglomerate, sandstone, marl, limestone, and tilestone, the newest beds of which dip conformably beneath the coal formation, whilst the oldest repose upon and pass into certain grey coloured rocks, which form the upper part of the Silurian system.

Convinced that the old red sandstone is of greater magnitude than any of the overlying groups, Mr. Murchison applies to it the term *system*, which in geology now implies various groups or formations of strata, indicative of so many distinct periods. Previous geological writers have generally regarded the old red sandstone as a portion of the coal formation, from which it is completely distinguishable both by lithological characters and zoological contents. The coal measures, or carboniferous system, Mr. Murchison therefore proves to be surmounted by one red group, and to repose on another, from both of which the coal measures are perfectly distinct, constituting of themselves a distinct system.

The reason why the old red sandstone has not been regarded as a distinct system Mr. Murchison thinks, is, that in France and Germany its equivalents are ill, if at all, developed. It has however been recognised in Poland and Silesia, while in Norway there are mountain ranges very similar in structure to the old red sandstone of the north of England, Scotland, and Ireland. There is a sandstone in India corresponding with the old red in England, occupying the same relative position to the coal measures, and presenting the same lithological characters, but how far its zoological contents will be found to correspond with those of the English rock, is a subject that must be decided by the observations of geologists in India.

We shall endeavour to put the Indian student in possession of the principal details brought together by Mr. Murchison in that part of the British isles of all others best calculated to afford the true distinguishing peculiarities of the old red system as it occurs in the western world. "The enormous thickness of the old red sandstone, included between the coal measures and Silurian rocks, will at once be comprehended by any observer who places himself on the eastern slopes of the latter near Kington, and casting his eye to the south-east, the circle of vision although extending over all the mountains between the Wye and the Usk, and terminating only in the Brecon mountains and Cærmarthen ferns, embraces nothing but old red sandstone; nor does this view include a wide superficies occupied merely by undulating masses of the same strata, but a territory, in which successive members of the system rise from beneath each other in distinct mountainous escarpments." Nor is Mr. Murchison's observations confined to this field, they are also extended to Shropshire, where a similar succession of the old red sandstone is displayed, as well as to Herefordshire, where the same rocks compose a great basin, the lower strata of which are turned up on both banks against Silurian rocks.

This ample field may be taken as the fairest example presented by the old red system in Europe; and Mr. Murchison's observations afford not only the latest, but the safest standard with which to compare the results of our observations on such rocks in India, as far as they appear to be representatives of the old red sandstone in Europe. Mr. Murchison divides the old red system into three divisions, as follows—

1. *Quartzose, conglomerate, and sandstone.*
2. *Cornstone and marl.*
3. *Tilestone.*

In the descriptions which follow, it will be seen, says Mr. Murchison, that the distinctions implied by these names are not absolutely peculiar to any one of the three divisions. Thus fossil beds occur partially both at the bottom of the first, and in the middle of the second division, while conglomerates sometimes take the place of tilestone in the lowest strata.

Mr. Murchison's descriptions are so connected with localities, that it becomes a very difficult matter to confine our abstract to the rocks alone, without reference to places, and still to preserve the true meaning of the author; difficult as this is, we must endeavour to do so, as it would be too much to attempt to quote the whole of the valuable details which Mr. Murchison has brought together. The southern face of the Cærmarthen and Brecon mountains, like most other parts of the edge of the South Welsh coal basin, slopes in an inclination of from ten to twelve degrees towards the centre of the coal-field, and is usually covered with turf bogs, beneath the bog a conglomerate of white quartzose pebbles in a red matrix forms the upper member of the old red sandstone.

This stratum is seen dipping beneath the carboniferous limestone, where it often assumes a slightly calcareous quality in the cement, with pink and white nodules of quartz, from the size of mustard seed to two or three inches, sometimes mixed up with grains of a green compact felspar; other and lower beds are however pure quartzose conglomerates. "When fresh quarried the conglomerate is sometimes of a pink or reddish colour, but after long exposure it frequently becomes nearly white, in which state it might be mistaken for the coarser beds of millstone grit, but it is separated from them by the carboniferous limestone. The conglomerate beds occupy a thickness of about 200 feet, and pass down into chocolate-brown, and reddish coarse grained sandstone, with blotches of red shale, and occasionally a very small pebble of quartz. Below, the conglomerate usually becomes finer, and passes into a pure sandstone of brownish and occasionally *gosling green*, and deep red colours; other beds are much spotted with green blotches on a dark red ground. Where roads are contiguous this sandstone is quarried for troughs, cider presses, and building purposes, and some of the lower layers of this division are so fissile and fine grained as to allow of their being quarried for flagstones and grindstones. These rocks are distinguished from the next division of the system by the absence of calcareous beds.* In some of the ridges where the lower beds pass into cornstone and marl, thin layers filled with fragments of carbonised vegetable matter have been found, but never in so perfect a form as to resemble fossil plants. These appearances have induced ill-advised speculators to drive galleries into mountains of this rock in search of coal.

These sandstones assume a very ancient aspect. "We must not, however," says Mr. Murchison, "judge of the antiquity of rocks by their mineral aspect, nor even by their lithological structure; for, as I shall have occasion to show, there are many portions of the old red sandstone undistinguishable in these respects from the oldest grey wacke, whilst strata of the *underlying* Silurian system, formerly termed greywacke, so far from assuming an air of higher antiquity, in numberless cases, and over very large areas, resemble closely some of the younger secondary deposits."

The reader will be desirous to know how far this description of the upper division of the old red sandstone in South Wales applies to any of the rocks of India. We have

* Very rarely, Mr. Murchison remarks; where this upper division of the old red sandstone is much expanded, it occasionally contains thin courses of mottled, red, and green, very impure limestone, not to be distinguished from some of the least calcareous beds of cornstone. In one of these beds Mr. Murchison discovered the scale of a large fish not yet described.

learnt from Mr. Murchison that it reposes beneath the limestone of the coal measures, and that the only fossil yet discovered in it is the scale of a fish, already alluded to.

The uncertainty connected with the relative position of rocks in districts not regularly investigated, must expose all casual observations on the identity of structure in remote situations on the earth's surface to serious difficulties.

To compare one district, the peculiarities of which have been thoroughly investigated with another but partially known, in a remote part of the world, we have not only to be on our guard against various forms which the same rocks are liable to assume under different circumstances, but we have also to recollect that the laws of geographical distribution of animals should prevent our expecting to find the same organic remains every where in the same rock.

In the first reports of the Coal Committee we stated our reasons for regarding the beds of sandstone which form the basis of the coal measures at Cherra Ponji as equivalent to the old red sandstone. The relative position of the beds in question to the coal formation, as well their position and lithological characters as far as we are acquainted with them, are all in favour of their belonging to the upper group of the old red sandstone, which formation, according to observations of Mr. W. Jameson not yet fully before the public, is largely developed in the North-western parts of India.

There is really nothing in the name that ought to deter us from using it to designate a formation agreeing at least in all its main characters with the English rock, and occupying the same relative position between the coal measures on the one side, and the more ancient rocks on the other.

Thus the vast extent to which the old red sandstone occurs in India is the best proof of the importance of the subject to the Indian geologist, and of the necessity of his being in full possession of all the particulars brought forward by Mr. Murchison in his valuable work. Our review would ill supply the place of that work itself, but we trust it will prove useful to such as cannot have recourse to the original in India; we shall therefore endeavour to give the reader as practical and concise a view of Mr. Murchison's details as possible. The second division of the old red sandstone is the

Central, or Cornstone Formation.

The central masses are chiefly composed of alternations of red and green argillaceous spotted marls, affording rich soil. These argillaceous beds sometimes alternate with sandstone, but more frequently with irregular courses of concretionary impure limestone, mottled also red and green. When compact the calcareous beds are termed limestones by the quarry men, but when mixed with sand and marl, giving them a brecciated or conglomerate aspect, they constitute the well known cornstone of Herefordshire and the adjoining counties.

"We may commend the detailed description of this formation in Cærmarthenshire, because, although the cornstones in that county are of very impure quality, their relations are clearly exposed in a section exhibited in descending from the Cærmarthenshire fens towards the bridge called Pont-ar-lleche. The river Sowdde here runs in a narrow cleft or channel, which cuts the strata at right angles to their strike. The inclination of the beds is towards the south-east, and the dip varies from 65° near the superior limits of the formation, to 75° towards its base, or junction with the tilestones. In the short distance, therefore, of about three-quarters of a mile, we obtain by means of the high inclination of the strata, and the clearness of the section, a perfect knowledge of all the beds comprising the cornstone division, which, owing to their slight inclination and gentle undulations, are expanded over the low and fertile tracts of Brecknockshire and Herefordshire, and are there rarely well exhibited *as a whole.* The strata consist of deep red shale, argillaceous sandstone, and hard, quartzose, dingy purple, or brown sandstone, slightly micaceous; with interculated calcareous beds, of a concretionary and pseudo-concretionary structure. These calcareous concretions, varying in colour from red to green, and in diameter from half an inch to three or four inches, are disseminated through the mottled marl, which becomes occasionally an impure limestone. They are arranged in bands occupying vertically from eight to thirty feet each.

"The finest example of limestone of the old red system in Cærmarthenshire, occurs in the cliff under the castle at Llanstephan, near the mouth of the Tawey. The rock is there from twenty-five to thirty feet thick, the upper part consisting of a number of small concretions, which are underlaid by three massive beds of impure limestones, mottled green, blue, and red, rising in a dome-shape, and slightly inclined; this calcareous mass is overlaid by red and green marls; and further to the south, or towards the marine headland, are flagstones, sandstones, and other well characterized beds of the system. In a subsequent account of Pembrokeshire, I shall have occasion to show that although the calcareous matter becomes much scarcer in the old red sandstone of that county, we still meet with mottled, imperfect, concretionary masses, which are in parts calcareous, and represent the cornstone formation.

"To the east of Brecon, the stones rise from beneath the uppermost or quartzose strata in the escarpment of the mountains of the Bock forest, where they are much more strongly developed than in Cærmarthenshire, as attested by different lines of lime-kilns which mark the lower limits of the mountains S. and SE. of the town of Hay. Some of the subordinate beds in the immediate vicinity of Hay, afford a most excellent thick-bedded freestone, of a delicate green colour, and of which the town is built. The cornstones, which are here so prevalent, rise to considerable heights on the sides of the escarpments, and dipping gradually to the south-east, occasionally reappear in deep demiductions in the valley of the Usk, near Abergavenny; and finally disappear under the great mass of overlying sandstone and quartzose conglomerate which has been described as forming the extreme margin of the south-west coal field. At the northern escarpment of the Skirrid, the remarkable ridge to the north of Abergavenny, before alluded to, thick beds of cornstone are exposed, dipping under red, brown, chocolate, and green sandstones, with blotches and concretions of red marl. Other courses of cornstone extend along the lower sides of the Skirrid, and are exposed in the transverse valley between that mountain and the Sugar-loaf; and a few thin layers have been already alluded to as appearing in the face of the great escarpment of the Blorenge.

"I refer the reader to the map, to obtain a notion of the large tracts in Brecon and Monmouth where these limestones prevail. A good descending section of the whole system of old red has recently been laid open by making the new road from Chepstow to Usk, which runs directly across the strata. On this road the traveller first passes over the quartzose formation of sandstone and conglomerate, rising from beneath the lower carboniferous limestone shale, next the marls and cornstone in the bold escarpment of Golden Hill, and thence traversing sundry calcareous courses, he meets with the Silurian rocks in the hills north of Usk, throwing off upon their eastern slopes the marls and tilestones. In the southern parts of Herefordshire (between Monmouth Cap and Whitefield), are numerous courses of small round concretions, which not being firmly bound together by the matrix, readily separate from the imbedding sand and clay, and are used as gravel for the roads. In the same tract, however, are strong courses of very pure concretionary limestone, of purple and green colours, one variety of which appears to have been formerly used as marble.

"To the north of the river Wye, the same system is prolonged in the central hills of Herefordshire; and traverses made across these hills from Hereford to the Vale of Woably, afford good sections of the cornstone group. The descending section of it may be thus enumerated, the beds dipping to the SE. or SSE. at angles of 12° and 15°.

"*a.* Slaty beds quarried for tiles in the hills above Mr. Peploe's Park (contain broken portions of vegetables often in a state of carbon).

"*b.* Marls, red and green.

"*c.* Cornstone, in parts semi-crystalline, seldom exceeding 4 to 5 feet in thickness.

"*d.* Argillaceous marls with impure limestone, fit only for road-mending.

"*e.* Great sandstone quarries (at Rauen's causeway, for example), from 30 to 40 feet in depth contain fine large flaggy beds of light greenish colour, used for tombstones; and strong beds of micaceous, finely grained sandstone ; the lines of deposit being sometimes marked by purple and light green stripes. This stone is of excellent quality for building.

"*f.* Argillaceous marls.

"*g.* Courses of impure concretionary limestone appear here and there in the slopes and lower sides of the hills; these descend into the rich low ground around Weobly. If powerful denudation had not destroyed the strata and covered them with gravel, the valley of the Wye, between Hereford and the Hay, would doubtlessly have afforded similar sections, for the same succession of argillaceous marl, sandstone, cornstone, and flagstone is displayed in the hills of Moccas on the south or right bank of the Wye, as those described in the

Weobly Hills. There can, indeed, be no doubt, that the strata of these two hilly ranges on the opposite banks of the river were once continuous, because whenever the gravel has been removed, the cliffs exhibit the red argillaceous beds.

"Similar arrangements of strata are exhibited in the escarpments of all the hills extending from Weobly to Leominster, and thence to Tenbury and Bromyard; the vast thickness of the formation, including many masses of strong bedded sandstone, being remarkably well displayed in the hills crossed by the new road from Leominster to Hereford. Wherever the marls have prevailed, the denudations have been most extensive, as is remarkably exemplified in the lateral valleys on the sides of the Pyons, two small conical hills probably saved from destruction by the hardness of the concretionary rock and gritty sandstones near their summits.

"Nearly the whole of the central and northern parts of Herefordshire and the contiguous parts of Salop and Worcestershire, are occupied by this formation, those hills having best resisted denuding influences, which contain the hardest concretion of cornstone, or the firmest ribs of sandstone. In the northern portion of this range, the subordinate limestones become thicker and more crystalline.

"Bands of cornstone appear at intervals in all the country lying between the Clee Hills and the southern extremity of the coal-field of Coalbrook Dale; the same suite of beds forms also the base upon which the greater part of the coal tracts of Billingsley and Forest of Wyre have been deposited. At Lower Harcott, on the west side of Kinlett, the cornstone dips south and south-south-west forty-five degrees, is five or six feet thick, and is burnt for lime. It here reposes upon a good sandstone of greenish colour. This cornstone, as in other parts, is of very irregular dimensions, contracting and expanding in the most capricious manner. In one district only I have traced it on the east bank of the Severn, where the existence of the old red sandstone had not previously been noted in geological maps.

"The formation is there displayed in a narrow and detached ridge on the south side of the thin zone of coal measures of Arley and Shatterford, ranging between these rocks and the new red sandstone of Wars Hill and Horsley Bank, near Kidderminster. The old and new red sandstones are in abrupt and unconformable junction on the sides of a new cut in the road ascending from Kidderminster to Shatterford gate, near which beds of true cornstone are burnt for lime. These beds are there clearly distinguishable from the calcareous bands of the adjacent lower new red sandstone, by their unconformable position.

"The extent of the changes made in the map of the boundary lines of previous observers, defining the junction of the old, and the contiguous new red sandstone of Worcestershire, can be best understood by comparison with such authorities. Much ambiguity, indeed, prevailed in this part of the region, owing to the anomalous lithological characters of the lower new red sandstone, (already explained in chapter 4,) which, on the confines of Worcestershire, Salop, and Herefordshire, puts on so much the characters of the old red, with which it is in contact.

"On the right bank of the Tenu, the hills of old red sandstone, ranging from Tenbury to the villages of Stamford and Shelsley Walsall to Lapey, &c. consists of marls, clays, sandstones, and flags, with some thick zones of concretionary limestones. In one of these bands near Hill Top, east of Tenbury, I found the crevices partially filled with minute thin coats of anthracite, mixed with white crystallized carbonate of lime. Besides the principal bands of limestone, which here vary in thickness from four to ten feet, there are, as in other places, thinner courses of cornstone, alternating with beds of deep red and greenish sandstones, of a flaggy structure. Much calcareous matter is disseminated throughout these hills, and gives rise to the superficial deposit of travertine and stalactite, which will be described in a subsequent chapter.

"The sandstones associated with the marls and cornstones sometimes expose upon their surfaces certain small depressions, frequently of circular and horse-shoe forms, occasionally having a raised central disc. These forms, which are remarkably exhibited in the bed of the Sapey Brook, near Knightsford bridge, appear to be due to the action of water upon blotches, or imperfect concretions of party-coloured marls, or soft argillaceous sandstones, which being of less consistence than the mass of the rock, have been corroded, leaving these cavities. Similar forms, indeed, are found in numberless portions of the old red sandstone. I may particularly cite the escarpment of the Skirrid, three miles north of Abergavenny, and the cliff called the Dareu, north of Crickhowell, as situations where they may be seen in countless profusion, imitating in their outline, horse-shoes, rings, almonds, &c. It is quite manifest that by exposing rocks of the varied composition of these in question, to the action of running water, as in the Sapey Brook, or to long continued atmospheric influences, as in the Skirrid, the inevitable result would be the wearing away of these blotches or concretions, which are softer than the inclosing mass of rock.

"There is no district in which the nature and relations of the cornstone can be better studied than to the north of Ludlow, where the formation occupies a distinct range of hills rising to the height of four or five hundred feet above the low country, and presenting escarpments to the valley of Corvedale. In these hills are several calcareous zones, separated by thick masses of sandstones, flagstone, and argillaceous marl, the strata dipping slightly to the north and south of east.

"Some of the best flagstones of these hills are quarried at Bouldon. The upper beds consist of marl, impure cornstone, and thin beds of deep coloured red sandstone. Beneath these lie about twelve feet of sandstone, which splits into flags. This stone is of a greenish colour, and highly micaceous, and its surfaces are marked by those undulations or ripple marks, so frequent in the sandstones of all ages, and which are supposed to have resulted from the action of water during the process of deposition. The flags are from three to eight inches thick, and sometimes of great extent, and they are largely used for staircases, doorways, wall tops, lintels, &c.; a course of impure cornstone underlies the flagstone. Similar flagstones, but generally of dull red colours, are extracted at the southern end of the Brown Clee, and on the south-western slopes of the Titterstone Clee. In the quarries of Sir W. Raughton, Bart. at Downton Hall, flags are often quarried of the great size of one hundred square feet.

"A section of the strata between the slopes east of Downton Hall and the valley of Corvedale is seen by reference to Pl. 31. fig. 3., and the structure of these beds is already sufficiently explained to render unnecessary the encumbering of these pages with similar details in other places. The courses of concretionary limestone are as usual not continuous; on the contrary, they expand and diminish, disappearing and re-appearing in their horizontal range.

"Similar exhibitions of concretionary limestone wrap round the sides of the Clee Hills.

"On the western face of the Titterstone Clee they rise to a great height, both at and above Bitterly Court; they surround the Brown Clee, and are largely quarried at Abdon, Ditton, &c. It is not possible to include these cornstones under one mineralogical description. In most places they are of red and lightish green colours; in others, however, they are light brown, with veins of dark chocolate and green, a variety of which in a highly crystalline form is extracted at Targrove, near Downton Hall. At Ditton, white and green colours prevail; at Bromsgrove the mass is brown, with light grey patches; while at intermediate places they consist of marl, limestone, and sandstone, irregularly concreted, and have the aspect of a conglomerate. In the last mentioned form alone, they constitute the cornstones of the inhabitants, and in this state are quarried exclusively for the repairs of the roads, and are not burnt for lime. The best courses are, however, almost crystaline, and if polished might be considered not inelegant marble, though the concretions are usually too small to afford large slabs. In some of the great works at Ditton and Abdon there are two zones, the lowest and largest of which is quarried to a depth of twenty feet, in caverns under the slopes of the Brown Clee Hills. It is needless to mention other localities in this neighbourhood, for the formation here ranges over a very wide area. Throughout the whole of its range, with the exception of this space between the coal field and the older rocks of Cærmarthenshire, and its protrusion through some of the poor coal-fields of Bewdly Forest, the strata of this cornstone are very little inclined, an arrangement which might naturally have been looked for in the central parts of a basin or triangle of large size. The spotted marls can never be distinguished from those of the new red sandstone, except perhaps when they are separated from each other by beds of hard micaceous sandstone. In districts where the argillaceous character exclusively predominates, there is some difficulty in persuading the inhabitants that they live upon the old red *sandstone*, although that name, when applied to the whole system, is as unobjectionable as any in the nomenclature of geology.

"Whenever the order of superposition is not apparent, the fragments of fossil fishes, which occur in abundance throughout the cornstones, constitute the best distinction between this formation and the lower new red sandstone, which it so much resembles. These fishes, which will be described in a subsequent chapter, are of very peculiar forms, and their fragments being often of brilliant purple and blue colours, are excellent points of attraction for the eye of the geologist, since they present a strange contrast to the surrounding dull red and green matrix in which they are enveloped."

We have given Mr. Murchison's detailed account of the cornstone in his own words, because we have yet to discover this member of the old red system in India. The fishes alluded to as characteristic of this rock in Britain, are various species of *Cephalopsis*, Ag. whose form somewhat resembled the Siluridæ; one of the most perfect examples that has been found is that of *Ceph. Lyellii;* we need not here give a figure of it, as it is already represented in Lyell's Geology and other popular works; and as to the other three species of the same genus they depend upon fragments which would hardly be intelligible to any one but M. Agassiz himself. They appear however to indicate a genus of considerable variety and extent, all the remains of which are confined to these beds, but not to this locality; for Dr. Malcolmson, who distinguished himself by his geological and medical researches in India, also discovered the remains of Cephalopsous fishes in Scotland, in beds of calcareous conglomerate, which he regards as equivalent to the cornstone of England. We now come to the third, or lowest member of the old red system, named by Mr. Murchison

Tilestone.

This lowest member of the group has very distinct characters both in structure and fossil contents from either of the foregoing divisions of the old red sandstone. Its upper beds pass into cornstone and marls, such as we have first described; while the lower beds change into Silurian rocks. The tilestone runs in nearly a straight course from a place called the *Bridge of Tiles* in Cærmarthenshire to near Builth, on the north east, occupying the loftiest part of the escarpments of wild mountainous tracts, at heights of fifteen to sixteen hundred feet. In this range the tilestones are extensively quarried, and the strata which inclined at angles from 45° to 80° dip invariably to the south-east. After a great flexure on the Wye to east of Builth, the tilestones are again found in similar relations, overlapping the Silurian rocks in the Clyro and other hills in Radnorshire, and extending from thence to Kington in Herefordshire, in which part of their range they are much less inclined. Throughout their course from Cærmarthenshire to Kington the distinguishing beds are finely laminated, hard, reddish or green micaceous quartzose sandstones, which split into tiles. Although the greenish colours prevail, these beds are usually associated with reddish shale, and the decomposition of the mass uniformly produces a red soil, by which character alone the outline of the division is easily defined, being always clearly separable from the upper beds of the Silurian system, which decompose into a grey surface.

In Shropshire and the contiguous parts of Herefordshire, this lower member of the old red sandstone rarely occupies high ground, and being for the most part recumbent on the talus of the upper Silurian rocks, where the latter sink down into vallies, it is generally much obscured by detritus. In a gorge near Ludlow, flag-like micaceous dark red sandstone, "bur-stones" of the peasantry, rise at an angle of about fifteen degrees from beneath the red argillaceous marls of Oakley park, and pass down into a light coloured grey, yellowish, and greenish grey freestone, which will presently be described as constituting the upper stratum of the Silurian system.

The "bur-stones" are here seldom so fissile as the "tilestones." They occasionally contain a few organic remains, such as Avicula, and a small Lingula, which will presently be described; but in some parts the remains of fishes prevail more than Mollusca, particularly *Dipterus macrolepidotus*, Sedg. et Murch., and others of the genus *Onchus*, Ag., palates of fishes and bufonites.* In the southern parts of Cærmarthenshire and in Pembrokeshire, the tilestone cannot be traced as a persistent zone, and the triple subdivision of the system can no longer be observed, but the previous sketch of the lower member of the old red sandstone Mr. Murchison derived from numberless transverse sections along an in-

* We shall probably give examples of the fossils illustrative of the important distinctions here pointed out by Mr. Murchison. We are only anxious before entering upon this part of the subject, to be favoured with the examination of any organic remains that may have been found in ancient beds in India, which there may be reason to suppose equivalent to the rocks described by Mr. Murchison.

terval of ninety miles. We may quote the following remarks on one of those sections.

Between Trecastle and Llandovery, "tilestones are quarried, rising at an angle of sixty degrees from beneath the marly and sandy beds of the cornstone group, the lower tilestones graduating downwards into the equivalent of the Ludlow rock. The uppermost beds are of a dark purple colour, the surface being covered by large plates of a grey mica, and here and there certain impressions resembling those in the old red sandstone of Scotland, called 'Kelpie's feet.'

"The lower beds, as worked on the steep acclivity of Horeb chapel, have their dip increased to sixty-five and seventy degrees, and are of greenish and grey colours, but these again are underlaid by other beds of a reddish colour, so that the whole of the tilestones are clearly subordinate to the old red system. The greenish beds split to an average thickness of three or four inches, are much jointed, and have frequently an imperfect slaty cleavage transverse to the bedding; they are highly charged with mica, both disseminated and in laminæ. The joints are for the most part vertical, and their faces are frequently coated with crystals of white quartz. Organic remains are abundant, and indicate clearly the lines of deposit, whilst the transverse cleavage and the faces of the joints are strongly marked by sharp planes cutting obliquely through the fossil layers. The fossils consist of unpublished genera, *Arca Avicula Bellerophon, Cuculloa Lingula Orthocera Terebratula Turbo Turritella Trachus* with the *Tentaculites scalaris* Scholothein. This assemblage furnishes convincing proofs that certain genera of Molluscs, such as *Arca Turbo Trachus Cuculloa,* &c. which have been supposed to be confined to the young tertiary and secondary deposits, have co-existed with *Orthocera, Terebratula, Bellerophon.*"

Mr. Murchison, in conclusion, estimates the depth of the old red system as it rises from beneath the South Welsh coal basin and over the Silurian rocks of Radnor, to be not less than nine or ten thousand feet—a vast accumulation of strata interposed between the coal measures and Silurian rocks, the importance and extent of which has been little understood until pointed out in the work before us.

Trap dykes, and other dislocations which were so common in the coal measures, are comparatively rare in the old red sandstone; but two examples of trap rocks are known throughout the whole extent of the old red sandstone of Herefordshire, Worcestershire, Shropshire, and Monmouthshire. One of these dykes which is exposed for a length of 120 feet and a depth of 50 feet, is in a quarry near Bartestree. The direction of the dyke is WSW. and its width varies from 60 to 20 feet. The prevailing variety of trap is a highly crystalline greenstone, made up of hornblende and felspar, the central masses having more or less of the speroidal, hard, compact structure with the minerals alluded to, finely and intimately mixed. Other portions of the dyke, particularly near the sides, assume a prismatic form, the ends of the prisms being directed towards the walls, and contain much felspar, a little quartz, and something like serpentine that gives the whole a greasy feel. The dyke passes through the central or cornstone division of the old red system, and on either side the rocks lie nearly horizontal. The spotted marls and cornstone are converted in contact with the dyke into a purple amygdaloid with kernels and nests of calcareous spar, and in the sandstones the grains of sand are converted into white quartz.* The effect of these changes extends to a distance of several feet into the adjoin-

* Mr. Murchison refers this effect to the calcareous parts of the cornstone acting as a flux. The aid of a flux may have been necessary to change the sandstone into quartz where there was so great a disproportion between the volume of heated matter, and the rocks exposed to its action; but we find the great sandstone formation in India, where it lies in contact with igneous rocks, converted into quartz rock over whole tracts of country, particularly Muflong in the Kasyah hills, the Chittore range on the northern confines of Malwa. Vide report of Coal Committee, p. 26, 79.

ing beds. Mr. Murchison remarks that the dyke lies in the direction of the elevated mass of Shuckness Hill, distant three miles from the spot at which the dyke is opened, and infers accordingly that the hill is connected with a line of disturbance occasioned by this dyke.

The second dyke is exposed by quarries near the Teme, eleven miles north-east of Worcester, and distant about a mile from the Abberley Hills, which follow its course. The dyke is at one place where it is exposed to a depth of 40 feet, about eight paces wide, and near its walls the trap assumes a prismatic form, decomposing like the basaltic columns of the Giant's Causeway. The composition of this dyke is unique, being partly dark green syenite, and partly an amygdaloid, containing kernels of carbonate of lime, which on exposure fall out, leaving cavities in the sides of the prisms. On either side of the dyke the sandstone is hardened and of dark purple colour, and the variegated marls and cornstone are converted into an indurated mass, resembling many trappean amygdaloids, and the lime is disseminated in veins and coatings of white crystallized carbonate of lime. This dyke is analogous in its structure, Mr. Murchison states, to some parts of the Malvern ridge, and as it points to the most prominent of those elevations, we obtain one of the proofs that volcanic forces have been in activity along the great fissure of eruption subsequent to the consolidation of the old red sandstone. "Again, from the highly dislocated condition of the patches of coal which adhere to the flanks of these hills, no doubt can remain that volcanic action was also continued upon this line after the deposit of the carboniferous system". With the evidence we shall afterwards adduce, says Mr. Murchison, of the frequency of trappean eruptions during the formation of the Silurian system, and with the proofs we have already given of the outburst of such rocks subsequent to the consolidation of the coal measures, it is surprising that during the accumulation of the widely expanded series of old red sandstone, there should apparently have been a total cessation of the eruptions, for the dykes just described must have been intruded after the old red strata were deposited.

The old red sandstone contains no metallic veins of any value. Throughout the whole extent of the system, Mr. Murchison found but two instances of metalliferous veins, which have been deemed worthy of the slightest attention; both were copper ore; nor is there any coal in the old red sandstone, or any vestige of the vegetable matter out of which coal has been formed; an exception however is mentioned in favour of one place on the banks of the Tweed, in which coal seams do occur beneath the mountain limestone in the *upper member* of the old red system.

Mr. Murchison next describes isolated patches of old red sandstone, under the term *outliers.* The most extensive outlier composes a district of nearly one hundred miles in extent, of which the forest of Cleen forms the principal part. The soil of this tract is red, and numerous natural sections of the rocks beneath it show they belong to the lower beds of the old red system, or tilestone, resting on Silurian rocks, which support the sandstone at low angles of inclination. The transition or passage between the Silurian and old red systems is here marked, as in other places, by hard, greenish, and reddish, highly micaceous sandstone, which contain *Septœna lota* and *Terebratula nucula,* together with casts of several shells identical with those found in the tilestone and upper Silurian beds. The casts of these fossils, though fragile, are beautifully preserved, and the cavities in which they are situated generally contain a black powder. Three other outliers are described in various parts of Radnorshire, but the largest of them is not above five miles in extent. They show the relations of the old red system to the Silurian rock, and confirm the accuracy of the sections of the former, previously described.

On the agricultural character of the old red sandstone, Mr. Murchison remarks, that in the higher mountainous tracts which are composed of the upper member of the system, the soil is light, sharp, and poor, but over the cornstone beds the soil is rich and productive, the red soil of Herefordshire being an instance. The most loamy of the calcareous soils afford the finest crops of wheat and hops, and bear the most prolific apple and pear trees, and the heavier or clayey tracts are renowned for the quality of oak timber. Water is plentiful, and found at various depths.

[To be continued.]

Correspondence.

Extract of a letter from Captain A. Jack, 30*th Bengal N. I. dated Neemuch,* 31*st August,* 1840.

I am very busy in the way of collecting birds, spiders, fishes, &c. for you, and shall send you some presently. I should like to send some things of that sort through you to Dr. Fleming. Though I cannot get up a Natural History Society here, yet I get great assistance from a number of the officers in collecting specimens of all sorts. I think I shall be able to get all the Vespertilionidæ of this part of the country for Dr. Horsfield shortly, and shall send down all birds merely skinned; they prefer getting them so at home. I have this morning got two of the pendent nests of the beā bird with four eggs in one of them, and five in the other, (and a pair of the birds) which are the numbers they commonly lay. I want another pair for the other nest. There is a bird here called the taylor bird, which builds a very curious nest by stitching a large broad leaf into a bag, and then constructing its nest in the bag. I shall try to get one of them. The Leek, a sort of florikan, is also met with here; it is different, I believe, from the florikan of most other parts of India, and the bustard is not uncommon. On the other side I give you the continuation of my thermometrical table, from which you will observe that this is a most salubrious climate, and although this is the most unhealthy season of the year, low fevers prevailing among the natives, yet they are not dangerous.

Date.	Wind.	July. Day.		July. Night.		Weather.
1	W.	93	...	84	...	Cloudy,
2	W.	89	10	83	20	Heavy Clouds,
3	SW.	89	...	82	...	Heavy Do. Rain,
4	SW.	90	...	83	...	Raining,
5	SW.	92	...	83	30	Ditto,
6	SW.	91	10	83	...	Ditto,
7	SW.	91	...	84	...	Ditto,
8	W.	92	20	85	...	Ditto,
9	SE.	94	...	84	...	Ditto,
10	SW.	89	30	84	...	Ditto,
11	SW.	91	30	82	20	Cloudy,
12	W.	89	40	81	...	Raining Stormy.
13	SW.	90	...	80	30	Cloudy,
14	W.	88	...	82	...	Raining,
15	W.	85	...	81	...	Rain,
16	W.	85	...	81	...	Ditto,
17	W.	83	...	79	50	Ditto,
18	W.	83	30	79	30	Ditto,
19	W.	83	30	79	...	Ditto,
20	W.	81	...	78	30	Ditto,
21	W.	83	...	78	...	Ditto,
22	W.	82	...	78	...	Ditto,
23	W.	83	...	78	...	Ditto,
24	W.	79	...	78	...	Ditto,
25	SW.	80	...	78	...	Ditto,
26	SW.	78	...	178	...	Cloudy,
27	SW.	78	...	78	...	Ditto,
28	SW.	79	...	77	30	Ditto,
29	W·	79	...	73	...	Raining,
30	W.	82	10	77	30	Ditto,
31	W.	82	20	79	...	Ditto,

Date.	Wind.	August. Day.		August. Night.		Weather.
1	WSW.	81	30	76	...	Cloudy,
2	WSW.	82	...	76	30	Ditto,
3	SW.	82	...	77	...	Rain,
4	SW.	82	10	77	...	Cloudy,
5	SW.	82	30	76	...	Ditto,
6	SW.	80	20	76	...	Rain,
7	SW.	81	10	77	...	Rain,
8	W.	81	...	76	40	Rain,
9	W.	82	...	79	...	Cloudy,
10	SW.	82	...	78	...	Ditto,
11	SW.	81	30	77	20	Ditto,
12	SW.	81	40	77	...	Ditto,
13	SW.	83	30	78	...	Ditto,
14	SW.	84	...	77	...	Ditto,
15	SW.	84	...	78	20	Ditto,
16	SW.	84	...	77	30	Dtto,
17	SW.	84	10	76	30	Heavy rain.
18	S.	84	...	75	40	Ditto,
19	S.	81	...	76	30	Ditto,
20	SW.	85	...	77	30	Rain,
21	SW.	85	...	77	...	Ditto,
22	SW.	84	40	76	30	Cloudy,
23	W.	85	...	77	...	Ditto,
24	SW.	84	30	77	...	Ditto,
25	W.	84	...	76	40	Ditto,
26	W.	84	30	77	...	Clear,
27	W.	85	...	78	...	Ditto,
28	W.	86	30	78	...	Ditto,
29	W.	86	30	78	...	Ditto,
30	W.	87	...	77	...	Ditto,
31	W.	87	...	78	...	Ditto,

Date.	Wind.	September. Day.		September. Night.		Weather.
1	SW.	85	...	80	...	Cloudy.
2	WSW.	85	10	79	40	Ditto.
3	W.	85	10	80	...	Heavy rain.
4	W.	82	...	77	...	Ditto.
5	W.	82	...	77	...	Ditto.
6	W.	81	...	77	...	Ditto.
7	W.	82	30	77	...	Ditto.
8	W.	81	...	78	...	Rain.
9	W.	81	...	77	...	Ditto.
10	W.	81	30	76	40	Ditto.
11	W.	82	30	79	...	Heavy rain.
12	W.	82	...	77	...	Cloudy slight showers.
13	W.	82	30	77	...	Cloudy.
14	W.	83	30	78	...	Rain,
15	W.	82	...	76	...	Heavy rain.
16	W.	81	20	77	...	Cloudy.
17	W.	83	30	77	...	Ditto.
18	W.	82	30	76	...	Ditto.
19	W.	82	30	75	30	Rain.
20	W.	81	40	76	40	Cloudy.
21	W.	83	40	79	...	Cloudy and close.
22	W.	84	...	78	...	Cloudy.
23	W.	84	...	80	...	Clear.
24	W.	84	...	78	30	Ditto.
25	W.	84	30	79	...	Ditto.
26	W.*	84	...	78	...	Ditto.
27	W.	84	10	79	30	Ditto.
28						
29						
30						

* Lat. 24^0 30, N. Elevation about 1200 feet.

The weather generally has been delightfully pleasant; and though you could hardly expect, from the nature of the soil, which is principally indurated clay, after heavy rain, four hours is sufficient to leave the roads which are not raised, comfortably dry.

I have sent a box of insects to you by Colonel Seymour, and was collecting away at a great rate, but this order puts a stop to all operations, until we get some arrangements made as to carriage.

I shall have an opportunity on the march of giving you a rough sketch of the geology of the country we pass through. I shall send you some fishes, &c. &c. before I leave this.

From the same, on the march from Neemuch to Ferozpore.

"Nyagong is 9 miles from Neemuch NNW. the whole is clay slate overlying hard basaltic rock, except at one place called the Stony Ghat, which is composed of a soft clayey shale, containing large round nodules of a crystallised rock, very similar to gniess, from three inches to a foot in diameter; they are so loosely bound in the shale that the whole surface of the ground is covered with them. The whole so much resembled the Cromarty fish beds, that I broke a great number of these nodules, in hopes of finding some organisms, but found none. It appears as if it might have been formed by the vomiting of a volcano sending forth mud and water, and masses of melted rock falling therein. 17th October.---Mungrowl, 13 miles NNE. clay slate. 18th., Chittore, 14 miles north---clay slate running nearly north and south, the dip near the hills being from 45° to 60° ; long lines of it in this position, run along the road, resembling a pavement formed of slates upon their edges.

The rock on which the fort of Chittore is built, is quartz and hornstone, the clay slate on the west side of the rock dipping to the west, that on the east to the east; the rock rises precipitously 400 feet above the surrounding plain. 20th October.---Puttowlee, 6 miles N. by W. clay slate, small hillocks of quartz shooting through it here and there. 21st.---Soonera 13 miles, rock same as last, N. by E. 22nd.---Mundapeeah 9 miles; N. by E. the clay slate becoming micaceous. 23rd.---Bheelwarrah 6 miles, the mica slate appears generally on this march, and its direction is at right angles to the direction of the clay slate, the dip is very variable. 24th.---Mhowah 9 miles N. by E. all deep sand. 25th.---Shahpoora 16 miles NNE. deep sandy soil, the hillocks about are of quartz in some places, containing particles of hornblende, which has been used in building some of the temples, and resembles white marble. 27th.---Khodera 15 miles N. by E.; soil deep, sandy, the rock granitic; all traces of clay and mica slate have disappeared. 28th.---Kekroe 14 miles NNE. deep sandy soil, with a small quantity of clay. 29th.---Deogong 13 miles NNE. in the bed of a river, some miles from camp large masses of sienite, the rest is all deep sand, seemingly disintegrated sienite. 30th.---Malpoorah 13 miles N. by E. soil the same as last. 31st.---Chourah 12 miles NNE. granite appears in a few places above the soil, which is same as before. 1st. November, 1840.---Phughie 10 miles NNE. ½ E. deep soil same as before, no rock above. 3rd.---Raenwal Cowise NNE. 9 miles, quartz which appears in hummocks above the soil. 4th.---Neutah 7 miles NNE. deep sand. 5th.---Jhootwarrah 13 miles N. by E. 4 miles west from Jeypore, very deep heavy sand; the river near Jeypore shews the sand to the depth of from 40 to 60 feet; the rock on which the fort and palace are built rises very precipitously from the plain, particularly on the side next the town; it appears to be of quartz and mica, and a great part of it is hornstone, of which the buildings around are principally built; but there is very good mica slate around it, which is also used in the buildings. I am informed that there is very fine marble got somewhere near, but I have not seen it. The town of Jeypore is well watered and extensive, the streets are wide, and would be handsome if the aqueducts which have been built along the centre of the principal ones were kept up, but they have been allowed to go to ruin, and in fact like all towns under native Raj, the greater half of the whole is ruinous; the original design has been splendid. 7th.---Nangul 8 miles, course north, sandy soil. 8th.---Samote, 12 miles N. by E. soil alluvial, the hills are all of quartz, and quartz united with mica in minute plates. 9th.---Munohurpore 13 miles NNE. deep sand, hills same as before. 10th.---Bhabra 12 miles NNE. sandy hills as before. 11th.---Prangpoor 11 miles N. by E. sandy ditto. 12th.---Khote Pootlee 9 miles N. by E. same as last, the hills some miles to the westward granitic; the pillars of a tomb at this place are of a very fine close granite, identical with the best Aberdeen granite; in the same range of hills there are copper mines, worked very imperfectly, at Suhamah, about 15 miles from this; it is principally the copper pyrites the natives work upon. There is also gold found in this range, generally I believe in the arborescent form. 14th.---Shunwar, 10 miles N. by E. an upturned ridge of blue clay slate which has the appearance of a trap dyke, and which is decidedly trap in some parts, forms the ridge at the back of which the town is built, having a couple of round towers built on the summit of it; to the west, the hills about a mile off are of lime, which appears of volcanic formation; it is twisted and turned, and as if it were in the state of slag, with thin layers of quartz, about ¼ of an inch in breadth, running through it, at about a distance of 8 to 10 feet from each other. There are crystals of copper pyrites in it, I got also malachite, and I found in one place in a mass of the rock a considerable lump of spathose iron, brown spar, Carb, Fé. Thereabouts it has every appearance of rich copper. 15th.---

Narnoul 14 miles north, sandy soil; the hills are some distance, but the town must be built from them, and presents in every wall clay slate, mica slate, quartz, limestone, gneiss, and granite, indifferently used. 16th.---Nagul 10 miles north ditto. 17th.---Bhowanee 14 miles N. by E. the rock is here generally quartz with a small portion of hornblende in it. 18th.---Doodha 9 miles NNE. rock ditto. 19th.---Dadree 9 miles N. by E. ½ E. same formation. 21st Munhiervo 10 miles, course NNW. light sandy soil, no rock, country very level. 22d.---Burra Rawanee 8 miles, level country, all same course NNW. ½ W. Chota Bowanee, course NW. soil more clayey. 24th.---Hansi, country the same, bearing rich crops along the canals, with which the immediate neighbourhood is intersected.

Date. Oct.	Day. 87°	Night. 80°
16	92	62
17	92	62
18	93	62
19	96	55
20	95	58
21	95	63
22	95	63
23	95	64
24	96	68
25	95	66
26	94	65
27	95	64
28	94	63
29	94	63
30	93	65
31	93	62

Date. Nov.	Day.	Night.
1	92	62
2	91	57
3	94	60
4	92	59
5	92	58
6	90	52
7	87	54
8	89	64
9	89	58
10	88	58
11	89	52
12	91	53
13	92	54
14	92	54
15	91	54
16	91	57
17	85	55
18	80	55
19	87	54
20	89	54
21	84	51
22	82	60
23	75	55
24	77	51

The Thermometer in tent, highest during the day and lowest during the night, in the sun it sometimes rose to 101° not above 102°. It may fall a degree or two lower than what I have marked for night, as we march generally at 4 o'clock A. M. and it is then at the lowest it has been during the night, and certainly falls steadily until daybreak at least, though on the whole I would not allow above 30′ difference between 4 A. M. and the coldest time of the morning.

Extract of a letter from Capt. Thos. Hutton, *dated Candahar,* 12*th September,* 1840.

This country (Affghanistan) I believe has hitherto been pronounced destitute of zoological novelties; believe it not,---there are forms well worth the naturalist's attention, and I am preparing papers on several interesting subjects; the want of my books of reference however is a drawback to the completion of any at present. We have two species of wild goat, to which, as I believe them to be undescribed, I have assigned the names of "*Capra collaris,*" and "*Capra megaceros.*" The wild sheep is also most interesting, and I think will prove to be the proper "Bearded Sheep" of Pennant. It is entirely distinct from the species which the French naturalists discovered near Cairo, and which Cuvier and Desmarest have considered to be Pennant's Bearded sheep, and have placed in our systems as the Ruffled Mouflon *(Ovis tragelaphus);* as mine is distinct from it I have, in order to interfere as little as possible with established names, assigned to the Afghan sheep the title of *Ovis cycloceros,* from the circular position of its horns;—but this perhaps I may see reason to change, when I can get access to my books. There is also an antelope, of which at present I am loath to speak, for fear of blundering.

The jerboa *(Dipus jaculus)* is abundant in the plains.

There is a small species of Lagomus, on the hills.

A *Gerbillus* and true *rat,* as also a *mole* at Quetta, which I think may prove to be the "*Chrysochloris asiaticus,*" or Golden mole. Of this I am not certain however as yet; there are three lynx, the common striped hyæna, the wolf, jackal, and a fox allied to Pearson's Vulpes mottana of the Himalaya. An otter, leopard, hedgehog, porcupine, mongoose, and a ferret (which I also think new.) There is a hare, if not two.

In the winter, ducks and waders are abundant. Among the former, European forms as follows:

The Mallard, *Anas Boschas,*
---- Golden Eye, *Clangula vulgaris,*
---- White Eye, *Nyroca leeccophthalma,*
White Goosander, *Mergus albellus,*
-------- Shoveler, *Spathulea clypenta,*
-------- Teal, *Anas Crecca,*
The Coot, *Fulica atra,*
A Grebe, Pelican, Spoonbill, Brahminee Duck,
---- Snipe, *Scolopax gallinago,*
---- Snipe, *Scolopax gallinula,*
---- Woodcock, *Scolopax rusticola,*

Summer birds are abundant, and among them the English swallow *(Hirundo rustica)* appears in immense numbers about the beginning of March, although some are seen earlier.

The tree sparrow *(Fringilla montana)* is very numerous, and holds the place of the *H. domestica,* or common house sparrow.

The magpie *(Pica Europæa)* and the Chough *(Pyrrhocorax graculus),* the first perennial, the latter a winter visitant. The raven and the *rook (Corvus frugiligus)* are also seen, the former in summer, the latter in winter. *Neophron percnopterus* arrives in summer and retires in autumn.

Several English wagtails are summer visitants, as are other birds too numerous to mention here.

Snakes are not abundant, and very few are venomous; I only know of two decidedly so, and one is a banded Cobra from the hills west of the Argandab river, the other is a species common in the upper and Western Provinces of India. There is said to be also a large Black Cobra, but I have not seen it. Lizards are abundant, and I think in the "Sand fish" of the Afghans, I have got a new genus, but *books* are wanting to determine. The animal inhabits the desert sands which stretch along the southern part of the Candahar district, away westward through Herat into Persia; it is caught and dried, and thus sold as a nutritious and invigorating diet. I have many curiosities in spirits, and among others *three distinct* species of *Scorpions*, and *two of Galeodes.* On the former I shall be able to write an interesting paper, I hope when I recover my Indian specimens also.

Land and fresh water mollusca are not wanting either, and in Entomology there are some English and Indian forms. Indeed the natural objects of this country are a mixture of Tropical and European forms. In the winter the latter, and in summer the former prevails.

The Geology of the country passed over from Dadur to Candahar is most interesting, and furnishes some valuable facts; the secondary strata in the Bolan Pass, have furnished me with some beautiful specimens of fossils, both marine and fresh water; but of this hereafter.

Of fish there are four or five species, and as I perceive you are engaged on the subject, I will endeavour to get you a specimen of each. Would that I could get them for you from the Lakes of Tartary and Thibet.

Arracan.

We have been favoured by Lieut. Phayre with two fishes from Arracan, one a species of Cyprinus from the Lemgoo river, the other a kind of Pike, of which we shall take as early an opportunity as possible of furnishing further particulars.

Lieut. Phayre has also favoured us with the skull of a species of goat-antelope, which inhabits the forests of Arracan, and which is called *Sha* by the Burmese, who say it is not above two feet high, although from the size of the skull Lieut. Phayre thinks it might be expected to be much larger. On referring to specimens for which we are indebted to Lieut. Phayre's kindness on former occasions, we find the horns and part of the skull of a much smaller species of the same group, *Næmærhedus,* Plate xii. fig. 3; the latter is probably the *Sha* of the Burmese, while the large skull to which Lieut. Phayre alludes belongs to a species at least twice the size, or as large as the *Næmærhedus sum matrensis,* see fig. 2. pl. xii. That there are more species of this group in continental India, than have as yet been identified or described, we may perhaps infer from the circumstance that Lieut. Phayre had before favoured us with the horns of what we should conceive to be a different species, being much smaller, as well as from there being two heads in the Asiatic Society's collection both referrable to the same group, but one a light reddish yellow colour, and the other blackish brown; we trust Lieut. Phayre will be able to capture a pair of these interesting animals for the Zoological Society's Gardens.

Lieut. Phayre mentions that wild dogs or wolves are said by the Mugs to inhabit the Arracan mountains, but strange to say there are no jackals, nor do the natives of Arracan know this animal, which is so familiar to the inhabitants of Bengal. A short time since Lieut. Phayre relates that he ventured up the river Nâf, which forms the boundary between Arracan and Bengal, and to his astonishment about the close of the very first evening after his arrival on the boundary he and his party heard the cry of jackals, a sound which he had nearly forgotten during his residence in Arracan, and which the Mugs or Arracanese who accompanied him had never heard before. Lieut. Phayre remarks that the climate of the southern part of the Chittagong district must be the same as that of the northern parts of Arracan, yet the Nâf river he considers is the extreme southern limit of the distribution of this animal. Nor is it to be found in any of the Malayan provinces south of Arracan. In addition to the above interesting observations, we are also indebted to Lieut. Phayre for two specimens of fossil crabs, one from the island Chaduba, and the other, which is more perfect, was found on the sand of the sea-shore, twelve or fourteen miles north of the mouth of the Myoo river; these specimens we hope to describe more fully on a future occasion. What we have now particularly to notice, is the fossil tooth of a monstrous species of shark of the genus *Carcharias,* Cuv. which we have figured plate xi. fig. 4. To show the vast difference of size between the fossil and a recent species of the same genus we have also figured 4 *a,* the corresponding tooth of an individual four and a half feet long, a comparison with which will show what a vast difference of size exists between the fossil and the existing species; for although the latter attain a great size, yet we can hardly conceive the difference to be so immense as the comparison of the teeth seems to indicate.

The jaw of a species of Scyllium with which we have been favoured by a friend, measures 11¾ inches wide, from which we may suppose the body could not have been less than 10 feet long. The length of its largest teeth is scarcely one inch, yet as each tooth is an inch in breadth, with sharp cutting serrated edges, it must have been a frightful monster, particularly when we recollect that there are 22 vertical rows of teeth, and 12 in each row, making a total of 264 teeth. However formidable such an animal must be, yet it sinks into insignificance when compared with one whose single tooth is equal in volume to twelve of the largest teeth of the Scyllium, just alluded to, whose jaws are twelve inches broad.

The fossil tooth has a perfectly recent appearance, the only injury it appears to have received is the loss of the point, which is broken off; before this accident happened the length of the tooth could not have been less than 2¾ inches, while the breadth is 1½; the edges are sharp and serrated, thickness from the inner to the outer surface half an inch. We found the base of the tooth below the enamel only afford 10 per cent. of animal matter, while the corresponding part of the tooth of the large Scyllium contained about 67 per cent. of animal matter, and it is for this reason alone that we regard the former as fossil, for the enamel is as perfect, and the marks of dentition are as fresh looking upon it as on a recent tooth. The individual to which it belonged must have corresponded very closely with the white shark found in the Bay, whose tooth, fig. 4 *a*, though comparatively minute, corresponds almost exactly with the fossil.

These gigantic teeth are found on the sea-shore of the Arracan coast, 10 or 12 miles north of the Myoo, along with the fossil crabs, and are, says Lieut. Phayre, called by the natives *Moo-gyo-Rhyouk*, or lightning stones. Further researches in that neighbourhood it is probable will lead to the discovery of some great fossil deposit.

Plants resembling Thea viridis, in Arracan and Tipperah. We were favoured by Capt. Bogle, the Commissioner of Arracan, some time since with the leaf of a plant which is found in that province, and which the natives believe to be the tea plant. We have also been favoured by Mr. Wise, of Dacca, with a similar leaf of a plant in the Tipperah hills, of which the natives prepare a tea which they use. We have seen so great a difference between the leaves of the veritable tea plant itself, as to render it impossible to decide in such cases from the leaf alone ; as far as can be decided from the leaves in question, we are inclined to regard neither of them as the tea leaf, but from their appearance we should suppose them to be the leaves of a camillia, or false tea. In neither of the leaves in question do the veins setting off from the midrib form so acute an angle as is observed in the leaves both of the true and false tea plants of Assam. This difference is more perceptible in the Arracan leaf than in that of the Tipperah plant, but the anastomoses of the veins round the margin of the leaf in both is far less distinct than in the *Thea viridis,* or true tea plant.

Naptha and Petroleum. Capt. Bogle, the Commissioner of Arracan, has reported to the Coal and Mineral Committee the existence of several springs of these minerals at a place called Paidong, about 5 or 6 miles distant from Ramree, 2 or 3 miles distant from the Cheduba roadstead, with a good road all the way; the wells are about 8 or 10 fathoms deep, and around them the surface is scantily covered with stunted jungle. Three wells yield about 10 or 12 maunds of Naptha in three months. Captain Hannay also reported to the Committee the existence of several springs of petroleum in Assam, and Mr. H. Inglis has also communicated to the Committee the existence of springs of petroleum in Sylhet. Samples of these have been arranged in the Committee's collection of useful minerals, and reports on their extent, &c. are in course of preparation.

Dr. Spilsbury has communicated to the Coal Committee intelligence regarding the existence of a bed of good coal* within nine miles of the station of Jubbulpore, at the head of the Nerbudda valley. The coal appears to be of very superior quality, only containing about 2.9 per cent. of ashes. The situation of this bed is of great extent, and is intermediate between that of the Hoosingabad coal brought to notice at Bombay by Major Ouseley, and the coal recently found at Kotah in the Mirzapore district by Captain Wroughton. Dr. Spilsbury also has forwarded information of other indications of coal occurring in various situations in the Rewah and Nerbudda territories, but as these will be noticed in the reports of the Coal Committee, it is not our intention to say more on the subject here than to acknowledge the information received, and at the same time to solicit further particulars from this and other quarters where coal and useful minerals occur. Along with the coal Dr. Spilsbury forwarded several specimens of substances which

* We were indebted to Capt. Ludlow for the first specimen of this coal, which induced us to write to Dr. Spilsbury for particulars regarding it.

he observes were noticed as fossils in the "Madras Spectator," and also from a different situation several globular bodies, which have been regarded as fossil fruits of various kinds. In addition to the specimens received from Dr. Spilsbury we have been favoured with others from the same quarter by Drs. Row and Drummond, as well as a very curious form of agate, supposed to be a fossil palm. Except the last, we doubt if any one of these bodies which we have as yet examined be of organic origin, but as the question is one of interest, we shall on a future occasion endeavour to examine them with more care. The substances supposed to be *alcyonites* or fossil zoophytes, appear to be radiated calc spar, which is found in two forms in the Nerbudda, namely globular, in which the crystals extend uniformly on every side from a common centre, which is hollow, and filled with calcareous earth, giving it the appearance of a fruit. In other cases the radii extend in fan-shaped clusters, so as to form portions only of the speroidal shapes, and several of these clusters are aggregated so as to give the whole a coralline appearance. While the former were considered to be fruits, the latter were regarded as a kind of coral or alcyonite. The general colour of these specimens is reddish yellow, the external surface is dull, with a silky glimmering kind of lustre.

" Other kinds of these fossil-like substances are spheroidal earthy balls, one of them is labelled as follows---'spheroidal balls found in limestone, some 6½ inches in diameter with a distinct corticle, inner part all crystallized carbonate of lime. Small hills near Jubbulpore.' Another is marked, from its external form, as a *fossil mangoe*, a third has merely a ticket indicating the locality in which it was found, attached to it. Its form also resembles that of a mangoe. First, as to the spheroidal earthy balls, nothing can present a stronger external resemblance to large fruit, and this general resemblance is further supported by the appearance of a distinct outer rind, but when we come to examine more closely we find the part within the rind to be composed of coarse and fine pebbles imbedded in a calcareous matrix, and the rind to consist of fine globular crystals of calcspar, without any thing organic in their arrangement more than in that of the sandstone on which they are deposited. Some of them appear from the label above quoted to contain radiated calcspar, perhaps such as that composing the substances supposed to be of a coralline character. These remarks will apply almost equally to the substance, called fossil mangoe, except that the outer layers enclosing the nucleus form a compact earthy crust, either to a nucleus of sandstone or a smaller nodule composed also of various layers as the crust itself. Some of these earthy spheroids are more calculated to impress on the observer an idea of their organic character than any of those previously described, from their being composed of dark earthy, as well as light earthy particles, more or less in alternate layers, with an intermixture of particles of different colours, grouped so as to resemble vessels very much, particularly when examined with a common lens, but with a higher power, which ought to develop organic structure more perfectly, this resemblance is not confirmed; but we shall consult Mr. Grant, whose experience in observations of this nature is equalled by few, regarding all these specimens.

The appearances in agate are often so very deceptive, that the transverse section of fossil palm would not have been received by us as fossil had not similar specimens been identified by Mr. Grant, after much careful observation, as the *roots of palm trees.* Before this point was decided, Mr. Grant, from the want of mechanical aid in India, sent specimens to lapidaries in England to be cut into longitudinal and transverse slips for the microscope, and these, when compared with the *roots* of certain living palms, leave no doubt as to their identity.

Remarks on Dr. Lord's account of Affghanisthan.

[From a Correspondent.]

By good fortune I have been able to get a sight of the reports and papers of Dr. Lord and others regarding "Scinde, Affghanistan, and adjacent countries;" I say good fortune, for if the "march of intellect," or the "schoolmaster when abroad," had made any advance in those mountainous regions, I would have in vain endeavoured to have accomplished my object, as no doubt the Gilzie chiefs would have prized more a learned disquisition about their own country than a bag of grain, the more so, as they might by chance have their own person, house, horses, &c. described in glowing and enthusiastic terms.

In the immense folio work now before us, there are many interesting and valuable articles, but in a scientific point of view those by Dr. Lord are most worthy of notice. I shall therefore endeavour to give you some idea of the substance of these papers; as for extracting the cream of them, I shall leave this to be done by abler hands; do not for a moment allow this to lead you to suppose that at present it does not abound, this may, or may not be, as the case, or rather circumstance of the case is. We differ however on many points, and there are many sentences very ambiguous, I shall therefore take notice of these in order that your experience may be thrown into the balance. The first article is entitled, *Some account of a visit to the plain of Koh-i-Damun, the mining district of Ghorbund, and the pass of Hindu Kush; with a few General Observations respecting the structure and conformation of the country from the Indus to*

Cabul. A parallel of latitude, says he, drawn through Kalabagh, and west of the Indus, would present a remarkable difference in the course of mountain chains, as observed to its north and south sides. In the latter direction the Soliman and Kala ranges, the one of which may be looked upon as a continuation of the other, generally preserve an almost perfect parallelism with the course of the Indus, while on the other side, every range, and they are numerous from the Himalaya and Hindu Kush to the salt range, inclusive, are at right angles with the direction of the stream. In other words, the general line of the former is north and south, of the latter east and west; it is of the latter, and the country they include, that I would at present more particularly speak.

"In addition to the general course of the chains thus laid down, there is another fact of no less importance, towards determining the physical formation of this part of the country. When the two mountain ranges have for some time preserved their parallel east and west course, the northern is observed to deflect, or send off a branch towards the south, while a corresponding deflexion or ramification of the northern chain comes to meet it, and the plain which otherwise would have been one continued expanse from east to west, is thus cut into a number of vallies, the longitudinal axis of which is still in general to be found in the same direction. If we can conceive these vallies to be few, spacious, and well marked towards the north and south, while in the central, or Kohat region, they become small, numerous, and crowded, so as to present a tangled maze, or net-work, we shall have just a general conception of that tract of country west of the Indus, which may be familiarly described as lying between Kabul and Kalabagh." The remarks here given are interesting, as they in part confirm what we have elsewhere stated, viz. that all the principal ranges among the Himalayas parallel with the central or high mountain range, and that all the principal secondary, &c. valleys, are *longitudinal*, or, in other words, have a direction from NW. to SE. as the central or high mountain chain has, that an eye not accustomed to geological surveying may be misled by the grouping of the small subordinate ranges, to form a different idea, is easily accounted for, seeing that the individual is not at all prepared to follow out the dip and strike of the different strata, and might consider himself in a "tangled maze," as Dr. Lord expresses himself, although he might have presented before him the most beautiful order of superposition. To the groupings of mountains, but little attention has, as yet, been paid by geographers, even our best maps are lamentably inaccurate; we hope that in the map of Affghanistan and Cabul, about, it is said, to be given to the world by that accomplished observer Major Garden, this subject will receive its due share of attention; we need scarcely venture to hope---for it is scarcely possible for the practised eye of this veteran officer to have overlooked such an important matter, that the grouping of the mountains will form the basis of his maps, and on the manner in which this department has been executed will depend the accuracy of his labours.*

"2nd. Unquestionable geological facts, such as the structure of igneous rocks, poured out under strong pressure, the presence of fossil shells, &c. lead me to the belief that several, if not all, of these vallies, (Jalalabad, &c.) were at some former time the receptacles of a series of inland lakes, and the nature of the shells found (principally *Planorbis* and *Paludinæ*) seem to indicate that the water of these lakes had been fresh. In this manner these grand sheets of water, separated by the mountain deflexions before alluded to, would appear to have occupied the entire country from Cabul to the Indus, and their basins may now be distinguished as the plains which afford sites to the three cities of Cabul, Jalalabad, and Peshawur. The drainage of the basins is most tranquilly carried on by the Cabul river, which runs along the northern edges of each, conveying their united waters to the Indus; but in former times, when more energetic means were necessary, the mountain barriers were burst, and the shattered fragments and rolled blocks that now strew the Kyber Pass, bear testimony to its once having afforded exit to a mighty rush of waters, while the Gide-gulla (Jackall's neck), or long defile east of the plain of Peshawur, clearly points out the further course of the torrent towards the bed of the Indus, whence its passage to the ocean was easy and natural. While at Jamrud I had an opportunity of observing a fact which strongly supports the idea I have ventured to propose; for a well which the Sikhs were employed in sinking within their new fort, Futehgurh, and which had already proceeded to the depth of 180 feet, had altogether passed through rolled pebbles of slate and limestone---the constituents of the Khyber range of hills. But the wells of Peshawur, generally 20 or 30 feet deep, have passed through anything but mud and clay strata. Now the fort I have mentioned is situated at the very mouth of the Khyber Pass, and Peshawur is 12 or 14 miles distant, towards the other extremity of the plain. If then this plain were once the basin of a lake, into which a stream had poured through the Khyber Pass, it is obvious that such a stream would at its very entrance into the lake have deposited the rolled pebbles and heavier matter with which it was charged, while the lighter mud and clay would have floated on to a considerable distance---in other words, the

* We have since heard from our correspondent, who states that he has seen Major Garden's map, which is a highly creditable and important work.—Ed. Cal. Journ. Nat. Hist.

former would have dropped at Jamrud, the latter gone on to Peshawur, and this is precisely the fact."

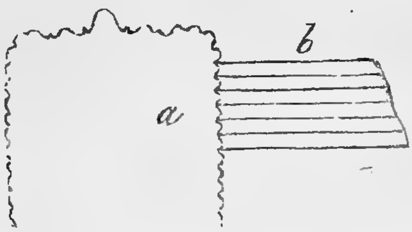
The conclusions of Dr. Lord are exceedingly plausible, and that the tracts of country which he has marked out were originally the basins of lakes, is not at all improbable; such was originally the case with the valley in which the town of Bilappore on the Sutledge is built, and here you have evidence of the lake having occupied a level some three or four hundred feet above the present bed of the Sutledge. The same we shall prove---and that too from incontrovertible facts, to be applicable to a series of other valleys on the banks of that river; we shall also prove that the great valley through which the Sicat river flows, whose waters are discharged into the bay at the city of Mundi, was also in the same position, but that the time when these lakes were emptied is geologically speaking comparatively recent, and connected probably with those convulsions and upheavings which raised the Sevalick or sub-Himalayan range to its present position. But we are quite at a loss to make out what he means by unquestionable geological facts, such as the structure of igneous rocks, poured out under strong pressure, &c.

That igneous rocks are distinguished from volcanic rocks by their structure, by the method of their formation, as he has mentioned, and also in not presenting any crater of eruption, is generally known. But he does not inform us whether those so-called igneous rocks have been the means of causing those convulsions which converted these lakes into valleys; if so, then they (igneous rocks) must belong to an epoch of comparatively recent date, because he mentions the presence of fossil shells belonging to the genera *Planorbis* and *Paludinæ*, both of which belong to the tertiary series, and many species of which are now in existence. If then he met with these shells imbedded in a rock upraised by the "igneous rocks," thus,---

a Igneous rocks.

b Lacustrine deposits, containing Planorbis, &c.

he is entitled to infer that the eruption of "igneous rocks" took place posterior to the deposition of the fresh water deposits, as the shells mentioned have only been met with in deposits of this description. If again, on the other hand, he found the lacustrine formation in a horizontal position at the line of junction, then he was entitled to infer that the "igneous rocks" were erupted anterior to the deposition of the lacustrine formation; for if it had taken place after the deposition, then both the position of the strata and the structure of the rock at the line of junction, would have been altered. To pay attention to these two circumstances is of the utmost importance, in order to ascertain the relative ages of the Neptunian and Plutonian or volcanic rocks, and we would therefore direct particularly the attention of Dr. Lord and Capt. H. Drummond, the latter of whom is now engaged in making a geological survey of Cabul and Affghanistan, to these points.



a Igneous rocks.

b Lacustrine deposits.

3rd. "Connected with these three basins, and joining that of Cabul almost at a right angle from the north, is the plain of Koh-i-daman (the mountain's skirt) which stretches away to the very foot of Hindu Kush, and gives exit at its northern end to four several routes,* by which that chain may be passed. It is an extensive and fertile plain, bounded on all sides by primitive hills, those to the north-east and south being chiefly of slate, including all the gradations from clay to mica, and even at times closely bordering upon gneiss, while the ridge to the west shews at the base granite, and it is at the base and along the windings of this, that occur the vineyards, orchards, and gardens of Shuterdarra, Istalif, and Isterkhech, so famed in the commentaries of the Emperor Baba."

On the first day's march towards the plain above mentioned, he says—"The trees had already put on their autumnal tint. The mountains exhibited the grandest varieties of light and shade. Clouds still lingered amongst their inequalities, and rested here on a spiral cliff, there on a lengthened streak of snow, which deep in a ravine had resisted the whole force of the summer's sun. The dead nettle, the thistle, the dog-rose covered with hips, the may-flower, glistening strawberries, the wild mint,

* From a point towards the centre of the plain (Dush-i-Bagram) I found the bearings of these four passes as under—

Punjthan, ...		N.
Ghutuh, ...		N.W.
Purwon, ...	2	N.W.
Goorbund	50	N.W.

fennel, lavendar, and a thousand other well known plants, perfumed the air, or recalled our recollections to our native land. The morning was calm, grey, and autumnal. We were filled with a tranquil pleasure.

" It struck us not a little singular, that amidst so great a profusion of vegetables, animal life seemed all but totally extinct, a few magpies, sparrows, and pigeons, with an occasional chikor (*Tetrao rufus*) were the sole representatives of the winged tribes, as were a small lizard and a frog of the reptiles. The greater number we were told had emigrated for the winter towards the warmer regions of Jalalabad and Peshawar, and even some, as the *Kulung* or Indian crane, to the plains of Hindostan. The thermometer in our tents at this time, ranged between 45° and 65° Fahr."

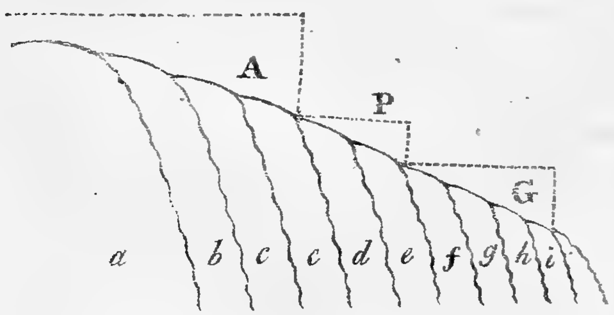
In regard to the migrations of birds throughout Asia, we know nothing, and this department presents a wide and interesting field for investigation. The magpie mentioned by Dr. Lord, is identical with the *Pica vulgaris* of Europe. What the sparrows and pigeons are we cannot say, but his chikor, erroneously named *Tetrao rufus*, is, if identical with the chikor of the Himalayas, the *Perdix chukar*, (Gould.) Having spent a few days on the lower hills, but finding that the snow had commenced to fall above them, they were forced to hurry on, or relinquish for a season their attempt to reach the Hindu Kush.

"The entrance," says he, " of the Ghorbund Pass, which we meant to penetrate, was but 4 or 5 miles in a N. W. direction from the town of Charikar, but though the foot of the mountains was thus near, the road through them was no less than 50 miles in length before it led us to the top of the pass over Hindu Kush, by which the great Caravans from Tartary or Turkhistan annually arrive in Cabul. As the Usbeks at the other side of the pass are notorious slave dealers, secrecy and dispatch were alike advisable; accordingly on the morning of the 18th October, equipped as Affghan horsemen, and accompanied by four mounted attendants, and a guide to whom alone we had entrusted our plan, we marched from Charikar, and halting an hour at noon to rest the horses, succeeded by sunset in reaching Gherikze, the last inhabited spot at this side of the pass, from which however it was distant 18 miles."

The summit of the pass Dr. Lord found to be composed of syenitic granite, resting upon it gneiss, which was succeeded by mica slate and clay slate, all of which passed imperceptibly into each other. At Sokht-i-chenar he found imbedded in the gneiss a large and valuable bed of sparry iron ore, which however is not worked; the iron afforded by this ore is admirably adapted for making steel. In the mica slate, immediately over the entrance of the pass, and on the very summit of the mountain, he found a small vein of silver ore, of but little value; he was informed however that there was a much richer vein in the pass of Pungshur, which is said to have been worked to a great extent in the time of the Ghazatais.

The height of the pass was calculated to be about 15,000 feet above the level of the sea. Here they were informed by the natives that individuals are frequently seized with giddiness, faintness, vomiting, and symptoms exhibited sometimes by travellers in ascending Mont Blanc. Even at Simla many individuals labor for some time under the rarefactions of the air, in a short time however they become habituated to it.

Associated with the gneiss, mica slate, and clay slate mentioned, limestone in many places is to be met with, and near to Mydan of a pure white colour fit for statuary purposes, and this same limestone is said to extend west to Herat, and south to Candahar. Till the time of the Emperor Shah Jehan this marble was unknown, he having received his information from a Herati marble cutter, not until however he had brought from a great distance, at immense expense, a large portion of the marble required in the construction of the mausoleum to his great progenitor Baber. Secondary limestone is also met with in many localities. "But," says Dr. Lord, "to attempt a generalization more extensive perhaps than I am strictly warranted in offering, though derived from many sections, in various directions, I would say, that an observer in passing south, from the top of Hindu Kush, the parallel of Kalabagh, would see first a core of granite (syenitic granite) with coating of slate as in the grand mountain chain, next a core of slate with a coating of limestone, as at Attock and Khyrabad, then hills of ancient limestone, now blue, and now fossiliferous, as in the ridge between Peshawar and Kohat, then a core of more modern limestone (fossiliferous) with a coating of new red sandstone, as in the hills south of Kohat, and then would find himself amongst aluminous clay, sulphur, gypsum, bituminous shale (bituminous marl slate) and rock salt, which occurs near Lachi, Ismael, Khyt, and Tiri."



A { Hindu Kush / Primitive series.
P Carboniferous.
G Saliferous series.
a Granite.
b Mica slate.
c c Clay slate.
d Limestone.
e Secondary limestone.
f New red sandstone.
g Bituminous marl slate.
h Gypsum.
i Rock salt.

This rough section will explain Dr. Lord's views.

At Layagard the mountains presented to Dr. Lord a very extraordinary appearance, which he thus describes—" The hitherto uniform tints of the mountain were soon to be variegated with red, green, and ashen grey, which on examination we found to be produced by ochre, red indurated clay, decaying green-stone, and strata of volcanic ashes. These indications of ancient volcanic action, carried along with them efflorescence and sheets of sulphate of lime, the deposits of springs which had whitened large tracts on the side of the range extending westward as we continued our course to Chandí, the volcanic indications being generally at an inconsiderable elevation, and in most instances capped by conglomerate, or beds of clay, to a depth of 50 to 200 feet; the valley we were told stretched away west and south-west, until it nearly reached to Bameean, but the upper end of it was inhabited by the Kaikh Ali, a lawless tribe of Hizarahs, who acknowledge no ruler, and rob every one that comes within their grasp, so that for a long series of years this road has been closed to the traveller and the merchant; we were therefore obliged to terminate our researches at Chandí, but it gave me no little pleasure, on a subsequent journey, to recognise the very same volcanic indication with basalt and amygdaloid superadded in the vale of Tohak, which is distant about 40 miles SW. from the point where we were now to turn back, and to trace these indications through Topchi up to Bameean itself, and finally to identify by its mineralogical characters, as well as by its geological connexions, the conglomerate from which the caves of Bameean are scooped, and its gigantic idols carved, with the conglomerate of the vale of Ghorbund.

Here we think Dr. Lord has fallen into an extraordinary error in considering the " ashes," as he calls them, to be volcanic. From the account he has given, we are led to suppose that these so-called ashes are nothing but decomposed claystones, claystone porphyries, and claystone tuffas. We have frequently examined the Pentland hills in Mid Lothian, Scotland, in company with individuals who were well acquainted with the volcanic district of Auvergne, &c. and who remarked the similarity between the decomposed claystones, porphyries, and tuffas of the former, with the volcanic tuffas and ashes of the latter. In the Pentland hills you have the claystone tuffa, which in many places is much decomposed, passing into claystone porphyry, and it into felspar porphyry or compact felspar, and these again are associated with amygdaloid, &c. and all bursting through or displacing the Neptunian strata, which consists of greywache, greywache slate, clay slate, old red sandstone, conglomerate, and sandstone. But before we can be correct in our premises, we must see a collection of rocks from the places mentioned by Dr. Lord; probably however the learned Geological Committee of the Agricultural and Horticultural Society of Calcutta, whose zealous exertions deserve every commendation, will be able to settle the point, seeing that as they have manufactured a geological map of the whole of India---they might as well daub with brown, blue, grey, or with as many party colours as they like, a map of the country west of the Indus. We hope and trust that the *labours* of the Committee will not be thrown away, and that the Society will soon publish this laudable undertaking. It matters not whether some of the members of the said Committee, as has been reported, do not know the difference between clay ironstone, and coal, without an analysis has been resorted to! and even when that has been undertaken, the specimen remains a *nondescript! that is a trifle*---so some individuals may think.

We shall only notice one other paragraph of Dr. Lord's paper. "Temperature of wells," says he, "as generally taken, without reference to the formation in which they occur, must needs be a most imperfect, indeed erroneous method of approximating to the mean temperature of the place, inasmuch as different rock formations, like different metals, vary much in their powers of conduction. Thus a well at Peshawur gave me a temperature of 64o, while one at Attock, almost under the same parallel of latitude, and the same altitude above the sea, was as high as 78o, the thermometer at sunrise of each standing at about 80o; but the well at Peshawur was in a loose clay mixed with vegetable mould---a notoriously bad conductor of heat, while that at Attock was in hard black slate; which would thus appear to have a very different quality; again, a well at Akroford, in limestone, latitude 35o N. shewed a temperature of 54o F., while another in slate, a few miles further north, stood at 48o ---the altitude of both being nearly equal, and the thermometer at sunrise below the freezing point; so that in this instance also the slate would appear to have had superior powers of conduction."

From the above observations it would appear that Dr. Lord is not at all aware of the attention that has been paid to this subject for some years past, in Europe. In Professor Bischoff's admirable work* on the temperature of hot and thermal springs, "*the unequal power of conducting heat, possessed by different rocks, causes differences in the progression of the increase of temperature towards the centre of the earth,*" is ably treated in the 16th chapter, and of which the sentence in italics is the title.

* First published in the Edinburgh New Philosophical Journal for 1837 and 38, and since reprinted.

Fox* observed in a mine in Cornwall that thermometers sunk into a metalliferous vein, stood in general 2·25 higher than when placed in holes bored in the rock, particularly granite, and that tin veins usually shewed themselves colder than copper. From observations made in the Prussian Mines, Von Dichen† has proved that the increase of temperature is, in general, much more rapid in metalliferous mines, but whether this is owing to the decomposition of the iron pyrites and coal, or the locality of the mine, he does not decide. Condier also mentions, in his observations on mines, the great influence of a metalliferous zone on the subterranean temperature, *owing to its superior conductibility of heat.* Professor Forbes has long been engaged in Scotland in carrying on a series of experiments, in order to shew the relative powers of conductions of each rock. It has also engaged the attention of the British Association,‡ and Arago§ considers this phenomenon of such importance, as to state that its further investigation would not only serve to prove the existence of a superior temperature in the interior of rocks and metalliferous veins, but would afford an additional objection to the hypothesis supported by several philosophers, that the high temperature in mines is the result of the action of the air upon substances, particularly the pyrites, on the walls of the galleries. To prove that the observation alluded to indicates a more important source of heat in the interior, he adds two mathematical formulæ from Fowrier's Theorie de la Chaleur, from which it follows that, *cæteris paribus*, the temperature of the mass of a lode which is in contact with the atmosphere is greater, the more easily heat is conveyed into the interior of the mass. There is however a certain depth throughout the whole earth, varying from 40 to 100 feet, where the temperature is invariable at all times|| and seasons, and which differs but little from the mean annual temperature of the place above. Thus it has been remarked that the temperature of the earth at a depth of 90 feet in the caves of the observatory at Paris, has never in the course of half a century been above or below 53° Faht. which is only 20° above the mean annual temperature of the city. "This zone," remarks Mrs. Somerville,¶ "unaffected by the sun's rays from above, or by the internal heat from below, serves as an origin, whence the effects of the external heat are estimated on one side, and the internal temperature of the earth on the other." By experiment it has been proved, that for

* Annal de Chimic de Phys. vol. xvi. p. 80.

† Poggend, Annal. vol. xxii. p. 497.

‡ Mem. de l'Acad. Royal des Sciences des Paris, vol. vii. p. 473.

§ Bischoff. loco citato, p. 126.

|| Transactions of the Association.

¶ Phillip's Geology, vol. ii. p. 231, and Mrs. Somerville on the Physical Sciences, p. 266.

every 80 or 100 feet of perpendicular descent beyond this limit, we gain 1° Faht. which ratio of heat would render the hardest substances fusible at little more than 300 miles of descent, and thus shewing that our earth is a mere crust surrounding a vast globe of liquid fire. The arguments *pro* and *con* have been ably discussed by many authors, so that we need not allude to them at present. We must now conclude our notice, but shall probably take another opportunity of examining Dr. Lord's papers further.

As we were just finishing this article, the melancholy intelligence of the death of Dr. Lord reached us. Our remarks we send for publication, in order that the attention of others may be drawn to the subject. In Dr. Lord, the Honorable Company have lost an able, zealous, and accomplished officer, whose talents promised to have raised him, ere long, to a most prominent place. Some of his actions may have been condemned, and they may or may not have been injudicious for aught we know, but in what place, in what society, will you find it otherwise; a talented, bold, and enterprising officer, raised by merit, is always exposed to the shafts of envy. To the medical profession of India, Macneil and Lord, in these stirring times, form bright ornaments, and a beacon, as it were, by which others may mark out their career, as in them we have examples of meritorious service receiving its due reward. If however Dr. Lord's career has been but short, it has been brilliant, and his death though sudden, has been honorable. To him the scientific world are deeply indebted, seeing that, until he visited those countries, their structure was quite unknown. From, however, the short time that he was there, and the important duties he had to fulfil, he has still left a vast field to be explored, and whoever enters on the investigation with the same energy, resolution, and enthusiasm, cannot fail to be amply rewarded for his trouble.

October, 1840. M. A. S. B.

New Publications.

Edinburgh New Philosophical Journal, July, 1840.

In an excellent article in the number of the Edinburgh Philosophical Journal, July 1840, on Phenomena necessary to be acquainted with in Preliminary Mining, Professor Mohs states that mining districts usually lie between two or more mountain groups, or constitute a portion of them. A knowledge of the external form of mining districts, though not without its value in the search for useful minerals, is nevertheless not altogether to be relied upon, as phenomena occur within a short distance to support, as well as contradict, known rules. The Professor first explains the peculiarities of granitic structure, together with the structure of slate rocks, and next points out the peculiarity of classes and formations, and the relations of these amongst themselves, together with their subordinate members, as porphyries, syenites, greenstones, and limestones. The paper is to be continued, and as the part which has appeared scarcely differs from the geognostical views of Professor Jameson, proposed to the Wernerian Society in 1813, we need not dwell on them in this place.

The next paper is on Danish Oyster Beds, by M. Kröyer, from which we learn that oyster beds are not essentially elevated portions of submarine land, or rocks. Oysters attach themselves by their valves to loam, sand, or mud, either of which answers equally well, only on such banks the oysters must necessarily lie loosely, or merely attach themselves to each other's shells, thus appearing in clusters. We must therefore be prepared to tolerate this inconvenience, in such oysters as may, out of consideration for the good people of Calcutta, establish a settlement within an available distance of the city.

The third article is a short notice by M. H. von Meyer, of a Fossil Passerine Bird, about the size of a lark, in a slate supposed to be of the age of the chalk, which is the more valuable, perhaps, as M. Meyer himself had long doubted the existence of birds in formations antecedent to the tertiary series, having referred many of the so-called bones of fossil birds to Pterodactyles, in whose bones M. v. Meyer discovered air cells as in those of birds.

The fourth article from Dr. Holland's work on the Influence of Weather on Disease, is interesting, but too long to quote, nor do we see any thing in it either new or curious to condense or distinguish. The paper is divided into sections; viz. temperature, moisture, pressure, and electricity of the atmosphere in relation to disease.

The fifth article, on the Colouring Matter of Red Snow, by R. J. Shuttleworth, Esq. is curious. The author learnt that some patches of snow near the *Hospice du Grimsel,* where he happened to be at the time with several distinguished naturalists, were red, and proceeded to examine these appearances, and found them to depend on the presence of various undescribed infusoria, which are destroyed by heat at a few degrees above the temperature of snow, and with them a kind of Algæ, *Protococcus nivalis,* which served to afford them nourishment.

Sixth, a paper translated from the *Comtes Rendus,* on the Mollusca of the *Schelles* and *Amirantes* Islands, in which the services of M. Dufo, who visited those Islands for the purpose of investigating their living mollusca is pointed out by MM. Dumeril, Milne, Edwards, and Blainville.

Seventh, a summary of the discussions arising from M. Mandl's recent publication on the Hair and other Tegumentary Coverings. The most interesting remarks elicited on the occasion were those relative to the art by which the Chinese are capable of permanently changing the colour of hair. M. l'Abbe Imbert, now favourably known by his account of the Chinese method of sinking artesian wells, or spouting fountains, was remarkable in Paris before his departure to China for glaring red hair. On arrival at his destination, those interested in his success, to prevent his detection as a stranger among people universally black-haired, subjected him to a constitutional and internal treatment, by which the hair became permanently black. Another missionary whose locks became grey before he was allowed to hold intercourse with the inhabitants, was on his arrival in the celestial empire subjected to medicinal treatment, by which his hair was also changed into a permanent black.

Eigth, *on the lake of Zirknitz in Carniola.* Two large caverns at the foot of one of the mountains of the Julian alps, of which wonderful narrations have been given in the older works of Sartori, Valvassor, &c. which it is the object of M. Knöpfer, whose paper is noticed, to correct. The basin of the lake is surrounded by mountains, so that the waters rushing into it could find no exit but for the loose and perforated limestone through which it forces a subterranean passage. When the water entering the lake is lessened, as in the dry summer months, the discharge being always the same, the lake falls. If at this time there should be storms or continued rain, the lake rises. The monks of Freudenthal in the seventeenth century, who like most people of the present day were fond of fish, and to whom the periodical drying up of the lake was particularly inconvenient, prevented this by covering the opening with an iron grating on which they placed slabs of stone: in this manner they often succeeded in keeping the lake filled for several years, until the dissolution of the fraternity, when the lake was left to ebb and flow its own way. M. Knöpfer says,

"That when he obtained a view of the village of Zirknitz, and the small towns lying around it in the plain, he looked in vain for a sheet of water resembling a lake, he could only see on the opposite hills a longitudinal white stripe, which at a distance has the aspect of a sandy steppe. This was in fact the deep bed of the lake, in which the small quantity of water remaining behind flowed in separate large channels like artificially formed canals (which rendered impossible an ascent for any great distance,) towards several larger openings, into which it fell with a rumbling noise. Two of these breaches were distinguished by their size and considerable depth. Several, perhaps all, of these passages for water, might soon unite in their subterranean course into one and the same canal, or might soon again separate, according as the power of the water could, by its natural pressure, form passages in the weathered and perforated beds of limestone. Eventually the water again makes its appearance in Freudenthal, near Ober-Laibach, from copious springs, and forms, by being united in a channel, the river Laibach, which, with exception of the time during which the lake is dry, is navigable at its very source."

The next paper we may notice is that of Dr. Barry, a continuation of his researches on Embryology. Being aware that observations alone do not suffice in researches of this nature, unless extended to the very earliest stages, he again directed his attention particularly to the ovum while it still remained within the ovary, and he has found that the germinal vesicle is the essential portion of the ovum. This vesicle becomes filled with cells after fecundation, and these multiply till the vesicle becomes opaque. Dr. Barry details the various stages by which this change takes place.

It was shewn, he remarks,

" that in the production of the embryo out of a nucleus, layer after layer of cells come into view in the interior, while layers previously formed are pushed further out, each of the layers being so distinctly circumscribed as to appear almost membranous at its surface. The same membranous appearance presents itself at the surface of the several layers of a nucleus in many situations. Further, in the formation of the embryo, a pellucid centre is the point around which new layers of cells continually come into view; a centre corresponding to that giving origin to similar appearances in every nucleus described in the present memoir. It was shewn that in the embryo this mysterious centre is present until it has assumed the form of the cavity, including the sinus rhomboidalis, in the central portion of the nervous system.

"The process above described, as giving origin to the new being in the mammiferous ovum, is no doubt universal. The author thinks there is evidence of its occurrence in the ova of batrachian reptiles, some osseous fishes, and certain of the mollusca; though the explanation given of these has been of a very different character. It has hitherto been usual to regard the round white spot, or cicatricula, on the yolk of the bird's egg, as an altered state of the discus vitellinus in the unfecundated ovarian ovum. So far from thinking that such is the case, the author believes the whole substance of the cicatricula in the laid egg to have its origin within the germinal vesicle, in the same manner as in the ovum of mammalia.

"The author shews that neither the germinal vesicle, nor the pellucid object in the epithelium, is a cytoblast. He suggests, that the cells into which, according to his observations, the nucleus becomes resolved, may enter into the formation of secondary deposits, for instance, spiral fibres, and that they may contribute to the thickening which takes place, in some instances, in the cell membrane.

"The germ of certain plants passes through states so much resembling those occurring in the germ of mammiferous animals, that it is not easy to consider them as resulting either from a different fundamental form, or a process of development which, even in its details is not the same as what has been above described; the fundamental form in question in mammalia, and, therefore, it may be presumed, of man himself, being that which is permanent in the simplest plants, the single isolated cell."

On the frequency of storms in the Polar Regions. M. v. Baer, whose description of animal life in Nova Zembla we have given in page 272, during his travels in the extreme north of Europe in 1837, extended his observations to the peculiarity of storms in those regions, where M. Arago in his work on thunder states beyond the 75° N. latitude thunder is never heard, either in Islands or in the wide Ocean. M. v. Baer remarks, that no one knew better than M. Arago that the further we are from continents the more rarely do we encounter thunder storms at sea; but no northern latitude ever yet attained by man is so free from thunder that it has not been heard by some passing travellers, whose records have been overlooked by M. Arago, who, M. v. Baer remarks, confined himself chiefly to the reports of English navigators, and consequently formed his conclusion on too narrow a basis. M. v. Baer remarks that it thunders at Spitzbergen, though rarely; and he himself witnessed a thunder storm beyond the 73° in Nova Zembla, and the Journals of the hunters of the walrus contain many accounts of thunder. Thunder is moreover of frequent occurrence in the northern and southern parts of Iceland, although not so common as in other parts of Europe of the same latitude, but it is rarely known on the western side of the peninsula. In Greenland thunder is still more uncommon, but is sometimes though seldom, heard in America. On the coasts of Hudson's Bay, thunder storms have been witnessed, though less frequently than at Archangel and similar latitudes in Europe, which leads M. Baer to conclude that thunder storms are influenced by isothermal, or still more by isotheral lines, rather than degrees of latitude.

We may here remark with reference to the desiderata of our correspondent on this subject, page 497, that India affords an excellent field for deciding this question, were meteorological registers simultaneously kept at different points from Cabul to Ceylon, exhibiting the duration and number of thunder storms in a given number of years at each place.*

Notice of elevated Sea-Beaches, by Allan Stevenson. The notice refers to two ancient raised beaches in the isle of Mull, one 25 and the other 40 feet above the level of the sea.

On the difference of level between the Dead Sea and the Mediterranean. Professor Schubert, Messrs. Moore, Beek, and Berton were each separately and simultaneously employed on this problem, when the last Russian expedition was occupied in its solution. Professor Schubert fixes the elevation and depression of various points as follows :—

The edge of the mountains of the upper valley of the Jordan he found to be 850 above the sea. The plain of the Jordan near Jericho 528 below the sea. Lake of Tiberias 535 feet below the sea level. Northern corner of the Dead Sea 600 feet below the Mediterranean. The above are Parisian feet. M. Callier, from the table of Barometrical observations made by Berton without regard to any great nicety, calculates the level of the Dead Sea at 1249.8 Parisian, or 1,330 English feet below the Mediterranean. M. Callier, from the observations on the boiling point of water by Messrs. Moore and Beek, which they found to be 216.5 Fahr. makes the depression of the surface of the

* Capt. J. Campbell, Assistant Surveyor General, Madras, has proposed to keep a meteorological register in conjunction with other observers in various parts of India, with the view of determining this and other questions of similar importance in meteorology. We shall be happy to keep a diary in Calcutta, and communicate with observers in other parts.—Ed. Cal. Journ. Nat. Hist.

Dead Sea 2000 feet below the level of the Mediterranean; but Messrs. Moore and Beek themselves have made the result of their observations to correspond nearly with that of Professor Schubert. There can be no doubt, notwithstanding these discrepancies, of a great difference of level, the real amount of which it is to be hoped will soon be satisfactorily attained.

The object of the last Russian expedition has been directed to the difference of level between the Sea of Azov and the Caspian; their measurements were trigonometrical and barometrical, and the results of five different methods vary from 73.1 to 81.3 English feet, the Caspian being the lowest.

The next paper is a notice of Professor Schouw's work on the climate and vegetation of Italy, and also on the climate of those parts of Africa and Europe, which are situated between the equator and 60° north latitude. There is also an elaborate article in the same number by Dr. Morton, on the crania of aboriginal races in America, in which he goes far to establish the connexion between the intellectual capacities of the various races of mankind and the form and capacity of their crania, but without the figures of the heads of the different tribes the paper could scarcely be understood. We would propose it as an example for a similar work on the aboriginal races of Asia, in which there is no less diversity than amongst those of America. The laws and customs, the languages, and *crania* of various native tribes which have been brought within the influence of British rule in India, alone would afford an ample subject for the anatomical philosopher.

Annals of Natural History, July and August, 1840.

Information respecting Botanical and Zoological Travellers.

It will give satisfaction to many of our friends to learn that letters have been received from our valuable contributor Dr. Parnell. He is now about to leave Jamaica, after a residence of nearly nine months, during which time he has investigated much of the zoology of that island. His entomological collections have suffered considerably from insects, but in ornithology he states, " I have been more fortunate, having obtained 140 species in a good state, several of which are very rare, and two or three of them I suspect have never been before noticed. In ichthyology I have been most successful, having obtained about 500 specimens." At the date of his letter (22nd March), Dr. Parnell was about to sail for Cuba, whence he expected to return to Britain in November or December next.

We have also letters from another gentleman, T. C. Jerdon, Esq., Assistant Surgeon 2nd Madras Light Cavalry, who has been for some years resident in India in the prosecution of his profession, and has employed his leisure time in studying the Zoology of that country, particularly its ornithology. Our parcel contains a partial result of researches in the latter department in the first part of a " *Catalogue of the Birds of the Peninsula of India, with brief Notes on their Habits and Geographical Distribution**; " and notwithstanding the information contained in the illustrated works of Hardwicke and Gould, and in the valuable Catalogues and Papers of Franklin, Sykes, Hodgson, and Eyton, several species among the Raptores are given as new. Mr. Jerdon divides the peninsula into four great districts or divisions. 1st, *The Northern Circars,* comprising a narrow tract of land (between 16° and 20° N. lat.) from the sea-coast on the eastern side of the peninsula to the Eastern Ghauts, by which it is separated from the Great Table-land; 2nd, *The Carnatic,* including the whole of the country lying south of the Northern Circars along the coast as far as Cape Comorin, and bounded on the west by the Eastern Ghauts, except the Coimbotoor district, where the eastern as well as western range is broken; 3rd, *Western coast,* including Travancore, Cochin, and Malabar, and comprising a strip of land of various width lying between the sea on the western side of India, and the range of Western Ghauts, which it includes; 4th, *The great central table land,* including Mysore, the Bara-

* Published in the Madras Journal of Literature and Science for September 1839. The Raptores.

mahl, the ceded districts (Bellary and Cuddapah), the kingdoms of Berar and Hyderabad, the Southern Mahratta country, and the Decan.

The species already noticed in this range are 390, and the list will probably be extended before the completion of the catalogue, which now reaches only to a part of the Strigidæ. Of the Falconidæ, 32 species are noted; and among those belonging to the British list we have *Pandion Haliaëtos, Aquila Chrysaëtos, Circus cineraceus* and *rufus, Falco peregrinus* and *tinnunculus, Accipiter fringillarius,* and *Astur palumbarius.* It is possible however that some of these may require a more rigorous comparison with the birds of Europe. This part of the catalogue is illustrated by a lithographic figure of an owl *(Huhua pectoralis),* very neatly engraved; and if figures can be produced in India equal to that now attempted, they will be of much importance in illustrating the views of the gentlemen who may in future attend to the zoology of this very interesting region. Our correspondent states, "I have 50 or 60 drawings in the same style*, drawn by myself and finished by the native artists I kept at Trinconopoli, most of them of birds hitherto unfigured. I shall commence sending my specimens next month, and hope by the end of the year to have forwarded to you a series of all I have procured, for the identification of species, &c. As you requested, I now add a few remarks on the Indian Fox and Wolf. *Canis Bengalensis,* Shaw, *C. Kokree,* Sykes, lives chiefly on the open plains, burrows in the ground, generally four or five openings to the burrow, some of which communicate with each other; others are blind: it feeds chiefly on lizards, locusts, grasshoppers, beetles, small snakes, and occasionally crabs and rats; runs with remarkable speed; the chase with greyhounds is a favourite pursuit in India.—*Canis Lupus, C. pallipes,* Sykes, Wolf: hunts in small packs and runs down antelopes and hares, seizes also sheep in a very daring manner in daylight, and carries off young calves, goats, sheep, &c. during nights, and not unfrequently children. It possesses great speed and most extraordinary powers of endurance. Though often chased by the best horsemen, unless it is gorged, it always outlasts the fleetest horse, keeping generally 20 or 30 yards ahead at whatever pace the rider may go.

"*Dr. Krauss's Return from Southern Africa.*

It will be remembered, that about two years and a half since, Dr. Ferdinand Krauss of Stuttgard, left England for the Cape, on his way to explore the interior of Southern Africa, with a view to collect objects of Natural History from those regions. He has within the last

* Specimens accompany the packet well drawn and beautifully finished.

month returned to London with his extensive collections of both animals and plants, collected principally in Natal and Amazoola land, where he resided about twelve months; during which period he assiduously devoted the whole of his time and attention to preserving objects in every department of natural history. The zoological collection comprises Mammalia, Birds, Fishes, Amphibia, Crustacea, Insects, Shells (land, freshwater, and marine), Zoophytes, &c. The Botanical collection comprises about 3000 species of native plants, carefully preserved, and in most instances 30 specimens of each species; those of Natal, amounting to about 1000 species, are offered to botanists at forty shillings the hundred; and those collected in the Cape Colony at twenty-five shillings per hundred species. A series of the zoological and botanical collections we understand are about to be purchased by the British Museum; the remaining sets will be disposed of to those desirous of possessing them.

In addition to the above collections Dr. Krauss attentively examined the geological features of the country through which he travelled, with a view especially to record the exact position and situation of the *coal fields*, very imperfectly known to the farmers in the interior of Africa. He has brought with him specimens illustrative of the different formations, including the coal and fossils from the beds: we anticipate giving a more detailed account of this traveller's expedition in a future Number.

Mr. Schomburgk's recent Expedition in Guiana.

"I have been told of eight varieties of Opossum which inhabit Guiana, five of which have come under my notice, I have identified four species with those described by authors, as *Didelphis cancrivora*, L., *D. quica*, Temm., *D. philander*, Temm. and *D. dorsigera*, L. and Temm.; but the fifth appears to me to stand intermediate between *D. virginiana* and *D. Azaræ*, Screb. Temm. It differs from the latter in the absence of the black markings on the head, black neck, and the black and white ears, which in the Guiana species are of a uniform black colour. If we could reconcile the geographical distribution of *D. virginiana* over a space so different in temperature, I should consider the specimen which I am now describing a variety of that species: the circumstance that the ears are of a uniform black would scarcely constitute a specific difference. Its body from the nose to the insertion of the tail measures 15 inches and a half, the tail 15 inches. The latter, which is prehensile, is for the length of 3 inches clothed with thick fur, the remainder scaly for about 4 inches, of a black colour, and afterwards white. The scaly part is covered with a few short hairs, black on the back part, and white for the remainder. The fore leg to the malleolus measured 3 inches, the hind leg 4 inches. The fur is of a brownish yellow, short and silky, but intermixed with longer hair of white colour and somewhat stiff. These white hairs are along the vertebral line from 4 to 5 inches in length, intermixed with shorter silky hair, which being black above and white beneath, give it the appearance of a black band stretching from the head along the back to the insertion of the tail. The fore and hind feet are of a dark mouse colour, intermingled with a few white hairs. The ears somewhat compressed at the base, naked, black, and about 1·2 inch in length. Round the eyes is a dark spot of an oblong figure, but otherwise the head is almost entirely of a brownish yellow. The neck is covered with the same short fur of a brownish yellow as the belly, while in *D. Azaræ* it is of a black colour. The specimen which has served me for description was shot in the neighbourhood of Georgetown, but as it was the only one of its kind which I ever saw, I hesitate to establish it as a separate species, until I have had opportunity of procuring individuals of the same appearance. It is said to be very common at the coast region, and is called the white Yawarri by the colonists, Nopu by the Warrau Indians, Yawarri by the Arawaks and Macusis. It does great injury to the feathered stock, and frequents the sugar-cane fields, being apparently partial to sweets.

The black Yawarri (*Didelphis quica*, Temm.), called so by the colonists from its appearance when at rest; the hair being long and black at the tip, but yellow towards the root. The tail is longer than the body, clothed with hair for one-fourth of its length, the remainder naked and scaly. Its size is that of a marten, but in its head it resembles a fox, and the muzzle ends with a whitish spot. I do not possess an actual measurement, but I should estimate the length of its body about twelve or thirteen inches, and the tail from fifteen to sixteen inches. The latter, which is prehensile, is of great assistance to them in climbing. They are very destructive to poultry and likewise to fruit. They are often found on those savannahs where the wild pine (*Bromelia*, spec.?) flourishes, to the fruit of which they appear to be partial. Like its congeners, the female possesses a pouch in which she carries and suckles her young until they are as large as half-grown rats. They produce from six to seven young at a time. They sleep during the day and hunt at night. They are sometimes eaten by the Creoles and Indians, but as they have a rank and disagreeable smell I doubt if they would prove palatable to us.

The *Didelphis cancrivora* is too well known to deserve more than a passing remark; moreover, I am not able to add anything about its habits, as it is more peculiar to the sea-coasts than to the interior of Guiana.

The Yawarri cusinai of the Macusi Indians, or Picanappa of the Warraus (*Didelphis philander*, Temm.) has an extensive range in Guiana. It is met with in the coast regions as well as in the interior. It resembles in size a full-grown rat; the fur, short and silky, is of a rust-colour, lighter beneath the belly; length of the body nine inches, tail ten inches and a half, clothed with fur for about two inches, the remainder naked and of a uniform brown colour. A deep furrow divides the nostrils, and the eyes are brown and very prominent, and surrounded by a reddish spot. Possessing all the peculiarities of its tribe, it appears to be more lively than the rest, and climbs with the alacrity of a squirrel. Although I have seen many in the day time, I am inclined to think that the night is their favourable time for going abroad in search of food. I have had tame ones that slept the greater part of the day. In their wild state they live principally on fruits and insects, but I have been assured by the Indians that they have the art of surprising small birds, and in this I am corroborated by Mr. Vieth, who found animal food in their stomach. In a tame state scarcely any thing comes amiss; boiled rice, yams, flesh, and fish seem equally agreeable to them.

One of the Opossums of that species which I had in a tame state was a female. It was kept in a bird cage of wire-work which permitted me to watch its habits. I have already observed that it passed the greater part of the day in sleeping, and that it fed alike upon fish or flesh. It might have been in my possession for about a fortnight, when one morning, on feeding it, I observed five young ones of the size of a new-born mouse crawling about in the cage. They were perfectly naked and blind. The mother allowed them to crawl about and did not appear to care for them. Next morning I found only four; the fifth had been eaten by the mother during the night; the four remaining ones had however returned to the pouch. The succeeding night two more were eaten by the mother, and the last two were crawling about in a helpless state, and the following day fell a prey to the voracity of their unnatural mother. It is remarkable, that although I had the animal longer than a fortnight, I never was aware that it had young ones until I found them crawling about, and it remains now a riddle to me how the mother could secrete them so well. I thought her with young all the time, but had no idea that they were already in a state so far advanced. Confinement no doubt was the reason of her acting so cruelly towards her offspring. She died a few weeks after.

The fifth species which I have observed during my journeys in Guiana is *Didelphis dorsigera*, L. and Temm. It is nearly the size of the former, its fur of a brownish-grey, the tail thin, covered with hair for about the fifth part of its length, the rest scaly, and of a uniform brown. The spot which surrounds the eyes is of a darker brown than in the former, but it is distinguished chiefly in the female's being without an abdominal pouch, and merely provided with longitudinal folds near the thighs, within which the young continue to suckle, or which serves as a place of security in case of danger. I have seen this species in a tamed state; it appeared however shy, and was fed upon milk and bread, and plantains. They are said to be very partial to the latter, and they frequent therefore the plantain fields in large numbers. They produce from six to seven young ones.

An individual of that kind, which had been kept for some time in the house where I resided during my stay in Georgetown, met with a tragical end. I had procured two young Jabirus (*Mycteria Americana*): the first exploit when landed and introduced to their new domicile was, that one assailed the cage which contained the opossum, and having seized the poor animal with its beak, drew it by force through the bars of the cage, and swallowed it without further hesitation.

Having brought these Jabirus under the notice of the reader, I shall leave the class Mammalia, and turn for a few moments to the Aves, in order to indulge in a biographical notice* of these two interesting individuals with an introductory remark on the whole tribe.

The Jabiru, or Negrokoop, as it is generally known to such of the colonists who have seen this bird in its natural haunts, frequents the great savannahs of the interior and the marshy environs of the rivers Pomeroon and Guainia, where they live on mollusca, crabs, frogs, and other amphibious animals. While at Pirara, I saw them in flocks of several hundreds feeding at lake Amucu, or on the marshy tracts along the Pacaraima mountains. During our stay in that village several were shot. Their flesh is palatable, and when prepared with the necessary

* These notices of animals which inhabit Guiana are gleanings from my Journal, taken at random as they occur, and without tying myself to any scientific arrangement or description. Those who have thought the preceding observations worthy of their perusal, will be aware that they do not pretend to scientific dissertations; it has been my wish to make the reader acquainted with the manners of such of the animated beings of Guiana as have come to my knowledge and under my personal observation, disclaiming all scientific descriptions and discussions, which we will leave to a period when I may have gained by experience, and when, not further urged by the desire of extending my travels, leisure may permit me to digest what practical knowledge I possess.

ingredients, as a steak, so strikingly resembles beef, that one unacquainted with the fact would pronounce it such. One was winged in shooting at a flock, and was brought alive to us. The bill measured 13 inches; it was laterally compressed, thick at its base, and ended rather sharply. The upper mandible was straight and triangular, the lower rather thicker and slightly turned up. The nostrils are narrow, as the bird seeks its food in the water; the feet with three anterior toes slightly united by a membrane; the hallux, or hind toe, high up on the tarsus.

From the head to the toes, that is to say, standing upright, it measured 6½ feet, from the tip of the beak to the tail 4 feet 4 inches, and to its end 4 feet 11 inches; from the end of the toe to the knee-joint 1¼ foot, from ditto to the thigh-joint 2 feet 10 inches. Its wings when spread out measured 8½ feet; it has therefore, next to the Condor, the greatest extent of wings. Its plumage is pure white; the bill, head, and upper part of the neck are black, and with the exception of a few scattered downy feathers, quite naked. The lower part of the neck is red, and likewise set with a few downy feathers. The skin of the neck, but particularly of the gullet, is generally wrinkled, but the bird can extend it. The neck measured 1 foot 10 inches. A species of *Ampullaria* (*guyanensis*) is found in prodigious numbers in the lakes and swamps, as well as in the rivulets which meander through the savannahs, and it appears they constitute the chief food of the Jabiru. In spite of their unshapely beak, they are able to remove the operculum most admirably, and to draw the mollusc out of its shell. I have found it difficult to procure perfect specimens of that *Ampullaria* for my collections, although shells partly broken or devoid of the operculum covered the low savannahs extensively, while in other parts I found the opercula equally numerous, but no shells.

The Jabiru builds its nest generally on trees, sometimes on rocks. It is constructed of dry branches, lined with a few feathers, in which the female deposits two eggs, which are perfectly white and somewhat larger than a swan's egg. The young ones are gray and not roseate as has been asserted.

When the waters subside after the annual inundations, they frequent in small groups the sand banks of the river Rupununy in search of crustaceous animals. Nothing can surpass the gravity with which they stalk along; their measured step and upright bearing frequently amused my military companion while on our first expedition in the interior, who was forcibly reminded of the parade, so that he could not refrain while passing the beach from giving these feathered recruits the word of command, and they ever afterwards among ourselves went by the name of his recruits. Before they rise on the wing they prepare for their flight by taking two or three hops, by which they are the better enabled to get on the wing. Their flight is light and graceful; and before they alight, or when rising, they first wheel round the place in gyral motions, either lessening or extending the circles according as it is their intention to do the former or the latter. They soar uncommonly high, and might vie with the eagle. Indeed they appear sometimes as a mere speck in the air. It is a beautiful sight to see a numerous flock on the wing; all appears confusion when they are first disturbed and rise in the air: they cross each other in the flight, and one would think from below they could not avoid coming in contact; but scarcely have they reached a height of 80 or 100 feet, when order is restored, and they begin flying in circles, rising with each circle higher and higher. When on a more extensive journey, they fly in a horizontal line, and change the leader like the cranes. When feeding on the savannahs, a party is always on the alert while the others seek for their food.

The Macusis call them Tararamu, the Brazilians Juju, the Arawaks Mora-Coyasehaa, which signifies spirit of the Mora tree (*Mora excelsa*, Benth.), the Warraus Doih.

In my former remarks I gave some account of the manners and habits of the Jabiru (*Mycteria Americana*), and alluded to two young ones which I received while in Georgetown. They were brought to me from the Pomeroon, and when keeping their neck erect they were about five feet high. Their plumage was still gray, and they might have been about a year old. They were so tame that I allowed them to run about the yard, to which, however, they did not restrict their perambulations, and they extended their walks frequently to the street. As they were a great curiosity, they had frequent visitors; or when in the street, a crowd collected generally around them, until annoyed by too great familiarity, they would begin to clack the under chap against the upper, and partly spreading their wings, those unacquainted with the bird fancied these to be the first preparations for a formidable attack; and the little knot of by-standers which had formed round opened their ranks without further contention, and allowed them to return leisurely to the yard.

I shall never forget the effect which the sight of them produced upon a woman of colour, who no doubt had never seen a Jabiru before. The woman with a tray on her head was walking down the street, when one of the Jabirus came with its measured step out of the gate. At the first sight of this gigantic bird she stared with half-open mouth at what she must have considered a monster; at that moment the bird spread its wings to their full extent, and changing its leisurely step into a hop, it approached her rapidly: this was too much for her; and throwing the tray upon the ground, she fled for protection as quick as her legs would carry her to the nearest shop, throwing together her arms during her rapid flight violently over her head. The ridiculousness of the scene cannot be described; it must have been seen to conceive it. I wished I had possessed the skill of a Cruikshank, in order to sketch it when yet fresh in my memory.

While they were in my possession I fed them on butcher's meat and the offals of the kitchen. They sometimes got fish, but its high price in Demerara did not permit me to feed them exclusively with it, although they appeared to prefer it to any other food. When the food was thrown in the air they caught it with great skill. They were very voracious, and would frequently quarrel with each other for a favourite piece.

When irritated they clacked their beaks violently, and partly spreading their wings, their appearance was certainly calculated to cause some precaution. I have seen them strike with their beak towards the face of those who irritated them; and in one instance a wound was inflicted, fortunately of no great moment. A dog stood no chance, as the clattering noise and their appearance was quite sufficient to frighten him away. In their wild state they are fierce; and I have seen them, although mortally wounded, defend themselves valiantly.

The season was too far advanced to send the two young Jabirus to Europe: and as I was on the eve of my departure to the interior, I gave them away, and am not acquainted with their fate.

All the pictures which I have seen of this bird are poor representations of it. It appears to be scarce in European museums; and the one which is preserved in the British Museum is not only in itself a poor specimen, but is besides so injudiciously stuffed, that it does not convey to the spectator any true resemblance of the bird in its natural state.

The representatives of the swine in South America are the banded or collared, and the white-lipped Peccari; but although their form of body, the length of the snout, and the shape of their legs are not materially different from the European swine, there are nevertheless differences, even in the outer appearance, which become evident when we come to examine them nearer. Their body is not so bulky, the legs are shorter, in lieu of the tail there is merely a short protuberance ; but the greatest difference consists in a gland upon its back, which although concealed, is easily perceptible from the turn of the hair around it, and which gland secretes a liquor of a strong smell. Both species appear to be common to Paraguay and Guiana. In the latter province, where they have come under my notice, they are seldom met with on the plains or savannahs, and frequent more the thick forests and swamps.

The collared or banded Peccari (*Sus Tajussu*, L., *Dicoteles torquatus*, F. Cuv.), the lesser of the two species, is generally met with in small families of eight or ten, frequently only in pairs. They are of a gray colour, that is, their hair, which is ringed alternately with black and yellowish white, appears gray at a short distance. The belly is almost bare, and the bristles on the sides are rather short, but they gradually increase in length as they approach the ridge of the back, where they form a kind of bristly mane. From the shoulders round the neck extends a narrow collar or band of whitish hair. Their legs are short and the hoofs long; they run nevertheless with great swiftness, and when hunted by dogs, take refuge in a hollow tree. They feed on seeds, particularly on those of different species of palms, which they crack with their strong jaws, and devour the shell as well as the kernel. They also turn up the soil like the domestic hog to search for worms or insects, and to procure them are often and more generally found in swampy situations: the assertions that they are only found in mountainous parts of a country, and very seldom in lowlands or marshes, may be correct with regard to Paraguay, but not so, as to Guiana, where we have found them generally in marshy situations, wallowing like our domestic hogs in quest of worms. They bear one young at a time, rarely two, which follows the dam until it can provide for itself.

They swim across rivers, but seldom take to the water when pursued by dogs, as they do not dive. Indeed they are awkward in the water, and the Indian hunter is sure of success if he can drive a herd into the river. They are then easily killed by striking them a blow on the nose; however, the Indian does not stop to pick them up when thus killed ; he is well aware of the peculiarity which they share with few animals, namely, that they float on the water, while almost every other animal sinks : the Indian therefore kills as many as he can, and picks them up when he is no longer able to add to their number.

When taken young they are easily tamed, and will follow any one they take a liking to, like a dog ; but are apt to bite and snap at those to whom they take a dislike. They appear very fond of being scratch-ed; and so pleasing must this operation prove to them, that they gradually lie down on the ground and give signs of their great delight by a low grunt. In a tame as well as in a wild state they show the greatest aversion to dogs; in a domesticated state their bristles rise and they begin attacking the enemy with their tusks. When hunted they make a desperate resistance, and severely wound dogs that are not accustomed to hunt them. Those which have been trained by the Indians separate one from the herd and keep it at bay until the huntsman arrives to shoot it with his arrow; the dog then sets off after the herd again and acts in like manner. I have known a hunter with a well-trained dog to bring three and four hogs as the fruit of his hunting excursion. The Indian who is not provided with a dog, on coming up with a herd climbs the first tree, and begins to imitate the barking of a dog; if young ones should be among the herd, at which period they are particularly fierce, this sound is quite sufficient to urge them to attack, and they soon gather in numbers round the tree, threatening with their tusks. This is the time for the Indian to discharge among them the contents of his gun, if provided with one, and with what success may be imagined: off sets the herd in full flight; the Indian is equally quick to follow them, and should he be nimble-footed enough to outstrip them and to get before the herd, he climbs another tree, and again imitating the barking of a dog, he is sure to assemble them in full rage around the tree, and has opportunity of firing a second shot at them. This method is now frequently practised, where guns, and even double-barrelled ones, are no rarity among the Indians of the coast regions. An Arawak Indian from the Lower Essequibo nearly paid this *ruse* with his life; the branch on which he sat when he was about to fire among the incensed herd which had gathered round the tree, broke, and he would have fallen among them if he had not caught one of the lower branches, not high enough however from the ground to be entirely out of their reach. His legs were almost literally torn to pieces by their triangular tusks; still he did not let go his hold, and kept presence of mind enough to try to swing himself upon the branch, in which he at last succeeded. Their victim having escaped, they exhausted their ire on the gun, and at length left the Indian, who in spite of the loss of blood crawled homewards and escaped narrowly with his life.

Their flesh is savoury, though drier and leaner than that of the hog; but precaution must be taken soon after the animal has been killed to cut off that part on the back which contains the glands, otherwise it communicates a musky taste to the meat. They form one of the chief articles of sustenance of the Indians; and as their being hunted with a well-trained dog insures more certain success, a dog of that description commands a good price. The Peccari is called Apuya by the Arawak Indians, Paraka by the Macusis, Pakira by the Paravilhanas, Pakityé by the Warraus.

The white-lipped Peccari or Kairuni (*Dicoteles labiatus*, Cuv.) is considerably larger than the preceding, of a darker colour, and white upon the cheeks and lips; and the hair about the head is so long that it almost covers the ears. The young are of a chesnut colour, and their cry resembles the bleating of a goat. Their manner of feeding and habits in general are not different from the Peccari, but they travel together in herds of several hundreds. They are more fierce when hunted, and often kill the dogs that attack them by ripping them up with their tusks; and they are also known to have attacked the huntsman. When they once take to flight they can be followed without much danger, as they seldom retain their courage or turn round upon their pursuers. The Jaguars commit great carnage among them; they remain generally in the rear and seize upon the last and all stragglers; but it is asserted by the Indians, and corroborated by woodcutters and others who live in the interior, that the white-lipped Peccaris frequently surround the Jaguar and tear their enemy to pieces.

Of all the rivers in British Guiana, the Berbice offered the greatest difficulties to our ascent, either in the shape of cataracts or from large trees, which we frequently found lying across where the river narrowed, which either the wind or age had prostrated. Our advance amounted on the 2nd of January (1837) scarcely to two miles, the trees which barricaded our passage were so numerous. While we were thus engaged in cutting through a large mora-tree, one of the Indians who had been straying about, brought us information that a herd of the larger Peccari were feeding at a short distance from a river. Our guns were put immediately in requisition, and off we started.

Akuritsh, the Caribi, armed with bow and several iron-headed arrows, accompanied us. I came first up with the herd and found them in a pool of water, where they wallowed in the mire like the common hog. One stood apart apparently as watch; and scarcely had it perceived me, when the bristles on its back rose erect, and turning round towards me, it began chattering with its teeth, and the whole herd rose: not a moment elapsed, and it lay prostrated in the mud pierced by my rifle-ball. How can I describe the bustle and the rush of several hundred, which at the report of the gun were seen flying in the opposite direction! An Indian who had come up by this time shot another, and the retreat was now complete. I had loaded again, but hesitated to wade through the swamp, when the Arawak chieftain Mathias, who had observed my hesitation, requested me to lend him my rifle; I gave it him, and he started off, while I remained at the spot where I first fell in with them. I heard four or five shots fall, apparently at some distance, and while I was yet considering how many of them might have told, I heard a rushing noise like a whirlwind approaching through the bushes towards the place where I stood: the peculiar growl and that awful chattering of the teeth, did not leave me long in doubt as to its cause; it was evident that the herd had divided and were coming directly towards me. I stood alone, unarmed; these were my last thoughts; the next image which stands fixed in my memory is, that I stood on the lower part of a mora-tree and looked down upon a herd of about fifty Kairunis rushing by in full speed, their rough bristles standing erect, their muzzles almost sweeping the ground, and their white triangular tusks clapping in concert. They came and passed like a whirlwind, and before I had recovered from my astonishment, I heard them plunge into the river to swim across. How I came on that tree I know not; to the rapid execution of what I must have considered my only means of escape I owed my life. The other hunters had not been so fortunate as I expected; excitement or fear made them miss, where it would have appeared almost impossible. Including the one which I had shot, three more had been killed with guns, and one by Akuritsh with bow and arrow: they were a most welcome addition to our reduced Commissariat.

I had never a better opportunity of watching their proceedings when on march than offered itself while traversing from the river Berbice to the Essequibo. We had fallen in with the herd and shot two, of which we took as much as we could carry, and continued our journey. A preconcerted signal called us shortly after back to our camp at the banks of the Berbice, where only a case of urgency could have induced those who were left in command to fire that signal. Anxious to learn the cause, I had distanced my party, and unaware and unperceived I fell in with the herd of the Kairunis; they were in regular line of march, and walked with slow step, though single, nevertheless so that the preceding covered partly the following; the young were walking under the belly of the mother. We shot two more, which as time did not permit to carry with us, we hung up on a tree, to send for them if circumstances permitted. A large party of Caribi Indians had arrived at the camp, which had been the reason of firing the signals for our return; they came, however, as friends;

and we returned next day for our hogs, and were not a little astonished to see no vestiges of them. They had been carried away by a Jaguar. After some search we found them, however, dragged to a thicket, where they were yet untouched, and of course we put an end to any further question as to who should possess them. Their meat is justly esteemed, and many prefer it to the lesser Peccari. The liquor which flows out of the gland is equally offensive as in the latter, and is peculiar to both male and female. They bear only two young ones, frequently only one; but they are more difficult to tame than the collared Peccari. I do not think that any attempts have been made to domesticate either one or the other species. The Indians tame sometimes the young ones, but never with the avowed purpose of breeding, although I have little doubt that their meat would vastly improve by regular attention; and after two or three generations they would be familiarized. There is no instance known of their having bred with the European hog and produced an intermediate race.

The white-lipped Peccari is equally indigenous at Paraguay as in Guiana. It is called Kairuni by the Arawaks, Poinge by the Macusis, Ipure by the Warraus.

Mr. Cuming, some letters from whom, while at Manilla, were given in the 1st vol. of Annals, pp. 57 and 147, we are most happy to state has lately arrived in London; bringing with him, as we understand, very extensive collections of the animals and plants found in the Philippine islands. Of shells, the quantity is large; there are said to be a very great proportion of new species. He has also brought alive, and presented to the Zoological Society, a fine specimen of a new species of Gibbon, a species of Paradoxurus, a large Flying Squirrel (*Pteromys nitidus*), the Argus Pheasant, a Fire-backed Pheasant, a Hornbill, &c.

Neuchatel, June 12.---Recent accounts have been received from the naturalist Tschudy, who some years ago, assisted by the late King of Prussia and some other gentlemen with four thousand francs, went out with the Edmond to Lima, in order from thence to make excursions into the Cordilleras and adjacent country. A considerable transport of objects of Natural History collected for the Museum of our town (Neuchatel) has already come to hand. He is still in the mountains of Peru; and having consumed the money taken out with him, lives by the chase, and is awaiting fresh assistance, which is on the way for him. He had much to suffer from hunger and want of shelter during the rainy season; this however did not abate his zeal. His collection for our Museum has considerably increased; for he announces 70 Mammalia, more than 500 Birds, Reptiles, Fishes, 1,100 Coleoptera, 200 Lepidoptera, and a hundred Conchylia, with several other remarkable objects, plants, and fossils. The assistance sent will enable M. Tschudy to embark with his rich booty, and return to his native country.—*Augsburg Allgemeine Zeitung*, June 19.

Miscellaneous.

Of the Flower or Fruit of Ferns.

At a recent meeting of the Royal Academy of Sciences of Berlin (March 19, 1840), Prof. Link read a paper, in continuation of his previous memoirs on the structure of Ferns, treating of the flower or fruit. The sorus is in general situated on a receptacle which, when roundish, consists entirely of short spiral vessels, so called, vermicoid bodies, similar to the thickened extremity of the leaf nerves, which might therefore be regarded as abortive recepticles. In the elongated receptacle, straight spiral vessels are met with. A spiral vessel never extends to the fruit. The parts which Sprengel years ago, Blume and Presl at present consider to be male organs of fructification and indistinctly figured, have been more accurately examined by Prof. Link, and illustrated by drawings. They are long hollow filaments, separated by septa into articulations, generally simple, rarely ramified; the last articulation is thicker, and filled with a delicate granular mass. It may also at times be observed that this mass is exuded at the last articulation, and surrounds this as a crust. These parts are frequently longer than the capsules, and are easily distinguished from the young capsules. It is certainly probable that they are the stamina of ferns, and Prof. Link has indeed found them, after frequent search, in most of the ferns which he subjected to microscopical examination. The germination of ferns is simple; the shell of the seed bursts regularly or irregularly, out of which the embryo grows forth in a foliaceous expansion, which subsequently first forms a bud, whence the plant proceeds in the form which it retains. This mode of germination presents, therefore, a similarity to that of Monocotyledons, only that here the evolution of the embryo is a state, and one of rapid transition.

Potamogeton Prælongus.

This rare plant occurs plentifully in the river Waveney, which divides Norfolk from Suffolk, in the neighbourhood of Harleston and Bungay, where I gathered it in June last. The only other station, to the south of the Tweed, is in ditches near Caversham Bridge near Reading, where it was found by Mr. Borrer in May 1836.—CHARLES C. BABINGTON.

The Cocos de Mer.

The singular plant known by the above title, was for many years a source of inquiry, and gave rise to some most absurd and monstrous conjectures. Its gigantic fruit was occasionally picked up floating at sea, and sometimes carried by the currents to various shores of the Indian ocean. Astonishing virtues were attributed to it, and were supposed to be communicated to medicines drunk out of its capacious shell. It is stated that as much as four hundred pounds sterling have actually been paid for a single nut.

The colonization of the Seychelles Archipelago by the French under M. de la Bourdonnais, the talented and patriotic governor of Mauritius, set the matter at rest. The Cocos de Mer was found growing in the islands of Praslin and Curieuse, whose mountains were abundantly covered with this stupendous plant. It is a palm, and like several other members of that family, the male and female flowers are found on different individuals. Its stem rises to the height of from 90 to 100 feet, and is crowned with the most superb leaves that can be imagined, which form a kind of pent-house around it is as impervious to water as if covered by a roof.

The leaves exactly resemble in form those of the fan-palm, but their dimensions are vastly superior. There are many of them that, measured from the base of the stem, are 20 feet in length, and their ample folds cover a width of from 10 to 12 feet. It is not till it has attained the age of from 20 to 25 years that it begins to bear. The enormous drupes, hanging in clusters of four or five, are so heavy, that a plant of less strength would give way beneath a single bunch, and they hang three or four years before they are ripe enough to fall. Thus although only one fruit branch is put forth in the year, the produce of three or four seasons burdens the stem at a time, the aggregate weight of which is very considerable.

Description cannot do justice to the beauty of these forests, nor convey an adequate idea of the singular fruit they furnish. The nuts are mostly double; but triple, quadruple, and sometimes, though very rarely, quintuple specimens are found. When green they contain a sweetish jelly-like substance of a refreshing quality. But when ripe the kernel is as hard as dry beach wood, quite white, and of a somewhat silky grain. They are left in a marshy spot to rot, a process which requires six or eight months before the shell can be emptied. They are applied to various uses, being very strong and light. Simply bored at the end they serve as very convenient buckets and kegs, which are in general use among all the inhabitants of the group of islands in which they are found; many of them hold upwards of three gallons. Many thousands of the shells, sawed in half, are sent to Mauritius and Bourbon, where they are universally employed by the blacks for holding food and water; they form also the best vessels that can be devised for baling out boats. The leaves are as good a covering for a house as shingle; a roof well thatched with them lasts ten years without any repair. They are also employed, when young and white, for a great many purposes; hats, bonnets, baskets, fans, flowers, and many other articles being manufactured from them.

It is a very remarkable fact that this plant will not flourish on any of the surrounding islands. Many have been planted on other islands, but they merely vegetate, and are widely different in appearance from the plants of Praslin and Curieuse.

Propagation by Hybrids.

In the autumn of 1838, a male bird, the produce of a Goldfinch and a hen Canary bird, escaped from my aviary, and was not seen again until the following spring, when we were agreeably surprised by the reappearance of our lost favourite, in company with a Goldfinch. As the pair were inseparable, we at once suspected that they had mated, and in a few days our suspicions were confirmed by seeing them feed each other, and collect materials for building. By watching their movements we soon discovered their nest in a cedar-tree near the aviary. In due time four eggs were laid, which I carefully removed and placed under a Canary bird; they however all proved abortive. In a few days after this disappointment a second nest was built by them in the same tree, which we left undisturbed, and the result was favourable; five birds were hatched, which I took from the nest when about ten days old and brought up by hand; of this number two cocks and two hens are still living.

I am aware that hybrids in a state of captivity and restraint have not unfrequently proved prolific when brought to pair with a mate of either of their parent stocks; but I do not remember that I ever heard an instance of an animal of pure breed in a wild and unrestained condition by choice selecting an hybrid mate.

The following are the results of my experiments made during this spring and summer.

Early in the spring I paired one of these young cock birds (which I have described as being three parts Goldfinches to one part Canary bird) with a hen Canary; a nest was soon made and three eggs laid; the cock bird, however, destroyed the nest, but I succeeded in saving the eggs, and placed them under a Canary bird: of this number one young bird was hatched, which is now full-fledged and in good health. After this partial failure a second nest was built, which shared the fate of the former one; I then removed the cock bird and turned him into the avairy, when he almost immediately selected another Canary bird as his mate. Upon my putting this pair into a breeding-cage a nest was formed in less than a week, and four eggs were laid; I had now taken the precaution to line the nest basket with flannel, so that although the nest was pulled to pieces, as on former occasions, the eggs escaped destruction, and upon them the Canary bird is now sitting. I again removed the cock bird, and upon his return to the avairy he at once *made up* again to his former mate, and she has this morning laid an egg. In truth I never saw a bird more ardent for propagation than this hybird.

My second experiment has been made by pairing my other hybrid cock bird with an hybrid hen of the same nest; the result has been three eggs, one of which was hatched yesterday morning by a Canary bird.

Now as the second pair have proved prolific (which are three parts Goldfinches to one part Canary bird), I do not see any reason why I may not obtain next year an equally successful result by putting together a pair of birds (if I succeed in rearing a male and female), the produce of my first experiment; and if so, a cross breed might be perpetuated, which would be five parts Canary birds to three parts Goldfinches.—GEORGE COOKSON.

Death of N. A. Vigors, Esq.

In the intelligence of deaths brought by the last Overland mail, we observe with much regret a name which is familiar to all zoologists—N. A. Vigors, Esq. Mr. Vigors was the first naturalist who availed himself of the views of Mr. MacLeay, regarding the natural affinities of animals. In a paper published in the fourteenth volume of the Linnæan Transactions, entitled "Observations on the natural affinities that connect the orders and families of birds," Mr. Vigors, after an elaborate analysis of the whole ornithological kingdom, found the divisions to correspond with five types, corresponding with those which had been discovered by Mr. MacLeay in the Lamilicorn insects. These types he distinguished as *Raptores* or rapacious birds, *Insessores*, perching birds, *Rasores* distinguished from the latter by their size, docility, and importance to man, as well as by several natural characters, *Grallatores*, or waders, and *Natatores*, or swimmers. With a philosophy and familiarity with the details of his subject unknown before, Mr. Vigors next pointed out the number and relations of the minor groups composing each order, and his results have been confirmed and adopted by all subsequent writers.

In the succeeding volume of the same transactions Mr. Vigors, in conjunction with Dr. Horsfield, described the rich collection of Australian birds in the Museum of the Linnæan Society, applying the same views to the numerous new groups of New Holland species. The immense labour bestowed on this undertaking can only be appreciated by those who know what it is to have the unknown productions of an uninvestigated continent before them for elucidation.

Mr. Vigors was one of the principal supporters of the Zoological Journal, in which his papers were more numerous, and no less valuable than his contributions to the Linnæan Society. He was also one of the founders of the Zoological Society, and a constant contributor to its proceedings and transactions. Yet as an instance of the public indifference to science in England, the only subject of regret connected with the death of Mr. Vigors, as announced in the various English newspapers is, that it leaves a vacancy in the representation of Carlow.

List of the principal objects of the Zoology of continental India required in Menageries and Museums in London.

Living animals, when practicable, should be sent in pairs, male and female; birds should be confined in cages, and their tail feathers cut short.

1. Any peculiar varieties or species of horned cattle that may be known to exist in the vicinity of Assam and the Nerbudda, or other remote parts of India.

2. The large black deer of Rungpore, Orissa, Nerbudda, and Terai, of which naturalists suppose there are in the

plains of India two distinct species, they are called *Cervus hippelaphus* and *Cervus aristotelis.* They both belong to what is called the Russa group, i.e. horns round, forked at the top, with a small antler over the brow; one of the above species is lighter coloured than the other, being in winter greyish brown, and in summer a more yellow tinge, with rough shaggy hair about the upper part of the neck.

3. There is a third species of the same group, an inhabitant of the Himalaya, about the size of the Roebuck. Its native name is unknown, as well as the animal itself, except by a skin described by Cuvier as *Cervus Wallichii.* Further information regarding the existence of this species, and living examples of the animal itself, would be very desirable.

4. The *Buhraia,* or *Maha,* and the *Bura singha,* are also two species of deer of which it is very desirable to obtain living specimens. They are somewhat allied to the stag, and have three antlers presenting forward from each horn, the summit terminating in a fork. The first is named *Cervus elaphoides,* and inhabits the Terai, and probably other dense forests; and the second, *Cervus elaphus,* inhabits the Himalaya.

5. There is an undescribed species of deer in the mountains between Cachar and Moneypore, nearly allied to the Russa group, but distinguished from known species by the basal antler descending down in front over the eye on either side. See page 501.

6. The antelopes of continental India are no less numerous, and no better known than the deer; living specimens of the following kinds are highly desirable for the public collections:—

Antelope acuticornis, De Blain, only known by a mutilated skull and horns in the Museum of the College of Surgeons, and supposed to be "the small deer" alluded to by Johnston in his sketches of Indian field sports, and known to be an inhabitant of the forests of Ramgur.

7. *Antelope subulata* of Colonel H. Smith, is another species only known by its horns, which were likewise brought from India and deposited in the Museum of the College of Surgeons.

8. The Indian *antelope, A. cervicapra;* with long, straight, undulating horns; dark brown above, beneath white.

9. The four-horned antelope, or Chekara of the natives, common in Bengal, Bahar and Orissa.

10. The Thar antelope of the Himalaya.

11. The Ghoral antelope of the Himalaya.

12. The wild goat of the Himalaya, called *Jharal.*

13. The wild sheep of the same quarter, called *Nayour*, or *Nahoor* by the Napalese.

14. The Chira antelope of Nepal. Two species of wild goat and one wild sheep are named and described by Captain Hutton, the two first as new species inhabiting Affghanistan. Two species of wild goats, called Jaral by the Madras sportsmen, or jungle sheep, are known in southern India; one is an inhabitant of the Neelgherries, the other of the plains at the foot of those mountains. There is also the *Burral,* or wild sheep of Nepal, which may be one or other of the above species.

15. A brown or yellow antelope, of the goat-like group *Nœmorhedus,* inhabits the forests of Arracan. This, from a skull and horns furnished by Lieut. Phayre, and a head of the same animal in the collection of the Asiatic Society, seems to be an undescribed species.*

16. It is unnecessary to specify the smaller quadrupeds of continental India which it would be desirable to procure, as scarcely any of them are known in Museums, much less in

* The *Nyl ghau* appears to be the only antelope of India introduced to England, where it is found to breed and thrive so well, that it is not now an uncommon animal.

Menageries; in all cases therefore where living specimens cannot be conveniently obtained, dried skins, with the skull and bones of the feet (freed from soft parts) remaining will be desirable.

17. Of birds, those kinds which approach nearest in their nature and habits to the domestic poultry are much desired in Menageries, and from their importance are entitled to our interest and attention. Colonel Sykes has remarked in the proceedings of the Zoological Society that the *Phasianus leucomelonos, Phasianus lineatus,* and *Phasianus ignatius* are intermediate species between the pheasants and the common fowl; so indeed they really appear to be, and therefore may become useful additions to the farm yard. The first of these birds, which is entirely black except the round tips of the feathers on the rump, is most abundant in the forests of Assam; the male bird has a crest of a few black feathers, the female is brown, and scarcely differs from the appearance of the common domestic hen, except by the naked spot round the eye, on which her character as a pheasant depends. Since this was written, a pair of these birds, now called *Sophophorus Cuverii,* have been received from Captain Bogle, the Commissioner of Assam, for the Zoological Society, along with two species of *Biverra* and several other interesting birds, and *Mammalia,* now deposited in the Barrackpore menagerie, till arrangements are entered into for their despatch to Regent's Park.

18. The *Phasianus lineatus,* or lineated pheasant, is as abundant in Kemaon as the former is in Assam; so abundant, that in some ravines, particularly near villages and cultivated fields, almost every bush contains one. In this species the feathers are nearly all lance-shaped as in the common cock, and variegated with grey and black.

The third species, *P. ignatius,* belongs to the higher parts of the Himalaya.

19. The Java hen, *Gallus furcutus,* and the Siam hen,

Gallus Stanlyanus, as well as the Malabar hen, *Gallus Banksivus,* are three superior kinds of the common poultry, some of them twenty-six inches in height.

The Chittagong poultry, celebrated in India for their size, is probably a mixture of these breeds.

20. Other birds of this division are so remarkable for their beauty, that independent of any direct utility, they must always be regarded as objects of interest; such are *P. melonocephalus;* this bird is red below, grey above, with a black head and crest, and all parts of the body covered with ornamental spots. It is brought down to Assam from the Abor mountains; it also occurs in the higher parts of the Himalaya.

Polyplectron Hardwickii, or Peacock pheasant, an inhabitant of Lower Assam and the Sylhet jungles.

Phasianaus purvasia, a grey bird with flowing lance-shaped plumage and a drooping crest. It is found in Kemaon and Nipal, and is larger than any of the other pheasants.

21. The Japan Peafowl, as it is called, but which nevertheless is very common in the forests of Arracan, is equal to the ordinary peafowl in size and appearance, with this additional ornament, its head is decorated with the brightest yellow and purple tints that can be imagined; when caught they become as domestic, and thrive as well as the ordinary peafowl. It is singular, notwithstanding the ease with which this bird may be procured, and its contentment in confinement, that it should be mentioned by Lord Derby as one of their desiderata in collections at home.* The Pigeons of

* Since this was written a pair of these beautiful peafowls has been procured from the Chittagong Jungles by Christopher Webb Smith, Esq. of the Civil Service; a third individual has also been presented by Capt. Bogle, forming part of the collection already alluded to as having been received for the Society from Arracan.

India are no less abundant than beautiful, and yet they are very rare in menageries in England.

22. The several kinds of Green Pigeons, and that remarkable bird *Geophilus nicobaricus,* or Nicobar Pigeon, would be very easily procured. The former are common in all parts of India, and the latter on the Tenasserim Coast, from whence several are often brought to Calcutta, where they do well for a time in cages.

There are other fine examples of this family in India, as the *Vinago aromatica,* with a cinnamon coloured back, green body, and short wing feathers fringed with yellow; and the *Vinago oxyura,* a green pigeon with a long sharp tail; both these last are common throughout India, and may be procured without any difficulty.

23. Of Waterfowl, perhaps the Adjutant *alone* is the only one that has hitherto been sent home, it is therefore almost unnecessary to enumerate those which it would be most desirable to forward. The *Bengal Ibis,** and the *Anastomus Coromandelicus,* which last, notwithstanding its name is a constant and common resident in our swamps, and which may be known by the interval between the mandibles of its bill, would be two desirable birds in menageries at home, as well as the *Jabiru,* or large black and white wader, with black recurved bill, and scarlet legs. When taken young they become perfectly tame like the *Sairus,* which is another crane required in collections in England. It is scarcely necessary to mention the black-headed stork with white neck, and blackish wings, so common in Bengal and Assam, the white spoonbill, and the white heron, whose scapular feathers are divided in long narrow filaments or egrets, which are eagerly collected as ornaments; these birds are seldom

* Our collector has just procured from the neighbourhood of Calcutta a beautiful specimen of the Ceylon Ibis, *Tantalus leucomelanus,* which we were not aware was an inhabitant of Bengal.

distinguished from the white heron, *Ardea orientalis*, or paddy bird of the English sportsman.

24. Since most of the remarkable species both of gallinaceous birds and ruminants of continental India are unknown in collections of animals in England, it would be quite unnecessary to attempt an enumeration of the less remarkable species, which are still wanting in European collections. It may be sufficient to mention the several sorts of wild geese and wild duck, and, lastly, all the numerous kinds of granivorous and carnivorous birds which might easily be supplied with their natural food during the voyage, as most of the *Conirostres*, *Hawks*, and *Jays*.

25. Of the class of fishes there are many which might be presented to Menageries in England with every prospect of their becoming eventually beneficial, such are the Ruee, Catla, Meerica, and other herbivorous carps; as objects of scientific interest, examples of those genera of fishes peculiar to India might be sent home alive, such as the *Bura chung*, or ground-fish of Boutan, and many others, while all should be forwarded in a prepared state or preserved in spirits to the several Museums in London. But as fishes may be collected for transmission in Calcutta, it is unnecessary to bring them from the interior, unless where peculiar sorts occur.

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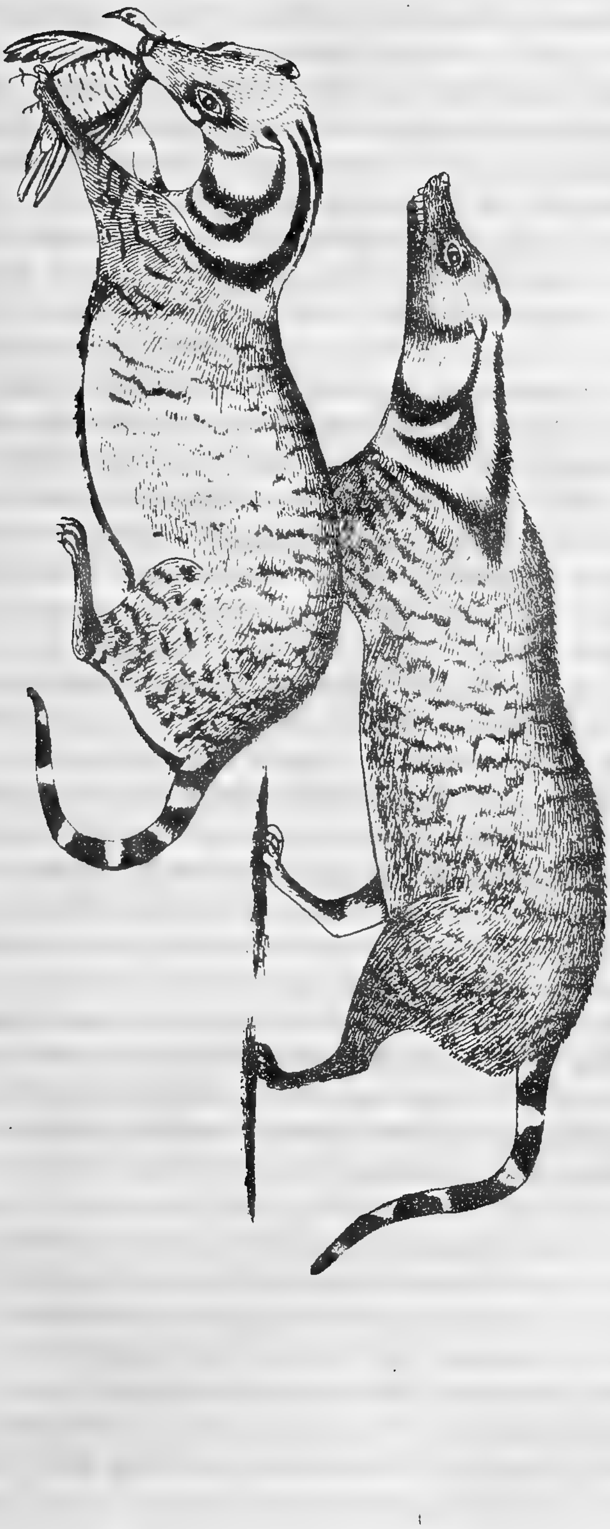
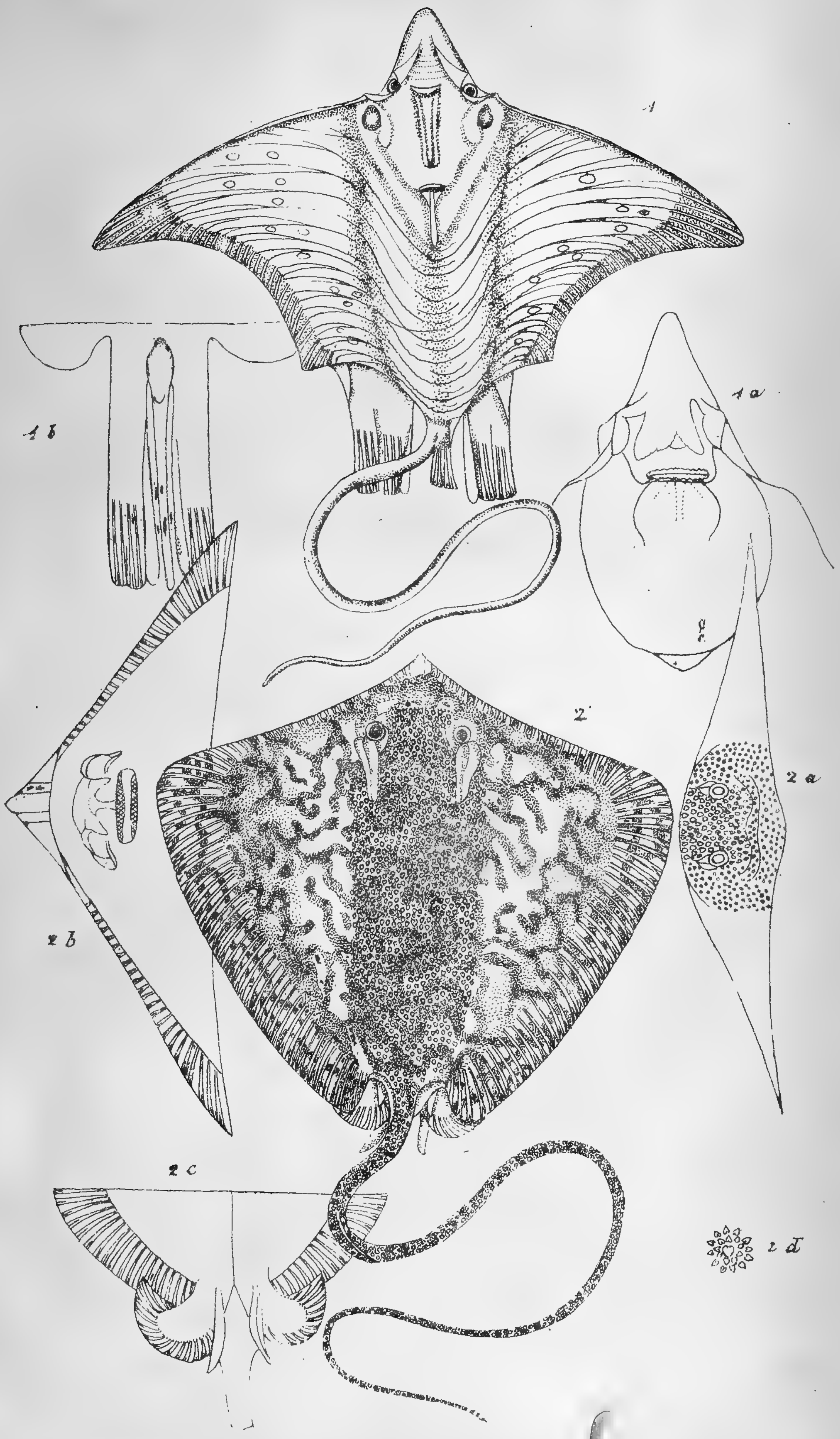
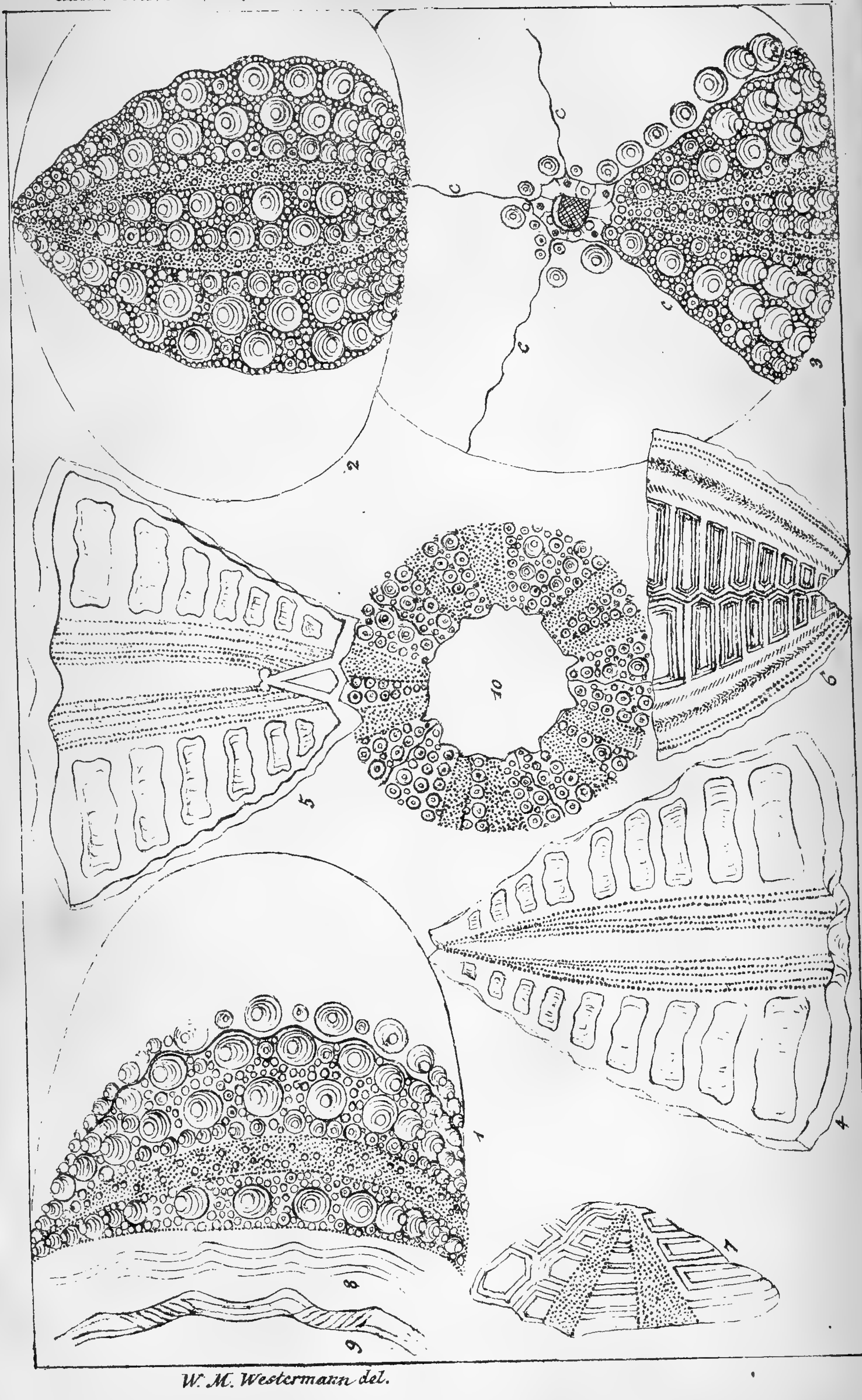


C. W. Smith Esq. del. J. M. Lith.



J. M. del & lith.



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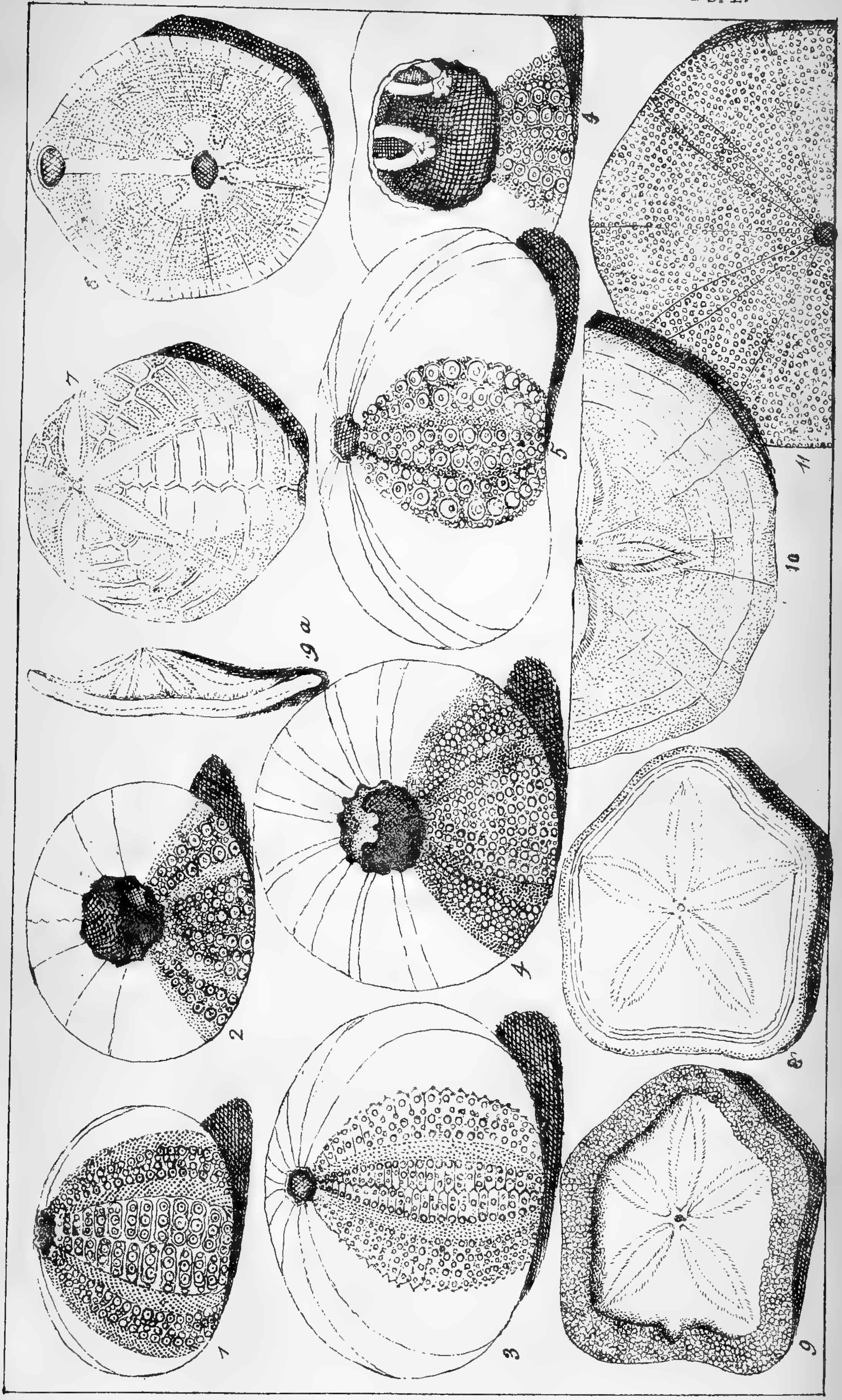

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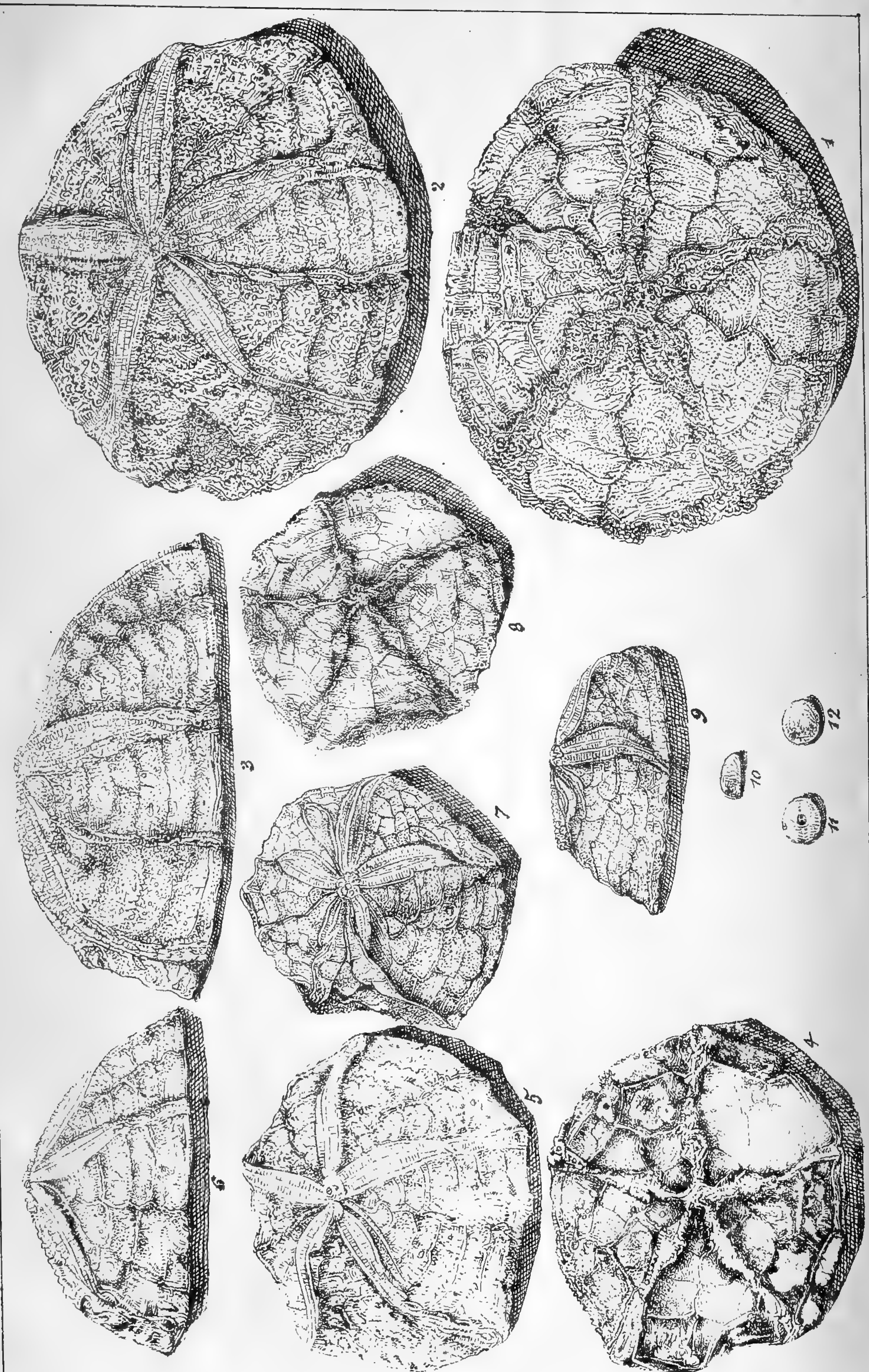

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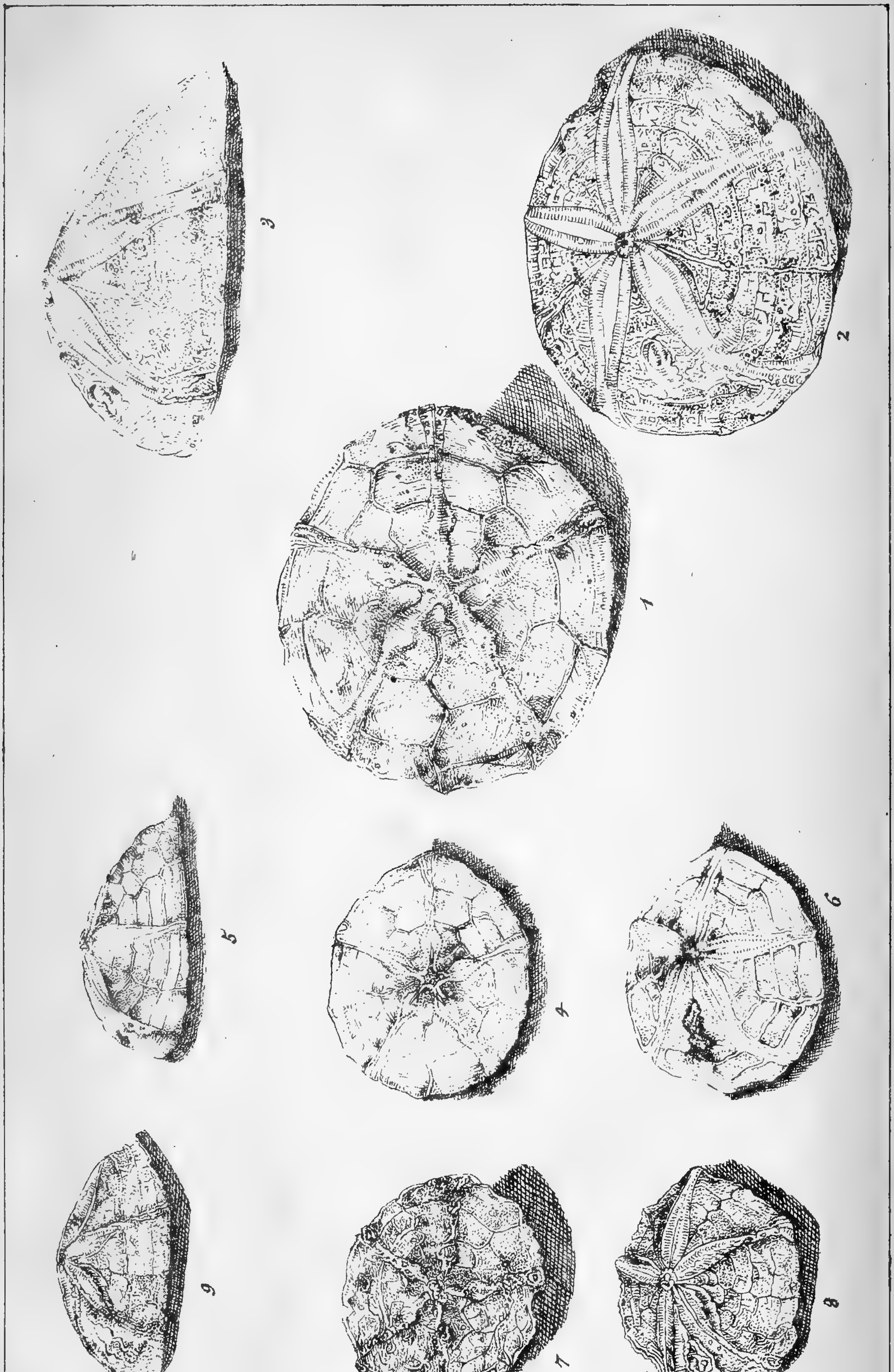
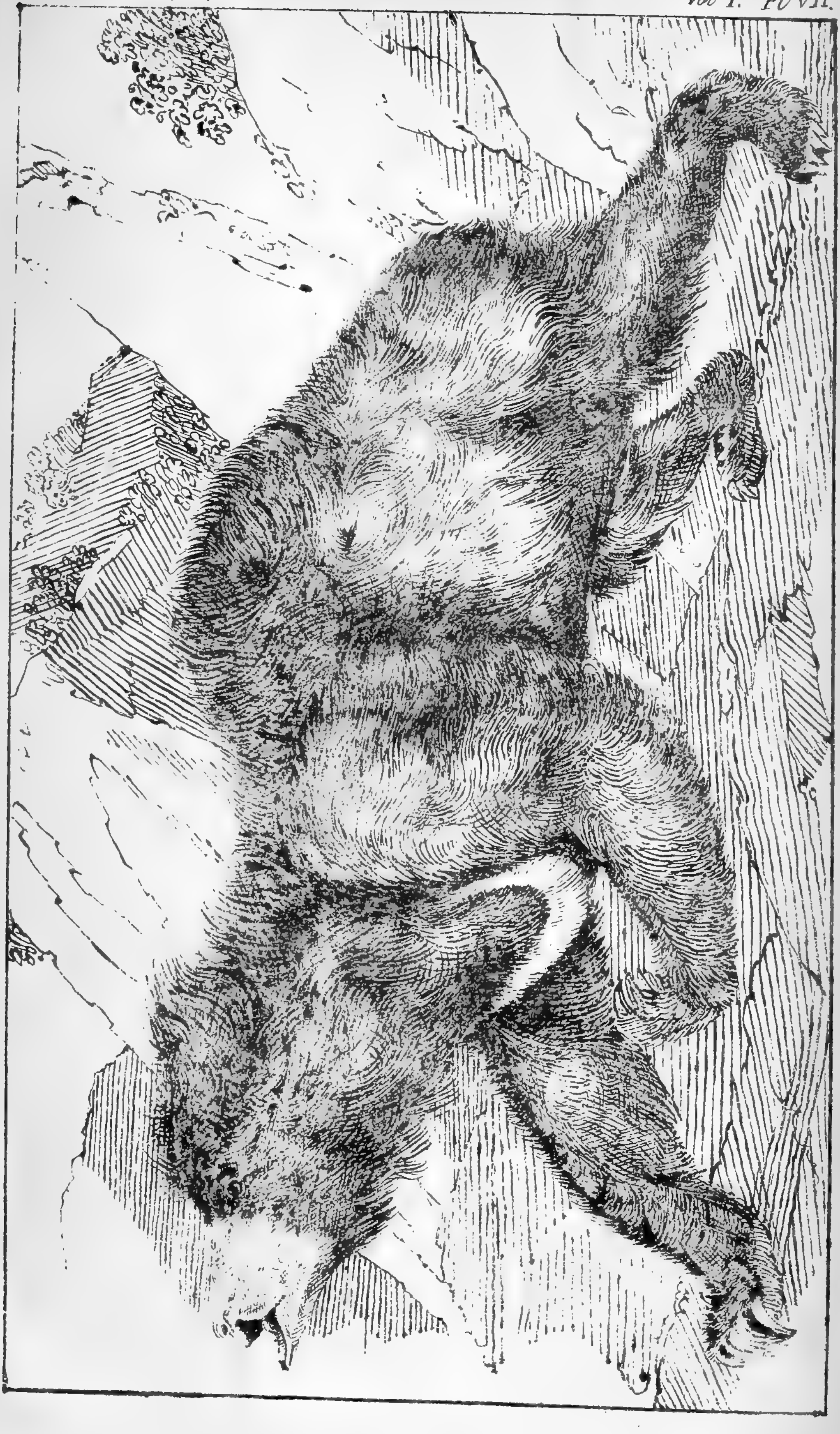
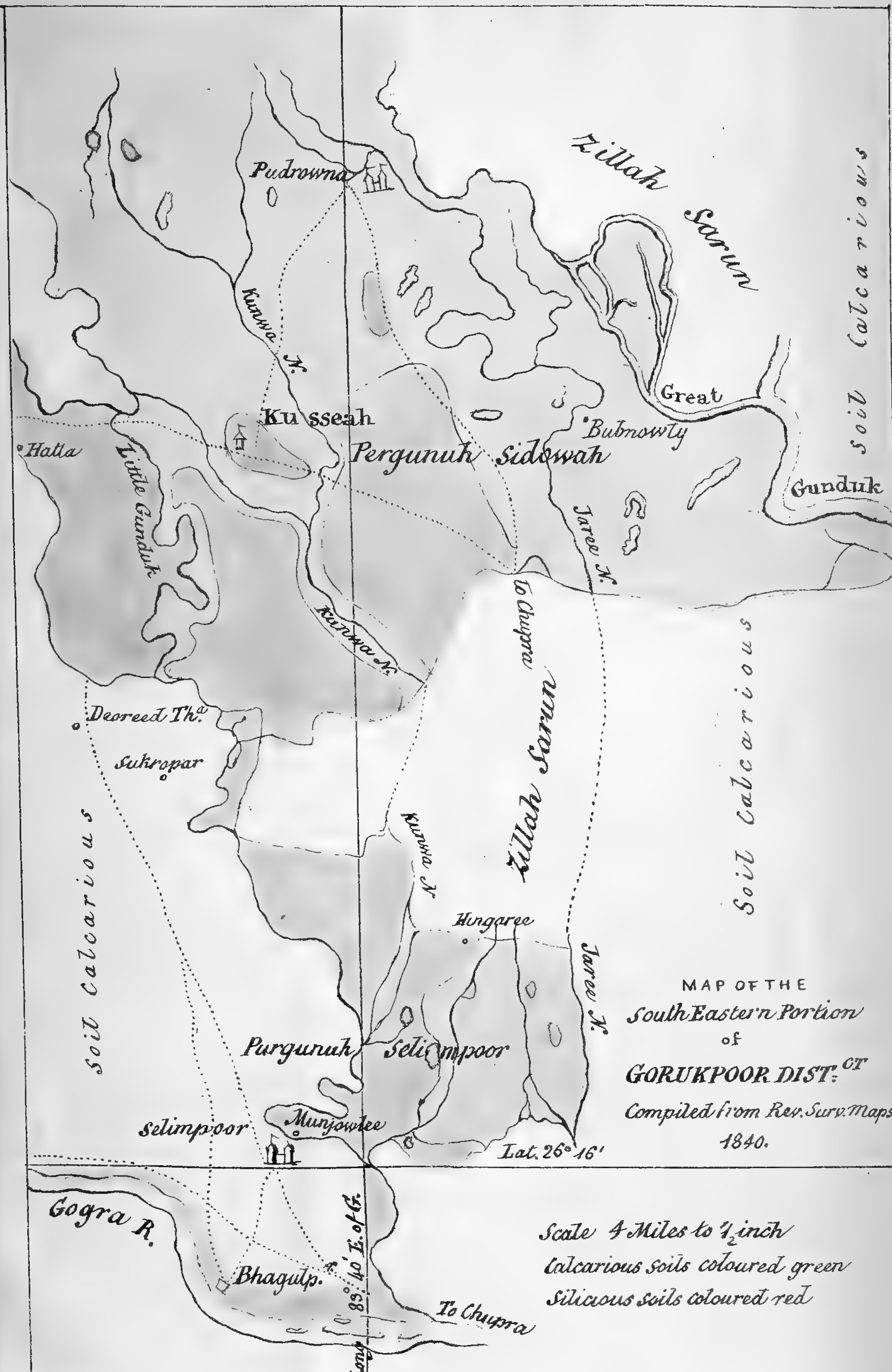


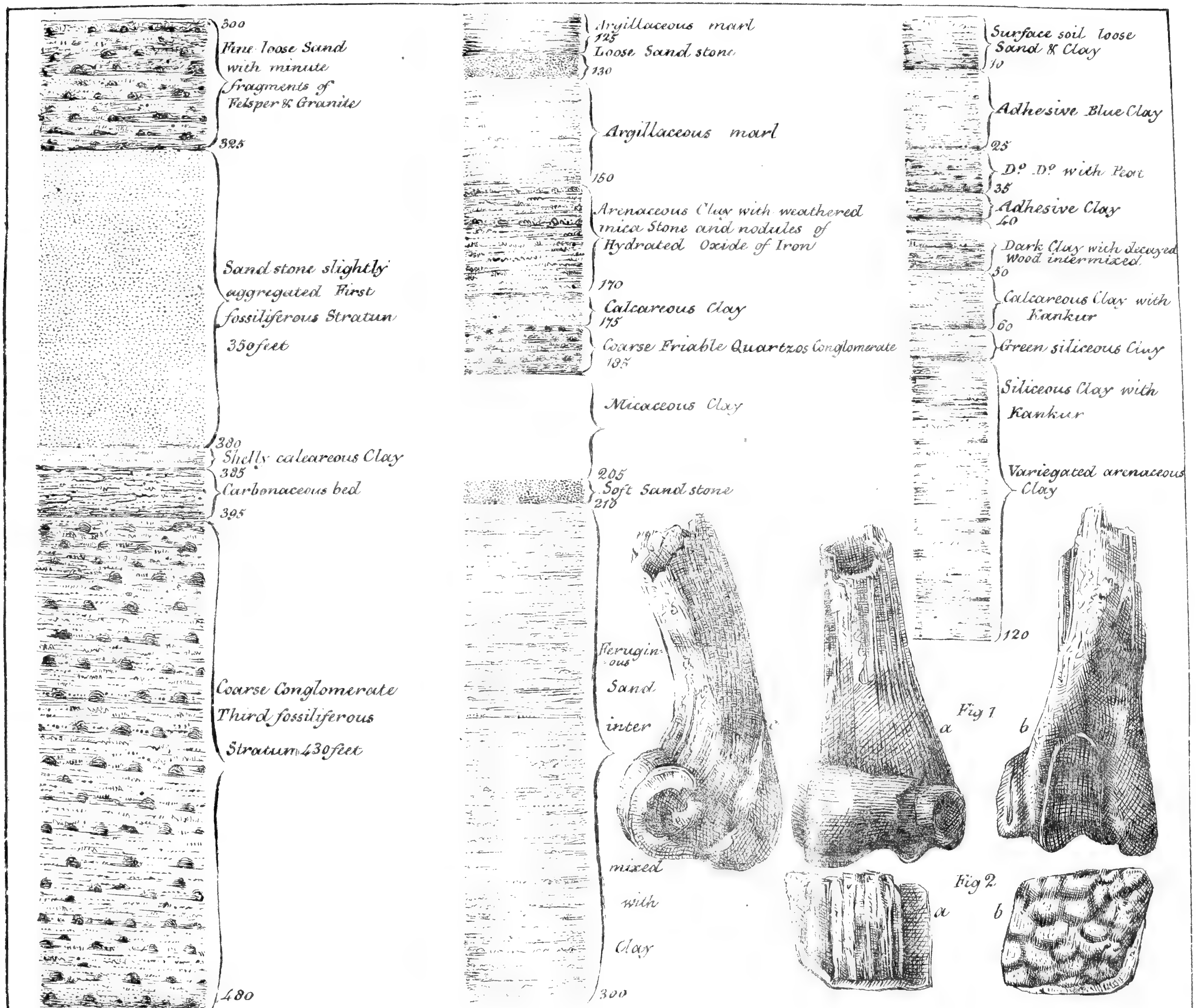


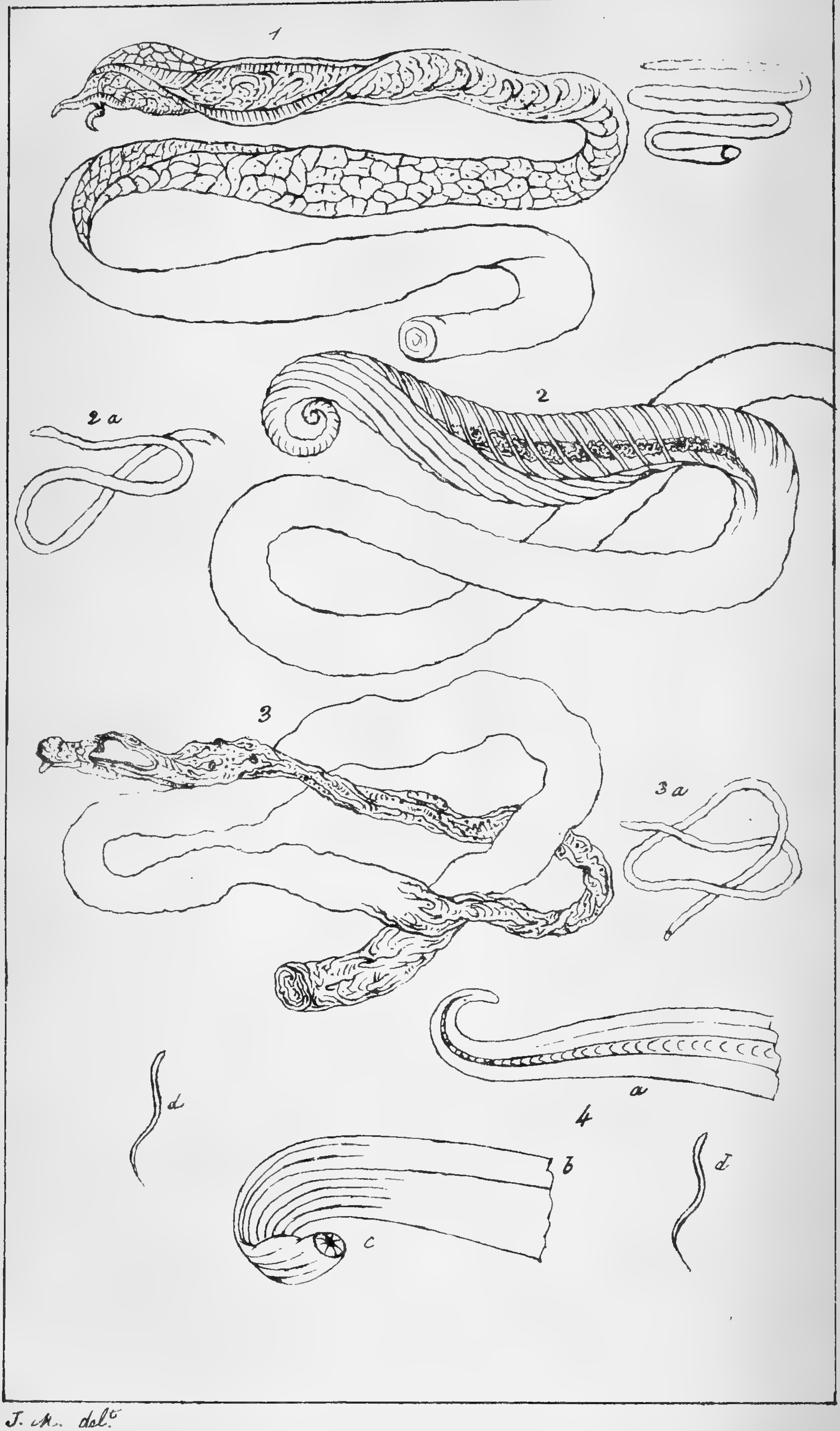
S. R. Tickell Esq. del.


Zillah Sarun
Soil Calcarious
Pudrowna
Kunwa N.
Kusseah
Pergunuh Sidowah
Bubnowly
Great
Gunduk
Hatta
Little Gunduk
Jaree N.
To Chupra
Kunwa N.
Zillah Sarun
Soil Calcarious
Deoreed Thª.
Sukropar
Soil Calcarious
Kunwa N.
Hingaree
Jaree N.
Purgunuh Selimpoor
Selimpoor
Munjowlee
Lat. 26° 16'
Gogra R.
Bhagulp.
Long. 83° 40' E. of G.
To Chupra
MAP OF THE
South Eastern Portion
of
GORUKPOOR DISTᶜᵀ
Compiled from Rev. Surv. Maps
1840.
Scale 4 Miles to ½ inch
Calcarious soils coloured green
Silicious soils coloured red

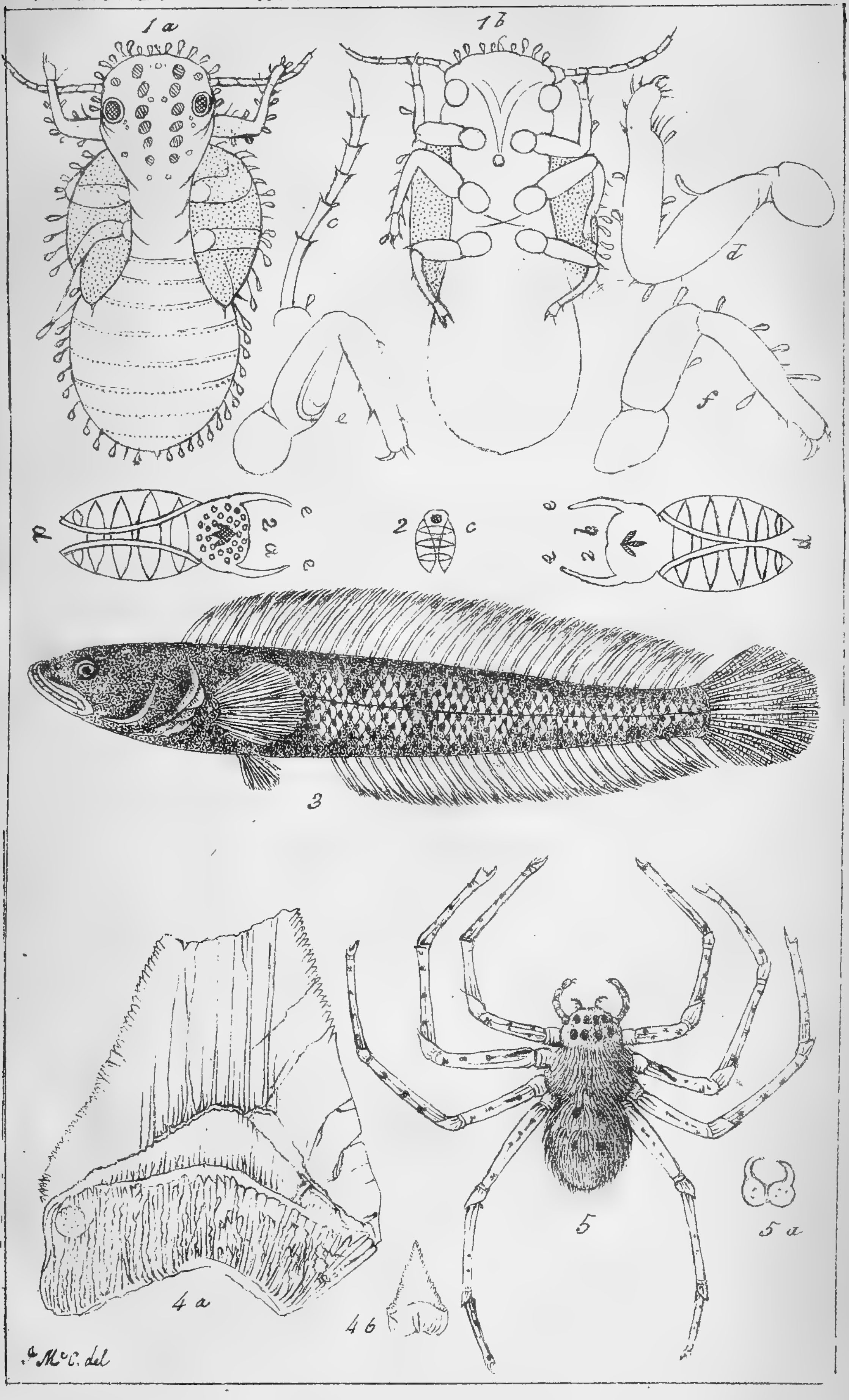
D.L.. del

Section of the Strata passed through during the Boring operations in Fort William Calcutta





J. M. delt.


1 a
1 b
c
d
e
f
2 a
2 b
2 c
3
4 a
4 b
5
5 a
J. McC. del


1 a
2 a
1 b
3 a
3 b
2 b
J. M. del