THURSDAY, OCTOBER 8, 1885

MR. GRIEVE ON THE GAREFOWL

The Great Auk, or Garefowl (*Alca impennis*, Linn.), *its History, Archæology, and Remains*. By Symington Grieve, Edinburgh. 4to, pp. x. 141, and Appendix, pp. 58. (London: Jack, 1885.)

AGREEABLY to the wish of the editor of NATURE that I should notice in its pages the lately-published volume whose title stands above, I undertake a responsibility of a kind which is for me as delicate as can be imposed upon anybody. It has long been no secret that for more than five-and-twenty years—since, indeed, the premature death, in 1859, of my friend and fellow-traveller, the late Mr. JOHN WOLLEY—I have had it in hand to prepare and eventually to produce a monograph of the presumably extinct species of bird, into the investigation of whose history he had thrown himself with all the energy of his character. During that time I am not conscious of having ever lost an opportunity of adding to my store of information on the subject, in doing which I was for several years assisted by the zeal of the late Mr. G. D. Rowley; and, though always having in view the ultimate publication of the monograph originally contemplated by Mr. Wolley, I never hesitated to supply any inquirer with the particulars for which he asked—as may be seen on reference to the publications of Dr. Victor Fatio[1] and of Prof. Wilhelm Blasius[2]—both of whom I rejoice to think I was able in some measure to help. Nevertheless, each attempt to elucidate the natural history of the Garefowl only added to the number of still unanswered or unanswerable questions relating to it; and, amid numerous other occupations or duties, I have with difficulty been able to keep myself abreast of the ever-increasing contributions to the subject—many (I may say most) of them proving on investigation to have little or no foundation; and those which had the least, or none at all, generally giving the greatest trouble.

Apology, I feel sure, is needed for an introduction so egotistical as that contained in the foregoing paragraph; yet without it, or something like it, I fear my remarks on the book before me may be misunderstood. The force of circumstances has compelled me to set up a very high standard; and, when that standard has not been approached by any writer on the subject, it is almost impossible for me not to see his shortcomings, though many another man might find in him no fault at all. I therefore wish at once to record my opinion that in the present work the author has done the best that in him lies, and especially that his book, so far as it goes, is an honest book. If, after working at the subject for more than a quarter of a century, a man still finds himself unable, from one cause or another, to publish the results of his labour, it does not follow that he should be hard upon anybody else who, with perhaps as many distractions, makes a praiseworthy attempt to set before the world what is known of the lost species, though he may not have devoted to the task a tenth of the time. Moreover, Mr.

[1] *Bull. Soc. Orn. de la Suisse*, ii. pt. 1, pp. 5-70, 73-85.
[2] *Ver. f. Naturw. zu Braunschweig*, iii. pp. 89-115; *Journ. für Orn.*, 1884, pp. 58-176.

Grieve begins his preface with the words: "In submitting these pages to the public, the author has fears that they will not bear severe criticism." I regret to say that regard to truth obliges me to declare that this is so; but I have no wish to be the severe critic, and it will be best here to describe the plan and scope of the work, which is obviously well chosen. Mr. Grieve begins with a very appropriate dedication to Prof. Steenstrup, that venerable biologist who first wrote a history[1]—he modestly called it only a "contribution" to a history—of *Alca impennis* that was in accordance with facts, and was worthy of the subject, of science, and of himself. The amount of indebtedness to him, due from all his successors in the investigation—but not always acknowledged—is not to be overrated. Hard as they may have found their work, it has almost entirely lain in clothing the form that he constructed; and, though there has been plenty of false tailoring, his outlines have proved to be true in almost every particular. In the dedication Mr. Grieve very justly states that he has not "much to relate that is new to British ornithologists;" but his desire has been "to bring within the reach of all, materials that at present are difficult of access."[2] These preliminaries over, the geographical range of the species—first in American and then in European waters—is entered upon, care being taken to warn the reader against the popular misconception that it was ever a bird of the high north, and then is given a description of its remains as found in the New World and in the Old. Under the last category come four chapters treating respectively of the discovery of its bones in Caithness, and in Oronsay, of the period to which the kitchen-midden on that island containing them presumably belongs, and of the single fragment found near Whitburn-Lizards, on the coast of Durham, by Mr. Hancock, which fragment, being the greater portion of the maxilla of what seems to have been an exceptionally large example, now in the Museum at Newcastle-on-Tyne, is very delicately figured (p. 64). After this Mr. Grieve enters upon a consideration of the bird's habits and of the regions in which it lived, and then proceeds to catalogue at some length (pp. 76-114) its existing remains—whether bones, skins, or egg-shells. Then follow three chapters on the uses to which the bird was put by man, on the names by which it has been known, with their possible origin and meaning, and on the period during which it lived. No fewer than nine appendices are added—all more or less of the nature of *pièces justificatives*—while an excellent index, with remarks on the accompanying chart, completes the volume, which is illustrated by several woodcuts and a couple of coloured plates representing the two eggs that doubtless came to Edinburgh in 1819 with Dufresne's collection, when it was bought by the University there, and, having been transferred to the Museum of Science and Art in the northern capital, were first publicly noticed by Major Feilden in 1869.

There cannot be a dispute as to the great pains which the author has taken with this work, but it would be inexpedient here to attempt any criticisms of its details, to an abundance of which exception may be taken. The

[1] *Vidensk. Meddel. Naturh. Forening i Kjöbenhavn*, 1855, pp. 33 to 118.
[2] Here may be added that, if report speaks truly, so strong has been this desire on the part of the author, that the book is sold to the public at less than cost price.

fact seems to be that up to a certain point the story of the Great Auk can be worked up and told by any one willing to labour at it. Beyond that point the difficulties begin. Mr. Grieve appears to be hardly aware of the existence of these difficulties, though some of them have been hinted at, if not pointed out, by his predecessors. The most serious charge that can be brought against him is that he has needlessly raised fresh difficulties for future investigators. Mistakes that have taken years of labour to correct, and the correction of which has been published, are again set agoing, just as if no progress in that direction had been made; and, even worse than this, some new assertions, or at least suggestions, are hazarded that have, I am persuaded, no firm ground. No doubt on some of these points I may be prejudiced; but according to my knowledge I perceive that on too many questions Mr. Grieve has been unable to distinguish between good evidence and bad. However, there is in this book a distinct gain to all historians of the Garefowl, and that is the information here first placed on record by Mr. Champley of Scarborough, who is known to have interested himself for many years in all that concerns this species.

I most sincerely wish that I could accord higher praise to this work than I have been able to do, for Mr. Grieve's enthusiasm in the cause deserves greater success. It is seldom that any one but a Fennimore Cooper or a Charles Kingsley feels the romance that clings around the history of an expiring race. Most men—men of science especially—nowadays believe in the survival of the fittest, and are content to let the dead bury their dead. The moral lesson I do not venture to draw, and in conclusion have only to ask pardon of the readers of NATURE for putting myself so forward in this article.

ALFRED NEWTON

"*THE WAVE OF TRANSLATION*"

The Wave of Translation in the Oceans of Water, Air, and Ether. By John Scott Russell, M.A., F.R.S. (London: Trübner and Co., 1885.)

THE late Mr. J. Scott Russell was one of the most prominent and gifted naval architects which this country possessed in the middle of the present century. His name will long be remembered as the builder of the *Great Eastern*, the early advocate of the longitudinal system of framing iron and steel ships: the ingenious and eloquent expounder of the "wave-line" principle of design; and for many improvements in the theory and practice of iron steamship construction. His personality was at once striking and attractive, and his abilities were of an original and versatile kind. He was the author of a massive work upon naval architecture; and of numerous papers read before various learned societies. No one exercised greater influence than Mr. Scott Russell in promoting the cause of scientific education in naval architecture, and in stimulating and helping students, by numerous speeches and writings, to acquire a general and clear knowledge of the laws upon which the qualities of ships depend.

Mr. Scott Russell's writings were always interesting. He possessed the rare faculty of making the driest and most complicated of subjects intelligible, and even fascinating. Where he may not be correct in the hypotheses, or justified in the sweeping generalisations, he sometimes hastily put forward, he is usually suggestive, and provocative of thought upon the part of his readers. He was a vigorous and clear—though with a tendency to be a too rapid—thinker; and there are no writings upon naval architecture which have the power of fixing the attention and stimulating the intellect in a greater measure than those of Mr. Scott Russell.

We regret to say that the present work is not likely to add to the reputation of its author. It exhibits *les défauts de ses qualités* in their most pronounced form; and if we were asked for an example of Mr. Scott Russell at his very weakest and worst we could hardly do better than refer to that portion of this book which has not been before published. One-half of the volume is devoted to a reprint of the Report made by Mr. Scott Russell to the British Association in 1842-43, in which a description is given of the "solitary wave of translation," which he discovered for himself in 1834, and the properties of which he did much to investigate and make known. This Report is not only printed *in extenso*, but Part I. of the work consists exclusively of extracts from it. The same matter appears twice over—once as Part I. of the book, and once as portions of the British Association Report. The Report describes the knowledge possessed by Mr. Scott Russell in 1843 of "the varieties, phenomena, and laws of waves, and the conditions which affect their genesis and propagation." This may be interesting from a biographical point of view, but its present scientific value is not great. Many things have happened since the date of this Report, such as the theoretical investigations of Airy, Stokes, Rankine, Froude, eminent French mathematicians, and others; and numerous observations have been made of the forms and properties of waves by scientific officers of our own and foreign navies. These constitute a mass of information which the present work completely ignores.

One half of the book is taken up with the reprint of the British Association Report referred to, and with those extracts from it of which Part I. is made up. The remaining half contains the only new matter now published. This is divided into two sections, one being "on the analogy between the solitary wave in water and the sound wave in air," and the other "on the great ocean of ether and its relation to matter." The less said of these chapters the better. The following is an instance of how Mr. Scott Russell frames a theory or invents a hypothesis: "I am so impressed with the truth of this law, that the velocity of this solitary wave in any fluid is due to the depth of the fluid in which it moves, whether thick or rarefied, that I hazard the hypothesis, that in the unknown element which pervades the universe, and which, though unknown, is the cause and medium of the most familiar phenomena of everyday life, proceeding on the same basis of calculation as in the air and water occurs, we shall find that the ethereal ocean should be given a height of 5,000,000,000 miles, and that the corresponding velocity of the solitary wave through that ocean would be 1,000,000,000 feet per second."

An atomic theory is framed upon the following basis: "The law of attractive force in the atom, in conformity with the law of Newton, is according to the *square of the* *nearness*, and I propose to take as the law of repulsive force, the *cube of the nearness*. I think I am justified in taking this as the true law of repulsion of atoms of matter, because I find from the researches of eminent chemists that all free gases do so expand as to double their bulk by an increase of the distance of the particles, in the ratio of the cube of their nearness, or as 111 cube to 367." Then the theory of heat that is put forward appears to be a kind of material theory: "We may therefore define heat as *the effort of ether to resist crowding*. . . . Ether existing all around us in a normal state may be called *free ether*. Ether enclosed by force in limited space surrounded by material atoms is imprisoned or stored ether; its greater or less degree of crowding or storing means degrees of heat, and the quantity of crowding among the atoms indicates the specific heat of these atoms, and sometimes the specific heat of that kind of matter."

One more extract and we have done:—"Even Sir Isaac Newton's calculations of the speed of sound fell 100 feet short of the truth, and therefore corresponded to an error of a mile in the height of the atmosphere, and he could invent nothing better to account for the error than this sudden inflammation of the atmosphere. To this the reply is that the existence of the solitary wave of translation was not known to Newton, that the nature of its genesis and propagation could not therefore be calculated; but that present knowledge of the nature and laws of this wave completely explain and accurately measure its phenomena without the introduction of any hypothesis contradicted by fact."

We have said enough to show the character of this treatise, and we will conclude by repeating that we are sorry to see a posthumous work by so eminent a man as the late Mr. Scott Russell, containing nothing more to justify its publication than a reprint of his well-known, and imperfect, views in 1843, upon wave motion, and a fanciful interpretation of great physical laws. It is a pity that greater skill and discretion were not brought to bear upon the production of this volume.

OUR BOOK SHELF

Publication of the Norwegian Commission of the Measurement of Degrees in Europe. (1) Geodetical Operations, Part IV. (2) Tidal Observations, Part III.

THE first of these publications contains an account of the northern portion of the trigonometrical work undertaken to connect the side Stokvola-Haarskallen with the side Spaatind-Næverfjeld. The former side is directly connected to the base measured in 1864 near Levanger, as described in Parts I. and III. of the "Geodetical Operations."

A trigonometrical survey of this part of the country had already been made in 1835-6 by Gen. Broch, and it was at first hoped that this survey could be utilised, but on closer investigation it was found that the observations were not of sufficient precision to meet the requirements of the Commission for the Measurement of degrees in Europe, for which this work was to a great extent undertaken. The old stations were, however, utilised in the northern part of the triangulation; there the signals were well-built masonry cylinders. In the southern portion, however, the stations had in many cases entirely disappeared and had to be reconstructed. A careful description of each station is given, and in every case, with one or two exceptions, the signal could not be placed at the centre of the station; the usual measurements for reduction were therefore made, and apparently with more than usual care. The observations were taken with a 10-inch universal instrument made by Olsen and with a 12-inch theodolite made by Reichenbach. It would appear that the graduation of these instruments is not of a very high order; at any rate, the differences in the readings are rather large, frequently exceeding 10″: but in extenuation it must be said that the instruments were too small for the work and that the observations were made under considerable difficulties, owing to sea-fog and snow. There is nothing special to remark in the method adopted to adjust the observations, it being the usual method founded on the principle of least squares. It is shown that the mean error of the finally-adjusted angles is

$$0''.547 \pm 0''.029.$$

A diagram of the triangulation is given, from which it is seen that most of the triangles are well-conditioned; a few, however, are more elongated than they should be for good work, the triangle Munken, Stokvola, Haarskallen, especially so; for instance, the angle at Munken is 5° 12′ 57″.416. It should also be observed that several of the stations are determined by only two intersections. The longest side measures about sixty miles.

The second publication is the third report of the Norwegian tidal observations, and contains the results of the work done at Oscarsborg in 1880-1 and at Stavanger, Bergen, Kabelvaag, and Vardö in 1883. This report is simply a continuation of Reports I. and II., already noticed in NATURE; it contains nothing but tables, and there is nothing in it that calls for special notice.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

On the Influence of Wave-Currents on the Fauna of Shallow Seas

FOR many years past I have endeavoured, without much success, to call attention to the widely-spread influence of waves on the bottoms of shallow seas. To the geologist this action signifies denudation, and accounts, among other things, for the wholesale destruction of marine fauna so often exemplified in the rocks. To the zoologist it signifies a factor in evolution of immeasurable magnitude.

On seeing the abstract of Prof. Moseley's lecture on the fauna of the sea-shore in NATURE, I troubled you with my letter of July 6; now that the full report has appeared, equally reticent as to the significance of wave-currents, I ask leave to add somewhat to my former letter.

The difficulty in arousing interest in this subject arises from the fact that, though the phenomena of wave-disturbance are well known to mathematicians, natural history text-books commonly agree in asserting either the non-existence, or unimportance, of such disturbance. Thus the question has remained unheeded.

My own experience in the matter is as follows:—Holding the orthodox view of the peaceful repose existing on the sea-bottom, I commenced cruising, some twenty years ago, on that excellent natural experimental tank, Torbay. I soon found, to my surprise, that the local fishermen and dredgers were as confident that the waves greatly disturbed the bottom as naturalists were of the reverse. Having kept my eyes open in this direction, I submitted a paper to the Devonshire Association in 1878, descriptive of the levelling action of the waves on the six-fathom area of Torbay (*Trans. Dev. Assoc.*, vol. x. p. 182).

With the kind assistance of Lord Rayleigh I was enabled to show that theory and observation were in complete accords a to the energy evinced by the waves in the particular instance under consideration.

Having learned from Lord Rayleigh that wave-action at the sea-bottom takes the form of reciprocal currents, I was led to make some experiments and observations on the formation of ripple-mark. In the course of this investigation I was soon impressed with the conviction that these alternate currents held at their mercy the marine fauna exposed to their attacks, and that the zoological side of the problem was at least as important as the geological. Accordingly, an outline of the subject in its zoological aspect was included in a paper on ripple-mark read to the Royal Society in 1882 (*Proc.* R.S., vol. xxxiv. p. 1).

Having come into possession of confirmatory evidence of the action of waves at a depth of forty fathoms in the English Channel, I submitted the facts to the British Association at Southampton in the same year, 1882. This paper, sent in to Section A, was handed on to Section C, a mathematical friend suggesting to me the reason, and a very good reason too, that mathematicians required no evidence on the point contended for. However, the transfer only went to prove that the geologists were as sceptical as to the existence of wave-action at forty fathoms, as the physicists were satisfied as to that fact. This paper, amplified, appeared in the *Transactions* of the Devonshire Association for 1883 (vol. xv. p. 353).

The zoological aspect of the question was submitted to the British Association at Southport in 1883; and again to the Linnean Society in 1884, in a paper "On the influence of wave-currents on the fauna inhabiting shallow seas." In this paper, profiting by experience, I made no attempt to prove the fact of wave-action from observation, but relied entirely on a valuable letter with which I had been favoured by Prof. Stokes, Sec.R.S. Neither at the British Association nor at the Linnean Society was any exception taken to my arguments in support of the importance of wave-action on the fauna affected; nor, so far as I am aware, has my position been shaken since. Now that Prof. Moseley's important lecture has appeared, discussing the fauna of the sea-shore without reference to the ever-regulating wave-currents, there is considerable risk that less experienced students of natural history will in like manner pass over this promising field of research as not worthy of their attention.

Prof. Moseley states, and states truly, that the littoral fauna is adapted in various ways to withstand "the action of the surf, the retreat of the tides, the numerous enemies"; but, beyond the reach of surf and tidal fall, agents which only affect the narrow belt of sea contiguous to the shore, the alternate currents set up by ocean waves search out the armour and test the defences of all small animals living on those extensive marine areas, exposed to the ocean swell, where the depth of water does not exceed fifty fathoms.

With respect to enemies, the waves themselves are perhaps the most formidable, as they attack and occasionally destroy whole colonies at once, whereas predatory foes rather affect the individual. For instance, let such helpless mollusks as *Aplysia* or *Pleurobranchus* wander over the sandy bottom of Torbay, as they sometimes do: the first easterly gale will sweep them out of existence. In fact, the waves so invariably prevent *Aplysia punctata* growing to its full size on the British coast, that a full-grown specimen taken in protected Guernsey waters has been considered a distinct species—viz. *A. depilans*. Similar large specimens have occurred under the shelter of the Torquay harbour works, but these, by a series of odontophores and shells, I have been able to connect with the common *A. punctata*.

Prima facie it would appear that the shells of certain mollusks are more especially adapted to resist animate foes; but a close examination will often prove the contrary. Take the cases of the oyster, mussel, venus, and limpet: these mollusks are all helpless in the presence of their living enemies: the oyster perishes by the attacks of boring-sponges; the mussel is destroyed wholesale by starfishes; the venus is perforated by carnivorous gastropods at their leisure; whilst the limpet, easily detached when taken unawares, is said to be destroyed by birds. All four are, however, admirably adapted to resist wave-currents, each in its respective habitat.

The conclusion that the shells of mollusks are so constructed as to have comparatively but little reference to living foes is supported by the interesting fact mentioned by Prof. Moseley, that hard shells tend to disappear in pelagic and deep-sea regions. That is to say, they disappear where predatory enemies abound, but where the great non-predatory enemies, the waves, are powerless or not existent. Occasionally we find the supposed protection against living enemies to be greatly in excess of requirements—*e.g.* the case of the solen, whose power of burrowing is far greater than requisite for escape from birds, but which is none too great for the evasion of waves and currents tearing away the sand in which the mollusk dwells.

Wave-action tends to differentiate species. This can be seen in such obvious cases as *Cardium aculeatum* and *C. norvegicum*, *Venus dione* and *V. chione*. One of each of these pairs has chosen the mooring method of defence with anchor-like spines, the other that of facile penetration with smooth, unresisting shell surfaces. As these two methods are opposite in action and any compromise tends to inefficiency, the wave-currents must necessarily influence the mollusks in the direction of divergence.

Instances of habits and forms protective against wave-currents could be multiplied almost *ad infinitum*, and, as the subject is a very interesting one, I still live in hopes that it may yet be taken up and worked out by trained observers qualified for the task. ARTHUR R. HUNT

Torquay, September 28

Prehistoric Burial-Grounds

THE account given in this week's NATURE (p. 518) of the discovery of a prehistoric burial-ground at Pitreavie has recalled to my memory the description of a similar find made in the eleventh or twelfth century by the monks of Noyon, and related to us us by Guibert, who was abbot of this foundation at the time. I believe that it is the earliest detailed account of any such discovery that has come down to our days; and it will be noticed that the leading features of this cemetery are almost exactly identical with those of the Pitreavie one. I am not aware that this passage has attracted the attention of modern writers upon prehistoric times.

Guibert, the author quoted, was born in 1053 and died in 1124, having been Abbot of Noyon for about twenty years. After stating his own conviction that his monastery was extremely old, he continues:—

"Quam opinionem, si nulla litteralis juvaret traditio, suppeteret profecto affatim peregrina, et non, putamus, Christiani nominis sepulchrorum inventa contextio. Circa enim ipsam et in ipsa basilica tantam sarcophagorum copiam conjunxit antiquitas, in multam loci famositatem tantopere expetiti, cadaverum inibi congestorum commendat infinitas. *Quia enim non in morem nostrorum ordo disponitur sepulchrorum, sed circulatim in modum corollæ sepulchrum unius multa ambiunt, in quibus quædam reperiuntur vasa, quorum causam nesciunt Christiana tempora.* Non possumus aliud credere nisi quod fuerunt gentium, aut antiquissima Christianorum, sed facta gentili more."

GUIBERTI Novig. *de Vita Sua*, L. ii. cap. i.

I may add that in Guibert's time there was a very old written tradition which ascribed the foundation of Noyon to a certain "rex insulæ Britanniæ," who was (so ran the legend) a contemporary of our Lord's. This tradition is, of course, worthless from a historical point of view, but certainly testifies to the extreme antiquity of the place; and shows that, long before Guibert's time, the inhabitants of Noyon had dim recollections of their prehistoric greatness, which naturally, in an age of Christian credulity, centred around the era of our Lord.

T. A. ARCHER

158, Walton Street, Oxford, September 30

MARS, JUPITER, AND SATURN

WITH Mars, Jupiter, and Saturn in the morning sky the telescopist has a varied assortment of brilliant objects to which he may devote his attention. The great distance of Mars during the ensuing opposition will have the effect of limiting the apparent diameter to a low value, but the chief markings are so conspicuous as to be visible notwithstanding this inimical effect. Indeed during the preceding opposition, which was equally unfavourable, some of the more delicate features appear to have been recovered. At Milan Signor Schiaparelli has partly confirmed his previous results as to the singular duplication of the "canals," and Mr. Knobel has obtained a series of valuable sketches, which are reproduced in the last volume of the *Memoirs* of the Royal Astronomical Society. With regard to Jupiter the declination of the planet will be somewhat less than during the opposition of 1884-5, but the configuration of the belts and the peculiarities of the variable spots will doubtless continue to be exhibited with nearly similar prominence as in previous years. Saturn, situated in Gemini, and having considerable N. declination, will present a grand display, the rings being still widely open and inviting that close and systematic scrutiny which is so much needed either to affirm or negative some of the questionable details suggested by recent observations.

Observers of Mars are extremely fortunate in possessing such valuable memoirs and charts as those of Schiaparelli, Terby, Green, and others, which form a comprehensive and accurate basis of future reference and comparison. The seeming permanency of the chief lineaments on Mars and their distinctness of outline have permitted observers to assign their forms and positions with great nicety. But this has been found practically impossible in respect to any of the other planets of our system. Their markings are of so variable a tendency or so uncertain and ill-defined, owing probably to their atmospheric character, that it is out of the question to frame representative views that will serve to express the appearances observable at any future time. We have accumulated a vast number of delineations, including many peculiar forms, but these exhibit so much discordance as to prove that any attempt to arrange them with the same consistency as those of Mars must for the present be utterly futile.

What is essentially required in furtherance of our knowledge of areographic features are delineations in which the more delicate alternations of light and shade are faithfully portrayed. The ensuing opposition, though not offering the most favourable inducements for attaining this end, may yet be utilised as likely to afford its share of corroborations to old features and perhaps indicate some modification of the outlines attributed them by former observers. Mr. Marth's valuable ephemerides in the *Monthly Notices* supply the data wherewith the passages of certain prominent markings across the central line may be readily calculated from night to night. Drawings effected at the telescope and subsequently attested by the charts, or independent projections made on the basis of the new drawings and then compared with previous work will be important as furnishing fresh confirmations and additions to old records. Whatever plan is adopted, observers must not regard existing delineations as *perfectly* reliable and prejudice the judgment by endeavours to discern the outlines of the spots precisely as they have already been figured. Our work should be pursued apart from such influences, the aim being rather to correct and extend past results, than to follow them with implicit faith and mould our new seeings on the same pattern. Though much has been accomplished by the consecutive labours of the many able and earnest students of Martian features, the present state of our knowledge is not only incomplete, but considerable uncertainty exists as to the more difficult formations comprised in the physical aspect of this planet.

Jupiter, with so great a diversity of atmospheric phenomena, some of them rapidly variable, and all influenced by the quick rotation of the planet, gives prospect of being the subject of increased investigation. Late in the preceding opposition the great red spot which had so nearly disappeared and had, during the winter of 1884-5, assumed the appearance of a red ellipse with interior light cloud, showed unmistakeable evidences of increasing condensation. The ellipse grew perceptibly darker, and the central light cloud disappeared, so that at the end of the opposition the spot had almost regained the striking aspect it presented a few years ago. The question now is has this well-known feature continued to gain ascendancy during the time the planet has been lost in the sun's rays? Observations in October will furnish a definite answer to this question, and the planet should be confronted with our best telescopes as early as possible, so that the necessary evidence may be obtained. The spot will pass the central meridian of Jupiter at about the following times, and ought to be well seen in small instruments unless some great changes in an unexpected direction have affected its position or appearance in the interim since the last observation made here on the evening of July 8:—

Date 1885		Red Spot Central h. m.	Date 1885		Red Spot Central h. m.
Oct. 7	...	18 34	Oct. 29	...	16 48
12	...	17 43	31	...	18 26
17	...	16 52	Nov. 3	...	15 56
19	...	18 30	5	...	17 34
24	...	17 39	7	...	19 13
26	...	19 17	10	...	16 43

With reference to the white spots bordering the dark belts, and the other definite markings, they will doubtless be remarked as heretofore. Their singular vagaries of motion and appearance call for renewed study. The varying intensity and colour of the belts and their disposition in latitude should be carefully assigned on several dates during each opposition. If this method could be persistently followed during many years it would supply the material either for tracing out periodical recurrences, or proving such changes to be intermittent in character.

During the past opposition of Jupiter much attention was directed to the transits of the satellites and their shadows. When near mid-transit, III. and IV. are often seen as black spots, I. is visible as a grey spot, while II. is rarely, if ever, visible otherwise than as a bright spot. These anomalies have never received a satisfactory explanation, and further observations are much required as to the relative tints of the satellites when on Jupiter and the variations noticeable in different transits.

Saturn, though not presenting such an extent of conspicuous detail as Jupiter, is yet equally deserving of systematic study. The rings and numerous array of satellites compensate for lack of detail in the belts. The outer division in the ring, called after Encke, supplies us with a crucial test object, and one which perhaps has originated more difference of opinion amongst observers than any other planetary detail of which the existence is well assured. Either this division must be liable to fluctuate at short intervals or the evidence afforded by various telescopes is most conflicting, and suggests how careful we should be before accepting individual results when not corroborated or supported by undeniable testimony.

During the last few oppositions a very definite narrow dark belt has bounded the southern side of the equator, and this has attracted more comment than usual owing to its compact and very obvious appearance. This belt exhibits no distinct spots, though one or two observers have delineated it with marked condensations. The fainter belts nearer the pole are so very feeble that their existence is sometimes questionable. Indeed the features of this planet are of extreme delicacy, and require not only very steady air but a thoroughly good eye and instrument to trace them in their more minute forms. Some of them are doubtless variable and have given rise to the contradictions we have referred to. As to the satellites they comprise test objects for telescopes of all calibre. The identification of these bodies may be suitably effected at any hour by means of Mr. Marth's ephemerides (*Monthly Notices*, June, 1885).

W. F. DENNING

RADIANT LIGHT AND HEAT[1]

III. (*Continued*)

Absorption—Terrestrial Applications.

LET us next consider the absorption spectra of substances, that is to say, the absorption lines which substances at ordinary temperatures produce in the spectrum of light from a high temperature source, such as the sun or the electric arc. This absorption may either be general or selective; it may be spread over a large portion of the spectrum, or it may act specially over a very limited district or line. It is in the latter case that we derive most advantage by studying absorption spectra, and there are many substances which may be known at a glance by means of their peculiar absorption. Professor Stokes has shown, for instance, that blood may at once be distinguished from other solutions of similar tint by means of the characteristic dark bands which it produces. By means of a spectrum microscope Mr. Sorby thinks that the thousandth part of a grain of blood may be detected, and the same observer asserts that wines of different vintages can easily be distinguished from one another in the same way. It thus appears that the absorption spectrum may in many cases furnish us with an efficient and simple means of ascertaining adulteration, for the presence of inferior substances which escape detection by the taste or sight will at once be recognised when spectrum analysis is employed. Russell, Gladstone, Abney, Festing, and others have studied with much success the spectra of solid and liquid bodies.

The absorption spectra of gases and vapours at low temperatures have been studied by various physicists, and amongst them by Janssen, Roscoe, Schuster, and Lockyer. Brewster, as we have seen, was the first to observe the effect produced on the solar spectrum by nitrous acid gas; other gases have since been tried in the same way, and many of these give out channelled or fluted absorption lines similar to those given out by nitrous acid gas. In fine, various researches lead us to conclude that gases, and more especially vapours, are in a state of greater molecular complexity at a low than at a high temperature, for at a low temperature they have a prominent absorption for many kinds of rays, whereas at a high temperature they have no such strong absorptive power, but absorb and radiate only a few definite spectral lines.

This simplification produced in spectra by the rise of temperature has been greatly insisted on by Lockyer, and will again come under our review when we have discussed the celestial applications of spectrum analysis.

Meanwhile, I cannot do better than quote the words of Lockyer in his Treatise on the Spectroscope and its applications (NATURE Series):—"We may state generally (says that observer) that beginning with one element in its most rarified condition, and then following its spectrum as the molecules come nearer together, so as at last to reach the solid form, we shall find that spectrum become more complicated as this approach takes place, until at last a continuous spectrum is reached."

Before concluding this division of my subject, it will be necessary to allude to the absorptive effect produced by the earth's atmosphere on the light and heat of the sun. This is a point of great practical as well as scientific importance, more especially if we reflect that the atmosphere is a covering of variable composition, and that the variable element (aqueous vapour) is one which no doubt exercises a large absorptive influence upon the rays of the sun. But there is another element of variability in the sun itself, for we more than suspect that the amount of radiant energy which we receive from our luminary depends to some unknown extent upon the state of his surface, and may thus be different in years characterised by a maximum number of sun spots, and in years characterised by a small number of these phenomena. An additional complication is introduced by the suspicion that one of these causes of variability may react upon the other in such a way that in those years when the radiation of the sun is intrinsically most powerful (if there be such) an abnormally large amount of aqueous vapour may be dissolved in the air, so that we may have on such occasions an increased absorption as well as a large intrinsic radiation, and the one of these causes may thus, to a great extent, cover or conceal the other.

Bearing these points in mind, I shall divide my remarks into two sections. I shall treat, *in the first place*, of the means which we have at our disposal for estimating the whole amount of radiant energy which reaches us from the sun at any station, whether this be near the level of the sea or at an elevation above it.

In the second place, I shall allude to the means we have at our disposal for estimating the amount of any one kind of radiant energy that reaches us from the sun.

An instrument by means of which we may ascertain the amount of the sun's radiant energy is called an *Actinometer*.

I have recently suggested such an instrument for measuring the heating effect of the sun, which has been tried at various stations, and appears to work well. It consists of a thick hollow cube of brass, surrounded with felt, and then again with a covering of polished brass. Into the interior of this chamber a suitable thermometer is inserted, its bulb being exactly in the centre. There is a small hole in one of the sides, through which the heat of the sun condensed by a lens is made to fall upon the bulb of the thermometer, the instrument having a motion in altitude and azimuth so as to enable it to catch the sun readily. The exposure is made for a definite time, as given by a good chronometer.

Instruments of this kind have been established in various places and at various elevations, and we shall certainly be able to derive from them information of importance as regards the meteorology of the place. To what extent we shall be able by their means to separate between the two apparent causes of solar variability, namely, that due to an intrinsic change in the sun itself, and that due to a change in the constitution of the earth's atmosphere, is perhaps an open question. It may be hoped that such an instrument may at least enable us to advance the problem, even if it prove insufficient to bring it to a complete solution.

Again, Professor Sir Henry Roscoe has invented an instrument intended to record the effect of the sun in blackening chloride of silver. He is able to prepare a paper of a standard sensitiveness, which, by an automatic arrangement, is exposed for known intervals of time. This is an instrument from which we shall no doubt obtain valuable information, more especially as the more refrangible rays of the sun play an important part in terrestrial economy. Still, however, it does not at first sight escape the objection above mentioned, or enable us to discriminate between the two apparent causes of solar variability—the celestial and the atmospheric.

It has been remarked by the Solar Physics Committee, in their report to the British Government (page 66) that by comparing with a standard certain definite regions of the solar spectrum, unabsorbed by any of the constituents of the earth's atmosphere, we might be able to ascertain any variation in the quantity or in the quality of the true solar radiation. This leads me to inquire what means we have at present of estimating the amount of any particular kind of ray which we receive from the sun. In the first place, we have the recent extension by Captain Abney of the powers of photography, in virtue of which it is not too much to assert that we can now obtain a complete map of the solar spectrum, with its absorption lines extending greatly beyond the visible spectrum on either side. We have also the invention and successful construc-

[1] Continued from p. 425.

tion by Professor Langley of his Bolometer, which is an instrument for detecting and measuring small quantities of radiant heat much more sensitive than the thermopile. It depends upon the fact that the electrical resistance of a metal is increased as it rises in temperature. Suppose, now, that two circuits conveying equal and opposite currents meet in a galvanometer, the needle will of course remain at rest. If, however, a portion of one of these two circuits be heated, its resistance will be increased, and the current passing through it will thus be diminished. The two opposing currents will now no longer balance each other, and in consequence the galvanometer needle will be deflected.

In the bolometer the two circuits each contain a sheet of extremely thin platinum foil, so that a very small quantity of radiant heat falling upon these may produce a considerable result. These sheets may be compared to the two faces of the pile, and if the one be heated we shall have a current in the one direction, while if the other be heated we shall have a current in the opposite direction. By this instrument Professor Langley has determined with much precision the exact distribution of energy in the solar spectrum. But he has done more than this: he has carried his instrument up to the top of Mount Whitney, in America, and has thus procured us much information regarding the absorbent effect of the various constituents of the earth's atmosphere.

The following diagram (Fig. 10) exhibits the result of his researches. In it the lower band represents the solar spectrum as obtained by a perfect method. The shaded curve above the spectrum represents the observations made by Professor Langley with his Bolometer at the foot of the mountain. We have next a dotted curve derived from observations at the top of the mountain, and, finally, another representing the probable curve of solar energy above the limits of the atmosphere. It follows from these curves that if we could view the sun beyond the limits of the atmosphere the light would be decidedly blue.

There can be no doubt that the improved process of photography devised by Captain Abney, and the Bolometer of Professor Langley, furnish us with excellent differential instruments by which we may compare at any place and moment the relative distribution of solar energy over the various parts of the spectrum.

If either of these observers could produce such a uniformity in his process that his results of to-day should be exactly comparable with those ten or twelve years afterwards, then his method would go far to obtain for us the requisite information regarding solar variability. But I fear that we cannot expect this, at any rate for some time to come. As it is, we learn by the foregoing diagram what are the regions of the solar spectrum most affected by the selective absorption of the components of the earth's atmosphere, for Professor Langley imagines that the gaps in the shaded curve are caused by this means.

Let me now venture, in conclusion, to make the following suggestion. By aid of the information furnished by the instruments now described, let us select certain regions of the spectrum for which in the shaded curve there are no gaps, and in the spectrum below it no corresponding dark lines; that is to say, regions for which there is no selective absorption. Now let us throw the energy from these selected regions either upon the standard sensitive paper of Roscoe's actinometer, or upon the thermometer of a suitable heat-actinometer, or upon both.

We shall by this means greatly simplify the problem under consideration, since these instruments will now be recording the intensity from year to year of those portions of the solar spectrum which are not subject, as far as we know, to selective absorption from the variable constituent of the atmosphere of the earth.

It is possible that the rays which blacken chloride of silver are rays on which this variable constituent exercises little or no selective absorption, although the general absorption of these rays is no doubt very considerable; in this case no special adaptation to the chemical actinometer would be necessary.

To conclude, I think we may entertain a well-grounded hope that by patience and persistence in these or similar means, we shall ultimately arrive at a definite solution of this very interesting and important problem.

BALFOUR STEWART

(*To be continued.*)

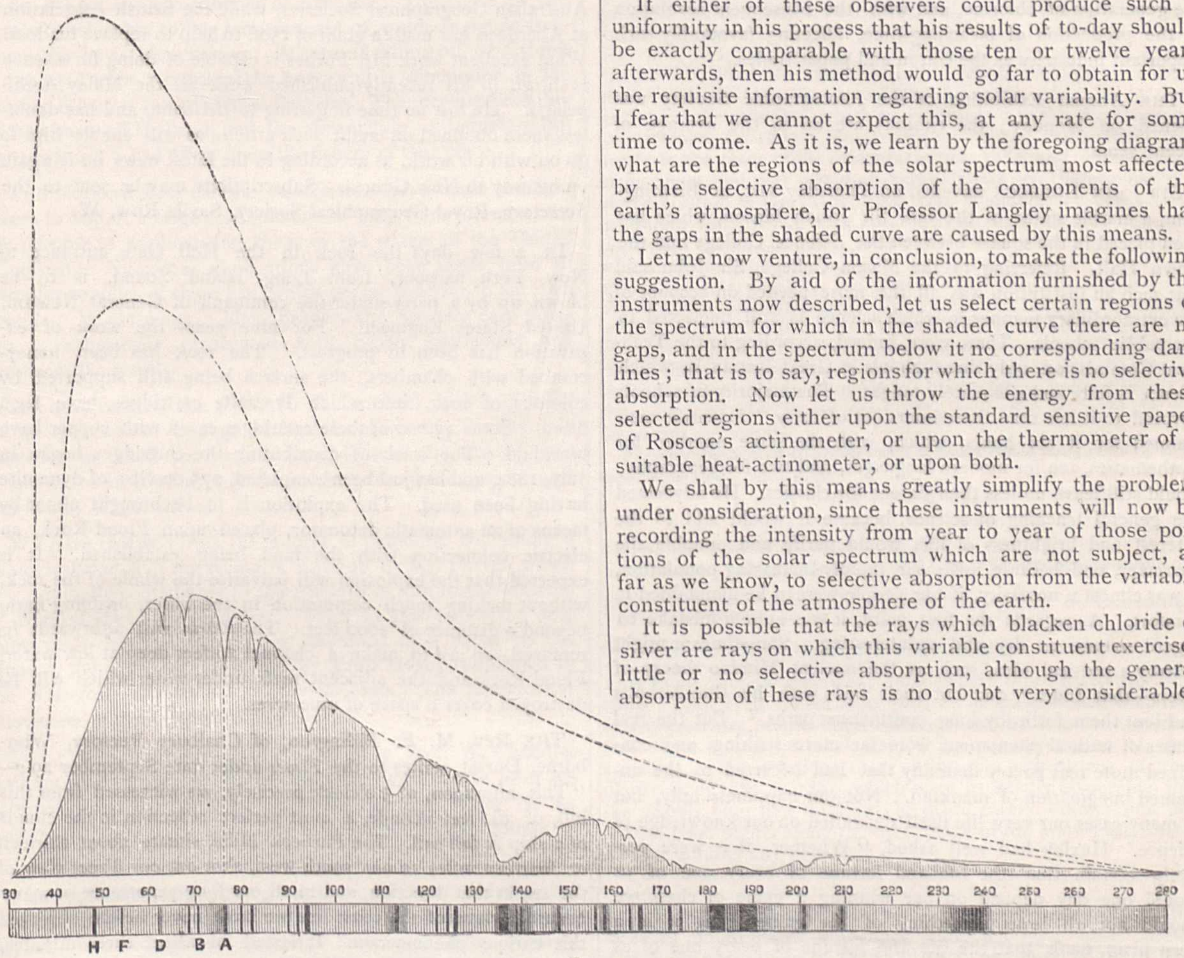

Fig. 10.

NOTES

THE Geological Congress met last week at Berlin. England was represented by Messrs. Geikie, Hughes, Bauermann, Hinde, Marr, Topley, White, Woodall, Lieut.-Col. Tabuteau, and

Capt. Shelley. Altogether there were 248 members, representing Germany, Austria, Belgium, Spain, the United States of America, France, India (Mr. Blanford), Italy, Japan, Norway, Holland, Portugal, Roumania, Russia, Sweden, and Switzerland.

MR. W. H. WHITE, who has succeeded Sir N. Barnaby as Director of Naval Construction, has entered upon his duties at the Admiralty.

WE regret to learn of the death of Walter Weldon, F.R.S., the eminent technical chemist, in his fifty-third year. Mr. Weldon's name is well known in connection with the Weldon process for the regeneration of the manganese peroxide used in the generation of chlorine, and with the consequent revolution in the production of bleaching-lime, affecting favourably such important industries as the cotton and paper trades.

THE Annual Exhibition of the Photographic Society was opened on Monday; the exhibits are up to the average of recent years.

SIR JOHN LUBBOCK unveiled on Thursday last, at Birmingham, a marble statue of the late Sir Josiah Mason, which has been placed in the square between the Science College and the Town Hall. Referring to the Mason College, Sir John said that such an institution was all the more needed on account of the extraordinary manner in which science is still neglected in our public schools. There were, indeed, according to the Technical Commission, only three schools in Great Britain in which science is fully and adequately taught. The majority of schools devoted to it less than three hours out of forty. Scientific men claimed for it six hours, which, with the same number for mathematics, ten for modern languages, and two for geography, would still leave no less than sixteen for classics. He advocated the general teaching of science, because it would add to the interest and brightness of life, would purify and ennoble the character, and because, with our rapidly-increasing population, it was almost a necessity, if our people were to be maintained in comfort. As regards the first point, it was quite a mistake to regard science as dry and uninteresting. Sometimes it might destroy a poetical idea, such as the ancient Hindoo theory of rivers—that Indra "dug out their beds with his thunderbolts and sent them forth by long continuous paths." But the real causes of natural phenomena were far more striking, and contained more real poetry than any that had occurred to the untrained imagination of mankind. Not our happiness only, but in many cases our very life itself depended on our knowledge of science. Huxley had well asked, "Whether, if it were perfectly certain that the life and fortune of every one of us would one day depend on our winning a game of chess we should not all learn something of the game. Yet it is a very plain truth that the life and fortune of every one of us depend on our knowing something of the rules of a game infinitely more difficult. It is a game which has been played for untold ages, every man and woman of us being one of the two players. The chessboard is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. The player on the other side is hidden from us. We know that his play is always fair, just, and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well the highest stakes are paid with overflowing generosity, but one who plays ill is checkmated—without haste, but without remorse." The national necessity for science was most imperative. Even now we required to purchase food to the amount of 150,000,000*l*. a year. A century hence our coal would be approaching exhaustion, our population would be trebled, and we should require, to speak moderately, 400,000,000*l*. to pay for food. Nothing but the development of scientific training and appliances would enable us, under these circumstances, to maintain our population in happiness and comfort. We had, in fact, the choice between science and suffering.

MR. H. H. JOHNSTON appeals in the *Times* for subscriptions to make good the loss which Mr. H. O. Forbes has sustained while embarking at Batavia for his exploring journey in New Guinea. The boat which was carrying all his baggage on board ship suddenly capsized, and the unfortunate explorer in a few seconds lost all his equipment, a loss which it would probably take about 1000*l*. to replace. Mr. Forbes, it may be remembered, was subsidised by the Royal, the Scottish, and the Australian Geographical Societies, while the British Association at Aberdeen has made a grant of 150*l*. to help to replace his loss. What excellent work Mr. Forbes is capable of doing for science is shown in his recently-published work on the Malay Archipelago. He lost no time in getting to Brisbane, and has doubtless there obtained on credit such articles as will enable him to go on with his work, as according to the latest news he is again on his way to New Guinea. Subscriptions may be sent to the Secretary, Royal Geographical Society, Savile Row, W.

IN a few days the rock in the Hell Gate entrance to New York harbour, from Long Island Sound, is to be blown up by a party under the command of General Newton, United States Engineer. For nine years the work of excavation has been in progress. The rock has been honeycombed with chambers, the surface being still supported by columns of rock, into which dynamite cartridges have been fitted. Some 45,000 of these cartridges cased with copper have been laid. The work of distributing the cartridges began in July, 1884, and has just been completed, 275,000 lbs. of dynamite having been used. The explosion is to be brought about by means of an automatic detonator, placed upon Flood Rock, an electric connection with the land being established. It is expected that the explosion will pulverise the whole of the rock, without making much commotion in the water, or doing harm beyond a distance of 1000 feet. The *débris* will afterwards be removed, so as to make a channel 26 feet deep at low water. Flood Rock and the adjacent reefs under water which will be destroyed cover a space of nine acres.

THE Rev. M. F. Billington, of Chalbury Rectory, Wimborne, Dorset, writes to the *Times* under date September 29:—"This afternoon, at 5 o'clock precisely, we witnessed from this hill, of 360 feet altitude, a most perfect reflection in the clouds of a ship in full sail. The Purbeck Hills, situate about thirteen or fourteen miles to our south-west, shut out our direct view of the sea in that direction, and in all our long experience of many beautiful views of the coast line we have never before observed this curious phenomenon. It lasted for about three minutes, and then slowly faded out of sight."

ON September 29, between 8 and 9 p.m., a mirage somewhat similar to that described last week (p. 541) was again observed by many persons at Valla in Sweden. The entire lower part of the north-western horizon shone with a lurid glare, above which was a cloud-bank assuming the most remarkable forms. From time to time animals, trees, and shrubs were seen. Soon a bear changed into an elephant, and soon a dog into a horse. Later on groups of dancers were seen, men being distinguished from women. Further north the cloud formed an oak forest, in front of which was a valley, and nearer still a park with sanded paths. At about 9.30 the cloud sank into a mass, and the phenomenon disappeared.

THE Royal Microscopical Society will meet at King's College, W.C., on Wednesday, the 14th inst., at eight o'clock, when the following papers will be read:—Dr. Maddox: On the Feeding of Insects with Bacilli. Mr. T. B. Rossiter: On the Gizzard of the Larvæ of *Corethra plumicornis*.

ARRANGEMENTS are being made for the establishment of a Zoological Garden in Christiania.

DURING last week a series of experiments were carried out upon North Sea trawling vessels with a view to lighting them by electricity. The attempt was on the whole satisfactory. The introduction of electric light into fishing-boats would prove invaluable, but the heavy expenditure involved in such a scheme would exclude its general usage.

THE United States Fish Commission report a great decrease in the halibut and cod fisheries of America. The cause for this is attributed either to low temperatures of water or the destruction of fry by reckless fishing. A general falling off of flat-fish is reported from Germany this year, and a diminution in the herring fishery is recorded from Belgium. The increased number of fishermen off Holland and the destruction of immature fish has produced a bad effect upon the fishery of that place.

THE National Fish Culture Association have made arrangements to import a large consignment of carp from Germany for the purpose of acclimatising them to the waters of the United Kingdom. Numerous applications have been made from all parts for supplies of these fish, which are far superior to our own species. In Germany, China, France, and America carp farming is extensively prosecuted with highly satisfactory and remunerative results.

WE have received the report for the summer session of 1885 of the Queenwood College Mutual Improvement Society. It describes in detail the various excursions of the session, and would make an admirable guide for the parts of Hampshire and the Isle of Wight visited.

WE have received from the author a pamphlet containing a geological sketch of the Island of Antigua, by Mr. Purves, which was originally contributed to the *Bulletin* of the Royal Museum of Natural History of Belgium. Prior to this paper the only information on the subject was contained in a paper by Dr. Nugent, published in 1819, and by Prof. Hovay, published in the *American Journal of Science* in 1839. The pamphlet is illustrated by a geological sketch map.

THE Queen has been pleased to grant to Prof. W. Chandler Roberts, F.R.S., of the Royal Mint, authority to use after his paternal name the name of his uncle, the late Major N. L. Austen, J.P., of Haffenden and Combourne, in the county of Kent.

THE additions to the Zoological Society's Gardens during the past week include a Toque Monkey (*Macacus pileatus* ♂) from Ceylon, presented by Mr. Septimus Smith; a Green Monkey (*Cercopithecus callitrichus* ♂) from West Africa, a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mr. S. T. K. D. Potter, F.R.G.S.; six Indian Fruit Bats (*Pteropus medius*) from India, presented by Mr. W. Jamrach; two Canadian Skunks (*Mephitis mephitica*) from North America, presented by Dr. C. Hart Merriam, C.M.Z.S.; a Common Badger (*Meles taxus*), British, presented by Lord Egerton of Tatton, F.Z.S.; a Ring-necked Parrakeet (*Palæornis torquata*) from India, presented by Mrs. Douglas; a Common Barn Owl (*Strix flammea*), British, presented by Miss Linda Raven; two Common Guinea-Fowls (*Numida cristata*), British, presented by Mr. C. H. Hopwood, M.P.; a Loggerhead Turtle (*Thalassochelys caouana*) from the Atlantic Ocean, presented by Mr. A. Duncan Fraser; four Hog-nosed Snakes (*Heterodon platyrhinos*), a Say's Snake (*Coronella sayi*), two —— Snakes (*Coluber alleghaniensis*), an American Black Snake (*Coluber constrictor*) from Indiana, North America, presented by Mr. F. J. Thompson; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Great Biid of Paradise (*Paradisea apoda*) from the Aroo Islands, a Common Cormorant (*Phalacrocorax carbo*), British, an Emu (*Dromæus novæ-hollandiæ*) from Australia, a Gigantic Salamander (*Megalobatrachus maximus*) from Japan, deposited.

OUR ASTRONOMICAL COLUMN

THE SATELLITES OF URANUS AND NEPTUNE.—In Appendices I. and II. of the Washington Observations for 1881, Prof. Asaph Hall has published the results of his investigation of the orbits of the outer satellites of Uranus, *Oberon* and *Titania*, and the satellite of Neptune. The satellites of Uranus were amongst the first objects observed with the 26-inch refractor of the Naval Observatory, after it was mounted in November, 1873. The first series during the oppositions of 1874 and 1875 were discussed by Prof. Newcomb, with the view to the determination of the mass of the planet, and the formation of tables of the motions of the satellites, which were published in the Washington Observations for 1873. Remarking that as the earth would be nearly in the plane of the orbits in the year 1882, and observations made about that year would probably afford a good determination of the position of this plane, Prof. Hall commenced a new series in March, 1881, which were continued through the four oppositions until the end of May, 1884; these observations were made with magnifiers of 606 and 888; in fair conditions of the atmosphere the outer satellites are stated to be easily observable with the Washington instrument. A comparison of the measures with Prof. Newcomb's tables showed that those tables required but small corrections, which were found by equations of condition in the usual manner. It should be mentioned that the tables were founded mainly upon Prof. Newcomb's own measures; those by Prof. Hall in the years 1875 and 1876 are included in his recent discussion.

For the position of the nodes and inclination of the orbits of the satellites, Prof. Hall finds—

$$N = 165^\circ{\cdot}81 + 0^\circ\ 0142t$$
$$I = 75^\circ{\cdot}30 - 0^\circ{\cdot}0014t$$

t being the number of years from 1883·0.

The mean value of the mass of Uranus by the observations of *Oberon* is $\frac{1}{22603}$, and by those of *Titania*, $\frac{1}{22833}$, or, combining the values with their respective weights, the final result is $\frac{1}{22682}$. This value, though somewhat smaller than those previously obtained, Prof. Hall thinks is as good as he could obtain with the filar-micrometer of the large refractor, and he does not consider that there would be much gained by a continuation of the measures. He mentions that during the oppositions of the planet from 1881 to 1884, which were especially favourable for the search after new satellites, he made careful examination on several good nights along the orbit plane of the known satellites, without finding any new ones.

The orbits of *Oberon* and *Titania* appear to be sensibly circular.

Prof. Hall's discussion of the elements of the orbit of the satellite of Neptune is founded upon his own observations during the oppositions of 1875 and 1876, and those of 1881—84; in addition, he has made use of Prof. Holden's measures in the interval 1874 December—1878 November, and has also discussed those of Lassell and Marth taken at Malta in 1863 and 1864. Prof. Newcomb's elements are corrected by the formation of equations of condition and their solution, as in the case of the satellites of Uranus. The following are the principal results:—

$$N = 184^\circ{\cdot}32 + 0^\circ{\cdot}0095t$$
$$I = 120^\circ{\cdot}05 + 0^\circ{\cdot}0005t$$

t being counted from 1883·0.

Comparing the observations of 1881—84 with those of Lassell and Marth, the periodic time is found to be 5·876839 mean solar days; that deduced by Mr. Hind, which was adopted by Prof. Newcomb in his tables, is 5·8769 days; the small difference would produce a change of about 5° in the true position of the satellite in its orbit at the beginning of next century, and Prof. Hall leaves it to future observations to decide whether his correction is required.

The values of the mass of Neptune from his measures at different oppositions, and from those of Lassell and Marth and of Holden differ sensibly. The mean result from Hall's own observations is $\frac{1}{19092}$; he remarks that his distances are generally smaller than those of other observers, and believes that, in order to eliminate the effect of such personal equation from the determination of the mass of a planet, the only way will be to increase the number of observers and to take a mean of their results. Hall's value approaches nearly to that found by Prof. Newcomb, $\frac{1}{19380}$.

On favourable nights examinations of the region about Neptune were made, but no other satellite was detected.

VARIABLE STARS (1).—The following Greenwich times of geocentric minima of Algol have been deduced from elements corrected by the later observations of Schmidt:—

		h. m.			h. m.
November	8	15 7	December	7	7 16
	11	11 56		18	18 33
	14	8 45		21	15 22
	17	5 34		24	12 11
	28	16 49		27	9 0
December	1	13 38		30	5 49
	4	10 27			

(2) R Leonis will now be approaching a maximum; there would appear to be indications of a sensible perturbation in the period during the last twenty years or more. (3) V Piscium, one of Argelander's supposed variables, is now favourably placed for observation; his estimates vary from 6·7 m. to 9 m.; the position of this star for 1885·0 is in R.A. 1h. 48m. 18s., Decl. + 8° 12′·9. (4) Argelander's formula of sines makes a maximum of *Mira Ceti* due on December 19, but it may probably occur earlier.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *OCTOBER* 11–17

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on October 11

Sun rises, 6h. 20m.; souths, 11h. 46m. 41·8s.; sets, 17h. 14m.; decl. on meridian, 7° 11′ S.: Sidereal Time at Sunset, 18h. 36m.

Moon (three days after New) rises, 9h. 40m.; souths, 14h. 28m.; sets, 19h. 13m.; decl. on meridian, 15° 18′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	5 55	11 35	17 15	4 35 S.
Venus	10 17	14 23	18 29	21 28 S.
Mars	0 11	7 49	15 27	17 44 N.
Jupiter	3 54	10 16	16 38	3 38 N.
Saturn	21 8*	5 16	13 24	22 18 N.

* Indicates that the rising is that of the preceding day.

Phenomena of Jupiter's Satellites

Oct.	h. m.		Oct.	h. m.	
12	4 37	IV. ecl. disap.	14	4 50	I. tr. egr.
13	4 51	I. ecl. disap.	16	4 7	II. tr. ing.

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Oct.	h.	
11	12	Venus in conjunction with and 6° 23′ south of the Moon.
16	10	Mercury in superior conjunction with the Sun.
17	2	Venus at greatest distance from the Sun.

GEOGRAPHICAL NOTES

ACCORDING to the report by Lieut. Wissmann on his last exploration in the Congo region, the Lower Kassaï constitutes a magnificent fluvial artery, frequently of enormous breadth, and leads without obstacle into the heart of the new Congo State. Between the station of Kwamouth and the confluent of the Lulua and above the station of Luluaburg the Kassaï, with a breadth of about 600 kilometres, is everywhere open for navigation. It runs through a country of wonderful fertility, presenting alternately plains and virgin forests, and inhabited by a dense population. With about one exception the travellers have been received everywhere with eagerness by peaceable tribes, all disposed to trade. During the forty-two days employed in the voyage from Luluaburg to Kwamouth the health of the expedition was excellent. There was no loss of life, except that two natives were drowned in the rapids of the Lulua. The five white men and the 200 Negroes of the Expedition arrived all in good health at Léopoldville on July 16.

THE current number of *Petermann's Mittheilungen* contains the conclusion of M. Thoroddsen's paper on a lava desert in the interior of Iceland. It supplies certain geographical and scientific observations of the writers, such as the superficial dimensions, height, &c., hydrography, climate, geology, volcanoes, glaciers, botany, and zoology of the interior of Iceland. Herr Hassenstein describes, with a large map, Bohndorff's journeys in Central Africa between 1874 and 1883. The usual geographical information for the month, and account of the literature concludes the number.

THE most interesting contribution, however, to *Petermann* this month is a short prefatory sketch on the history of the great geographical house of Perthes of Gotha, September 11 being the centenary of its foundation. In 1801 the first geographical work was published by Perthes, and in 1809 he published a large atlas by Prof. Heusinger. Under the second proprietor, Wilhelm Perthes, who was head of the establishment between 1816 and 1853, the publications of the house assumed their geographical and cartographical character. In 1817 appeared the first edition of Stieler's Atlas, consisting of fifty maps, and between 1823 and 1831 a supplement of twenty-five more was added. This Atlas has now for nearly seventy years been the principal work published by the house of Perthes. It has been kept up to date, and the number of the maps, which in 1862 was 84, grew in 1871 to 90, and in 1879 to 95. The total number of maps, old and new, amounts to 197. Besides Stieler, Berghans (1797-1884), Spruner and Sydow supported Perthes. In 1832 Berghans's great atlas of the extra-European countries appeared. It was a financial failure, but it carried the name of the house abroad, and laid the foundation of its world-wide fame. In 1838 the publication of the same author's Physical Atlas in 93 maps was completed. Between 1837 and 1852 Spruner's Historical-geographical Atlas appeared, and was followed by various editions. Wilhelm Perthes died in 1853, and Bernhardt Perthes reigned in his stead for only four years, leaving a posthumous son, the present Justus Perthes. Petermann, who died in 1878, commenced his celebrated *Mittheilungen* in 1855. The publications of the house since that date are well-known to all geographers; Behm's "Geographical Year-Book," and Behm and Wagner's "Population of the Globe," are works of world-wide celebrity.

ON Friday last, after an absence of nearly three years, the Danish exploration expedition to the east coast of Greenland, under Lieutenants Holm and Garde, returned to Copenhagen in the ship *Constance* from Godthaab. We have from time to time given particulars of the progress of this expedition, the chief object of which was to penetrate as far north along the east coast as possible, and to attempt to reach certain native settlements known to exist between latitudes 65° and 66° N. The expedition has fulfilled all expectations, besides the collection of a valuable scientific material, Lieut. Holm having wintered in lat. 65°-66°, the highest point reached being lat. 66·08° N., the northernmost ever reached by Europeans. Lieut. Holm is stated to have made some very valuable geographical and ethnographical discoveries, having spent last winter among East Greenlanders never before visited by Europeans. He has named the stretch of coast explored, King Christian IX.'s Land.

A WRITER who has travelled widely through Tonquin and Southern China describes, in a recent number of the *République Française*, the route from Lao-Kai, on the Red River, to Mengtsze in Yunnan. Premising that the river from the mouth to Lao-Kai, on the Tonquin border, is tolerably well known, he refers to the various routes for getting into South-Western China, but is far from enthusiastic about any of them, although he thinks that France in Tonquin has as much chance of getting the China trade as any of her rivals in the south. The writer then describes the route along the river from Lao-Kai to Manhao, the head of the Red River navigation. From this point the road to the plateau of Yunnan is said to be mountainous and difficult in the extreme. The article is of special value at the present moment, when the question of trade routes into South-Western China has assumed so much prominence.

THE BRITISH ASSOCIATION

SECTION C—GEOLOGY

Some Results of a Detailed Survey of the Old Coast-Lines near Trondhjem, Norway, by Hugh Miller, F.G.S., H.M. Geological Survey.—During a short visit to Norway in October, 1884, it appeared to the author that the best way to help to a solution of the vexed questions connected with the coast-terracing of Norway was to execute a careful survey of a few square miles of some suitable coast-region upon a sufficiently large scale. The neighbourhood of Trondhjem is remarkably well suited to this purpose. The map employed was partly a municipal chart on the scale of 1-10,000, and partly an enlargement of the Ordnance map. The limit of all the terraces and marine deposits is the famous "strand line" west of the town, a double range of old coast-cliff cut in the rock of the mountain-side. Its upper line is 580 feet above the sea, and answers to the "marine limit" over Norway generally. Numbers of level terrace-lines have been incised—chiefly in greenish clays, like brick-clays—all along the arable slopes east of the town between this rock-terrace and the sea. Above the Bay of Leangen, two miles east of town and river, and far beyond all erosive influence of the latter, thirty of these lines were mapped one above another in the first 300 feet of ascent, a distance of one and a half mile. Many of these are small but extremely distinct, the earthy clays being well suited to retain sharp impressions of successive sea-margins, which these unequivocally are. The present coast-line, neatly etched out by the waves in Trondhjem and Leangen Bays, is the key to these tiers of older ones. It also resembles them in having made little or no impression where the coast becomes rocky, the lines of incision in both cases stopping short at once when they reach the harder material. The old coast-lines are most numerous in well-sheltered positions. Thus a single pair of large terraces in an exposed situation east from Christiansten, where they face the open water of the fjord and the prevalent north-westerly storms, is represented in the recess above Leangen Bay by ten or twelve. The same fact is brought out on rising from this recess to the higher and more exposed ground. Thus, while thirty-three or thirty-four terraces are mapped below 350 feet (approximate) elevation, only nine or ten appear between that level and the rock-terraces of the upper marine limit, the numerical average height of the terraces thus rising by more than a half. In recesses of the coast further east, but beyond the map, these upper terraces seem to be preserved in considerably greater numbers. The number actually mapped was forty-three, or, with the two rock-terraces, forty-five. The largest number of terraces hitherto described at any one place in Norway seems to have been eighteen. Some of the general conclusions of the author are as follows :—(1) These terraces are all post-glacial, *i.e.* formed since the rock-glaciation of the district. This is confirmed by the condition of the high coast-cliff, which has been cut in ice-rounded rock, but is not itself glaciated. It appears, however, from the fauna of the raised shell-banks of the country (as worked out by Sars and Kjerulf), in which recent shells do not rise above 380 feet, that the seas of the upper levels were still glacial ; and, though the Trondhjem fjord was free from land-ice, other deeper fjords and higher coasts may still have had glaciers coming into conflict with the sea, and producing the glaciated rock-terraces described by Sexe. All the evidence obtained discountenances Sexe's view that these rock-terraces were cut out by glaciers, as well as Carl Petersen's that they were rasped out by floating ice coasting the shores. On the clay terraces coast-ice has left no more sign of its presence than the winter freezing of our British rivers leaves upon our river-terraces. (2) If the country was upraised by a succession of elevatory jerks, as supposed by most geologists from Keilhau downwards, most of these would seem to have been small—much smaller, at least, than is supposed by Kjerulf. It is improbable that even Leangen Bay was secluded enough to contain a record of all the original coast-lines. The longer pauses and greater storms may have effaced an unknown number by a process of excision exemplified in all its stages by the map. It is hard to say, in fact, where the subdivision would end if all were preserved. The smaller terraces remind the eye of the incised lines and little planes engraved on the sandbanks bordering the rivers after a flood, in which case there is no periodicity in the subsidence of the waters. (3) The preservation or excision of the terraces thus seems to depend as much upon local circumstances—exposure to storms, resistance of coast-line, &c.—as upon anything else. It is impossible at present to predicate which of them shall in any given place remain. Whether elevation by jerks, therefore, be postulated or not, all hope of correlating these terraces throughout the country must be deferred until their heights have been accurately determined by level. The measurements hitherto made, not even excepting those of Profs. Kjerulf and Mohn, are probably inadequate for the purpose. This observation seems to apply also to the terraces graven in rock. In their aneroid measurements of the upper strand-line at Trondhjem these observers differ by 55 feet. (5) On entering the mouth of the Trondhjem Valley the terraces come under an influence other than that of the sea-waves. The valley was worked out, in deposits partly levelled out by the sea, according to the laws of river-terracing under the accelerating influences of a falling sea-level. The processes of automatic river-terracing are beautifully exemplified within the district mapped in the deep lobe-shaped curve of the river just before it enters the sea. The terraces have been added one after another to the point of the lobe of land thus surrounded, which is known as Öen.

The Glacial Deposits of Montrose, by Dr. J. C. Howden.—These consist, in order of age—(1) a marine clay containing fossils of a purely Arctic type, apparently the bottom of a deep sea. Above this is seen the estuarine clay, beneath which, however, are often found deposits of peat. Over the estuarine clay is a bed of stratified sand, and above that a dense non-fossiliferous Carse Clay, varying in thickness from 4 to 6 feet. The sequence of these deposits was held by the author to indicate interglacial periods.

Irish Metamorphic Rocks, by G. H. Kinahan, M.R.I.A.—This paper is an epitome of what is known as to the age of the Irish Metamorphic rocks.

Barium Sulphate as a Cementing Material in Sandstone, by Prof. Frank Clowes, D.Sc.—The author described the "Hemlock stone" and other similar blocks of Lower Keuper sandstone in the neighbourhood of Nottingham. They stand out in hard masses from the more easily denuded sandstone around them. Analysis has shown that the cementing material of the upper part is barium sulphate. This being practically insoluble withstands denudation and protects the lower part from waste, this lower part being mainly cemented by calcareous matter. Bischof has proved the occurrence of barium sulphate as a cementing material in some foreign sandstones, but the fact is probably new in Britain.

On Deep Borings at Chatham. A Contribution to the Deep seated Geology of the London Basin, by W. Whitaker, B.A., F.G.S., Assoc.Inst.C.E.—A few years ago the Admiralty made a boring in the Chatham Dockyard extension, to the depth of 903½ feet, just reaching the Lower Greensand, and in 1883-84 followed this by another boring near by. After passing through 27 feet of Alluvium and Tertiary beds, 682 of chalk, and 193 feet of Gault, the Lower Greensand was again reached ; but, on continuing the boring, was found to be only 41 feet thick, when it was succeeded by a stiff clay, which, from its fossils, is found to be Oxford clay, a formation not before known to occur in Kent. At its outcrop, about seven miles to the south, the Lower Greensand is 200 feet thick, and is succeeded, a little further south, by the Weald Clay, there 600 feet thick. Not only, however, has this 600 feet of clay wholly disappeared, but also the whole of the next underlying set of deposits, the Hastings beds, which crop out everywhere from beneath the Weald Clay, and are also some hundreds of feet thick. More than this, the Purbeck Beds, which underlie the Hastings Beds near Battle, are absent, and also the Portlandian, Kimmeridge Clay, Corallian, &c. ; beds which have been proved above the Oxford Clay in the sub-Wealden Boring, to the great thickness of over 1600 feet. We are therefore faced with a great northerly thinning of the beds below the Gault, a fact agreeing in the main with the evidence given of late years by various deep wells in and near London. Three other deep borings have been made or are being made near Chatham, all of which have passed through the Chalk into the Gault, and one has gained a supply from the sand beneath. The practical bearing of the Chatham section is, however, to enforce the danger of counting on getting large supplies of water in the London Basin from the Lower Greensand by means of deep borings at any great distance from its outcrop. Even if Lower Greensand occur at all in such places, it will probably be in reduced thickness, and therefore with reduced water-capacity.

American Evidences of Eocene Mammals of the "Plastic Clay" Period, by Sir Richard Owen, K.C.B., F.R.S., G.S., &c.—In the year 1843 a fragment of a lower jaw with one entire molar of a mammal was dredged up off the Essex coast. A canine tooth of the same was found in a well-sinking near Camberwell, in piercing the "plastic clay." The author had described the above as belonging to an animal of the Lophiodont family, and proposed for it the generic name Coryphodon. Shortly afterwards De Blainville had noticed certain fossils as "probably Coryphodont," but had referred them to *Lophiodon anthracotherium*. Ten years later Prof. Hébert had recognised two species of *Coryphodon* in the plastic clay of France. Explorations by Leidy, Marsh, and Hayden, in the "Mauvaises Terres" of Nebraska had led to the discovery of a large hoofed mammal allied to *Coryphodon*, to which the name *Titanotherium* had been given, and Prof. Cope has now recognised, from Evanstown, Wyoming, seven species of *Coryphodon*. From these materials, which have been rendered accessible to European palæontologists by the superb volume of reports recently issued by the United States Government, the author is enabled to give a general description of this family of hoofed mammals of large size which flourished in early Eocene times. To the details of this the major part of the paper is devoted.

Some Results of the Crystallographic Study of Danburite, by Dr. Max Schuster.—In studying the characters of the faces and the structure of the Danburite crystals found in Switzerland the author has met with vicinal faces of a peculiar kind, for which he proposes the term "transitional faces" (*Tschermak Min. Mittheil.*, vi., 1884, p. 511). Attention is called to the fact that these faces are easily affected by those causes which produce an unequal development of faces otherwise symmetrically disposed, and an illustration is given of the way in which their indices are numerically related to those of the principal faces of the crystal.

Notice of an Outline Geological Map of Lower Egypt, Arabia Petræa, and Palestine, by Edward Hull, LL.D., F.R.S., F.G.S. —The map exhibited was enlarged from that which accompanies the author's book, "Mount Seir, Sinai, and Western Palestine," giving a narrative of the expedition sent out into these countries by the Palestine Exploration Society in 1883–84. It embraces a region extending from the valley of the Nile on the west to the table-land of Edom (Mount Seir) and Moab, including the Jordan, Arabah Valley, and the mountains of Sinai. Its northern limit is the Lebanon. The main lines of fault and dip of the strata are also indicated. A topographical and geological map of the Arabah Valley on a scale of about six miles to one inch was in preparation, and would accompany the Geological Report now in the press for the Palestine Exploration Society.

A Preliminary Note on a New Fossil Reptile recently discovered at New Spynie, near Elgin, by Dr. R. H. Traquair, F.R.S.—Of this most important fossil the author had as yet only seen a photograph submitted to him by Prof. Judd, the President of the Section. This photograph represents pretty nearly a vertical longitudinal section of a reptilian skull, of which one very prominent feature is the presence of a large conical tusk in the upper jaw, projecting downwards and forwards, immediately behind the premaxillary part of the skull. This tusk is seen only in impression, but the cast of the internal cavity which is well shown indicates that it grew from a permanent pulp. No evidence of any other teeth is visible, and the whole appearance of the skull as seen in the photograph, with the position and shape of the tusk, indicate that the reptile here represented, if not actually belonging to the genus Dicynodon, is certainly a member of the group of Dicynodontia. Geologists will not underrate the importance of this discovery in its bearing on the question of the age of the reptiliferous sandstone of Elgin.

On the Average Density of Meteorites compared with that of the Earth, by the Rev. E. Hill, M.A., F.G.S.—The average density of the meteorites which fall on the earth is attempted to be calculated. Different methods give as results 4·55, 4·58, 4·84, 5·71, the last value being influenced by the size of one particularly large metallic specimen. The average density of the earth is usually regarded as 5·6. Meteorites are samples of the materials of space. A mass of them would aggregate into a body of density not widely differing from that of the earth. The densities of the other planets are not inconsistent with a like origin. Consequently any theory of the genesis of the earth from pre-existing materials involves a probability that an important part of its nucleus is metallic.

On the Occurrence of Lower Old Red Conglomerate in the Promontory of the Fanad, North Donegal, by Prof. Edward Hull, LL.D., F.R.S., Director of the Geological Survey of Ireland.—The district in which the Old Red Conglomerate occurs is formed of ridges and valleys of metamorphic rocks, consisting of beds of quartzite, schist, crystalline limestone, and trap, chiefly diorite. It lies between Lough Swilly and Mulroy Bay, and is washed on the north by the waters of the Atlantic. The remarkable tract of the Old Red Conglomerate, recently discovered by the officers of the Geological Survey, is far remote from any mass of the same formation, and it is unrepresented on any geological map hitherto published. The beds consist of red and purple sandstones and conglomerates, made up chiefly of quartzite pebbles and blocks, but also containing others of limestone and trap; all derived from the surrounding metamorphic series. They occupy an area of over two miles in length and half a mile across, extending along the northern base of Knock Alla, a ridge of quartzite which traverses the promontory from side to side. The beds dip against the base of the mountain, against which they are let down by a large fault, and they terminate along their northern edge by an unconformable superposition on beds of quartzite and limestone. They reach a total thickness of about 800 feet. From the position of these beds it becomes evident that they are unconnected with any of the recognised basins of Lower Old Red Sandstone, either in Scotland or Ireland, and may, therefore, be regarded as having been formed in an isolated basin, which, following the example of Dr. Geikie, I may be allowed to name "Lake Fanad." The tract will be a new feature on geological maps of Ireland.

On Bastite-Serpentine and Troktolite in Aberdeenshire; with a Note on the Rock of the Black Dog, by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., Pres.G.S.—Bastite-serpentine (as noticed some time since by Prof. Heddle) occurs near Belhelvie and on the shore near the Black Dog. The author describes the microscopic structure of this, showing that it consists of olivine and its alteration products, enstatite in various stages of alteration, and a mineral of the spinellid group. Associated with this in the Belhelvie district is a fairly normal troktolite, consisting of a plagioclastic felspar allied to anorthite, olivine, more or less altered, and a little diallage. It closely resembles the typical Volpersdorf rock, but has rather less magnesia and more alumina, corresponding chemically more nearly with a rock described by the author from Coverack Cove, Cornwall. He is of opinion that the two rocks differ somewhat in age, though probably the earlier was still at a high temperature when the latter was intruded, and he inclines to the view that the serpentine is the older rock of the two. The Black Dog has been incorrectly described as consisting of "crystals of *talc* matted in such confusion as to form both a tough and hard rock." The rock really consists of quartz, sillimanite, two kinds of mica, an iron oxide (hematite?), and most probably some dichroite, with perhaps a little kyanite. In short, the rock presents a very close resemblance under the microscope to some specimens of the well-known "cordierite gneiss" of Bodenmais.

On the Re-discovery of Lost Numidian Marbles in Algeria and Tunis, by Lieut.-Col. Playfair, H.M. Consul-General for Algeria and Tunis.—The author explained that the name itself was a misnomer, as they are not found within the limits of Numidia proper, but in the province of Africa and in Mauritania. Most of the "Giallo antico" used in Rome was obtained from *Simittu Colonia*, the modern Chemton, in the valley of the Medgérda, the quarries of which are now being extensively worked by a Belgian company; but the most remarkable and valuable marbles are found near Kleber, in the province of Oran, in Algeria. There, on the top of the Montagne Grise, exists an elevated plateau, 1500 acres in extent, forming an uninterrupted mass of the most splendid marbles and breccias which the world contains. Their variety is as extraordinary as their beauty. There is creamy white, like ivory; rose colour, like coral; Giallo antico; some are as variegated as a peacock's plumage; and on the west side of the mountain, where there has been a great earth-movement, the rock has been broken up and re-cemented together, forming a variety of breccias of the most extraordinary richness and beauty.

On some Rock-Specimens from the Islands of the Fernando Noronha Group, by Prof. A. Renard, LL.D.—The rock-specimens described in this communication were collected by Mr. J. G. Buchanan, during the voyage of the *Challenger*. The islands have been described by Darwin in his "Geological Observations on Volcanic Islands" (2nd edition, p. 27). The author, after having explained the geological structure, gives lithological descriptions of the chief types of the rocks, which may be referred to the phonolites (St. Michael's Mount). These phonolites are composed of sanidine, augite, nepheline, hornblende, magnetite, nosean, and titanite. The rocks of Rat Island are basalts with nepheline. The constituent minerals are augite and olivine. The ground-mass is almost entirely composed of nepheline. Biotite and apatite occur as accessory constituents. The little island known as Platform Island is also basaltic, with a doleritic texture. It is composed of labradorite, augite, olivine, magnetite, and biotite. This rock has undergone alterations.

Preliminary Note on some Traverses of the Crystalline District of the Central Alps, by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., Pres. G.S.—During the past four years I have made several traverses of the Central Alps from north to south, and venture to lay before the Section the general results as bearing in some respect on the geology of the Highlands. (1) The ordinary rules of stratigraphy as learnt from most lowland districts are commonly quite inapplicable to the Alps. The most highly crystalline and the older beds often form the higher parts of a mountain region, the newer the lower. The newer beds frequently appear to underlie and dip regularly beneath the older. Gigantic folds, overturns, and overthrust faults abound. The true stratigraphy of a district can only be worked out by the exercise of patient and cautious induction from observations extended over a wide area. (2) The non-crystalline rocks of the Alps are of various ages. There are some of Carboniferous age, but the great period of continuous deposition generally begins with some part of the Trias. The conglomerates, which often occur at the base of the non-crystalline deposits, indicate that the principal metamorphism of the crystalline series was anterior to both these epochs. There is at present no reason to suppose that either in the Central Alps or for some distance on each side are there any representatives of the earlier Palæozoics. I believe that the conglomerates at the base of the Carboniferous contain fragments of the later crystalline rocks of the Alps as well as of some of the earlier—though I do not assert that these crystalline rocks have undergone no modifications since Carboniferous times. (3) In the heart of the principal Alpine chains, and apparently at the base of everything, are coarsely crystalline gneisses. These differ little from granites, except that they generally—almost always—exhibit a certain foliation, and occasionally seem to be interbedded with thin seams of micaceous schists or flaggy fine-grained beds. (4) On examination we find reason to believe that both the latter are generally due to crushing. Their strike agrees with that of the apparent foliation in these older rocks, and with that of a foliation which is also present in the newer crystalline rocks. This corresponds with the strike of the main physical features of the district, and with the cleavage in the included troughs of sedimentary rock. It runs for great distances with remarkable uniformity. (5) This apparent foliation is due to the devolopment of extremely thin films of a micaceous mineral. In many cases it causes the rock to bear the aspect of a highly micaceous schist; yet, on examining a transverse section, the rock is distinctly seen to be a crushed gneiss—*i.e.* though so conspicuous, it is a mere varnish. As it thus differs materially from a true foliation, it would be convenient to give it a name, and I should propose to call it the "sheen surface." It is, in fact, a kind of "cleavage foliation," that is, a foliation due to cleavage, and subsequent to it. (6) The pressure which has produced this "sheen surface" has in many cases affected the orientation of the minerals, which are present in the true "foliation" layers of the more distinctly foliated, *i.e.* mineral-banded, rocks. (7) In the crystalline schists very commonly the "sheen surface" corresponds with the original foliation surface, as in the slates the cleavage sometimes does with the bedding. This is due to the fact that the axes of the great folds often make a very high angle with the horizon. (8) Thus a non-foliated crystalline rock may be rendered to some extent foliated by pressure (followed by a certain amount of mineralisation): *i.e.* some gneisses may be formed by crushing from granites, some schists out of other igneous rocks. It may obliterate an earlier foliation, or it may intensify it, or it may produce an independent and more fissile foliation. In this sense gneiss may be said to pass into granite, because a rock which is now, both macroscopically and microscopically, a gneiss may prove to be a granite which has in some parts yielded to pressure more than in others. (9) As we pass outwards from the great central granitoid masses we come to gneisses and schists where the evidence of some kind of stratification becomes more marked; bands of crystalline limestone, quartzite, and granulite being associated with mica schist of many kinds—simple, garnetiferous, staurolitic, actinolitic, and the like—the bands of different mineral character and composition varying from mere streaks to layers up to many yards in thickness. In fact the above-named rocks are associated exactly as limestones, sandstones, and clays are associated in the ordinary sedimentaries. (10) Although the crushing of a crystalline rock *in situ*, or the squeezing and shearing of a breccia or conglomerate of crystalline fragments, occasionally gives rise to local difficulties, these are on a small scale, and sedimentary beds belonging to the Palæozoic or later periods of deposition are generally readily distinguishable from the whole of the crystalline series. Though folded and faulted in the most extraordinary manner, the members of the two series can generally be separated and in the Alps there is no evidence of a mingling of the one with the other in the process of rolling out or squeezing together; so that, after patient study and microscopical examination, we can generally decide without hesitation whether a particular set of rocks has originated from the crystalline or the sedimentary series. I do not say that we can always decide whether a schist or a gneiss has originated from an igneous rock or from an older schist or gneiss, but I think that in the Alps we can say that it has originated from one of these. Fortunately, intrusive rocks are very rare in the Palæozoic and later deposits in this part of the Alps. (11) Thus, although the Tertiary metamorphism of the Alpine rocks is very important, it is more pretentious than real, and its effects seem to have been the greatest where it has found a rock already crystalline to act upon. Hence I believe that every true gneiss and schist in the Alps is much older than the Carboniferous, and is probably older than any member of the Palæozoic period.

The Direction of Glaciation as ascertained by the Form of the Striæ, by Prof. H. Carvill Lewis.—As there seemed to be a disagreement between certain Scotch geologists and the Irish geologists regarding the inferences as to direction of glaciation to be deduced from the form of glacial striæ, the author was led to bring forward some observations of his own, made in America and in Great Britain, which threw light upon the disputed point. Well-preserved striæ are frequently blunt at one end and tapering at the other, the shorter ones sometimes resembling the characters used in the cuneiform inscriptions. This form may be seen in striæ of all sizes—from those several yards in length, when the blunt end may be an inch or more in breadth, to the finest scratches, where a microscope is necessary to detect any difference between the two ends. As shown in the Reports of the Boulder Committee of the Royal Society of Edinburgh (Fifth Report, pp. 18–20, 29, 58; Seventh Report, p. 18) and elsewhere, certain Scotch geologists regard the blunt end as the point of impact of the striating agent, and as therefore facing the direction from which the motion came. On the other hand the Irish geologists ("Memoirs of the Geological Survey of Ireland," Explanation to sheets 86, 87, 88, p. 55; Explanation to sheet 193, p. 18, &c.) interpret the shape of the striæ as indicating motion in the opposite direction, believing the tapering end to point to the direction from which glaciation proceeded. The point at issue is of importance, especially in outlying islands and elsewhere, where other indications of the direction of glaciation fail. In Pennsylvania, which is crossed from east to west by the terminal moraine of the great ice-sheet, and where the glaciation is uniformly in a southward direction, the author had observed that the blunt ends of the striæ, where flat surfaces were studied, were always to the south ("On the Terminal Moraine in Pennsylvania and Western New York." Report Z, Second Geological Survey of Pennsylvania, pp. 33, 85, 86, 107, 275). In certain instances the mode of formation of the striæ was also indicated by their shapes, which showed that a stone pushed along under the glacier had ground in deeper and deeper until in some cases it stopped or hopped out, in other cases was ground down to another cutting edge, and in others *turned over*, and began its work of engraving by a fresh and sharp corner. The peculiar gorges at the farther end of certain striæ showed a sort of slow rocking motion in some stones before they finally turned over. The author's observations in Ireland, both at localities where there could be no doubt as to the direction of glacial movement, and at localities where such direction was not previously known, led to conclusions entirely in harmony with those already reached in Pennsylvania and with those held by the Irish geologists. One of the best examples falling under the former category was among the local glaciers in the mountains of the Dingle promontory, a region not invaded by the great confluent ice-sheet of central Ireland. The striated beds of these small glaciers, beginning in a "corey" and bounded below by a semicircular terminal moraine, are beautifully defined and afford good opportunities for striæ study. It was found that *on upward slopes or in flat surfaces the striæ as a rule are blunt at the end towards which the motion was directed, but that in downward slopes the reverse is generally the case.* While this rule does not hold good for every individual scratch at a given locality, it has been found most useful when applied to striated surfaces in general. At Glengariff, where some finely striated surfaces occur, a number of tracings were taken directly from the rock, which clearly show the broader ends of most of the striæ to be to the south, the direction towards which the glacial stream advanced. Similar observations were made at several localities south of the Shannon. Finally, as an instance where the direction of glaciation was previously unknown, certain striæ were described which the author had observed on the top of the cliffs facing the Atlantic at Kilkee. These point N. 58° W. and S. 58° E., and the question to be determined was whether the glaciation proceeded from the Atlantic towards the land or whether it went north-westward and out to sea. The form of the striæ alone decided it. Their broad blunt ends were as a rule toward the north-west, the surface being horizontal, a fact which, taken in connection with other observations made about the mouth of the Shannon, showed that a great ice stream had flowed westward along the valley of the Shannon, and had opened out fan-shaped as it plunged into the sea.

The Geology of Durness and Eriboll, with special Reference to the Highland Controversy, by B. N. Peach, F.R.S.E., and J. Horne, F.R.S.E., Geological Survey of Scotland.—With the permission of the Director-General of the Geological Survey, the authors gave an outline of the geological structure of the Durness-Eriboll region, illustrated by a series of horizontal sections. They showed that the Silurian strata of Durness are arranged in the form of a basin, bounded on the east side by powerful faults disconnecting them from the same series in Eriboll. The order of succession in the two areas is identical, from the basal quartzites to the horizon of the limestone group. On the west side of Loch Eriboll the basal quartzites rest unconformably on the Archæan gneiss, but on the eastern shore there is conclusive evidence of the repetition of various members of the Silurian series by a remarkable system of reversed faults, culminating in a great dislocation which has thrust the Archæan gneiss over the truncated edges of the quartzites, fucoid beds, serpulite grit, and basal limestone. Reference was made to the effects of these mechanical movements on the Silurian rocks, and to the developments of new planes of schistosity in the gneiss above the thrust-plane. At intervals small patches of the basal quartzites are met with throughout this mass of Archæan gneiss, which are abruptly truncated by great reversed faults; but in the district between Eriboll and Assynt the whole Silurian succession from the basal breccia to the lowest limestone occurs repeatedly above the first great thrust-plane, separated by wedges of highly-sheared gneiss. It was shown that the alteration produced by each successive displacement gradually becomes more pronounced as the observer passed eastwards across the area. The old north-west strike of the Archæan gneiss gave place to a new foliation running more or less parallel with the strike of the thrust-planes; the felspathic basal quartzites and the "pipe-rock" pass into quartz schists and mica schists, and the Silurian limestone is felted with the crushed Archæan gneiss. Reference was next made to the outcrop of the great thrust-plane extending from the Whitten Head coast far to the south, which ushers in a highly schistose series with a north-north-east and south-south-west strike. After describing the lithological characters and order of succession of the eastern schists, the authors stated that the new planes of foliation had been superinduced by the mechanical movements that took place between Lower Silurian and Old Red Sandstone time, and that along these new planes a re-arrangement and re-crystallisation of mineral constituents took place, resulting in the production of crystalline schists. Applying the knowledge thus obtained from the study of the eastern schists to the undisturbed Archæan masses, they had found conclusive evidence of similar mechanical movements. Each plane of schistosity exhibits the parallel lineation like slickensides trending in the same direction over a vast area, while the minerals were oriented along these lines. From a consideration of these phenomena the authors inferred that regional metamorphism need not necessarily be confined to any particular period, and further that the planes of foliation or schistosity in those areas which had been subjected to regional metamorphism were evidently due to enormous mechanical movements which had induced molecular changes in crystalline and clastic rocks.

The Highland Controversy in British Geology: its Causes, Course, and Consequences, by Chas. Lapworth, LL.D., F.G.S., Professor of Geology and Physiography, Mason College, Birmingham.—The author gave a *résumé* of the views of the earlier geologists respecting the geological age and possible mode of formation of the Highland metamorphic rocks; and sketched, in brief, the rise and progress of the controversy between Sir Rod. Murchison and his followers on the one hand, and Prof. Nicol, of Aberdeen, on the other, till its temporary close in 1861, by the publication of the Highland Memoir of Murchison and Geikie. He then reviewed the reopening of the controversy by Dr. Hicks in 1878, and the work of the Archæan geologists, up to the date of publication of Dr. C. Callaway's paper in 1883, in which Nicol's view of the great physical break between the Palæozoic rocks and the Eastern or Upper Gneissic series was shown to be correct, but the so-called Eastern gneiss was provisionally erected into a new Archæan system, the Caledonian, having the Arnaboll gneiss as its lower member. The author next gave a summary of his own views as deduced from his personal study of the Durness Eriboll district in 1882 and 1883, and published in 1884, illustrating these by coloured maps and sections. He held that (exception being made of the local Torridon Sandstone) the only rock-formations in the Durness-Eriboll area are, as Nicol originally contended: (1) The Archæan or Hebridean gneiss; and (2) The Palæozoic quartzites, fucoid beds, and limestones. But the so-called upper gneiss or eastern metamorphic gneiss appears to be composed of elements derived from one or other of the foregoing. There is no conformable ascending succession from the Palæozoic rocks into this Eastern Metamorphic series. The line of contact is, generally speaking, a plane of dislocation, and where this is wanting the Palæozoic rocks rest unconformably upon one of the members of the eastern gneiss. The present physical relations of the eastern metamorphic series are the effect of lateral crust creep, by which the eastern metamorphic rocks have been forced over the Palæozoic rocks in grand overfaults to the west, often for many miles. This Eastern Metamorphic series is composed of two petrological members, the *Arnaboll gneiss* to the west, and the *Sutherland schists* and gneisses to the east, having between them a series of *variegated schists* possessing characters common to both. The Arnaboll gneiss is simply the easterly extension of the Hebridean of the west. The remaining gneisses and schists of the eastern metamorphic series are mainly composed of re-metamorphosed Hebridean, with included patches of igneous and Palæozoic material. The planes of schistosity which divide the layers of the Upper Gneissic series are not planes of bedding, but planes of dislocation. The dip and strike of these planes have been given to them since Silurian times by the agency of the great earth-movements. In some instances the original structures of the rocks are still recognisable; usually, however, they are wholly obliterated: the old minerals have disappeared as such, and new minerals have been developed. The Eastern Gneissic series has thus no pretension whatever to the title of a sedimentary rock-system. It is a petrological rock-massif, a metamorphic compound, composed of local elements of very different geological ages. In all their essentials these views appear to agree with the far more contended and minute results worked out independently, and published by Messrs. Peach and Horne in November 1884.

In the second part of his paper the author gave a summary of the work accomplished among the metamorphic rocks of the Alps and Eastern Germany by Heim and Lehmann; and described the several types of rock-metamorphism found in the Eriboll district, as worked out by himself. The Arnaboll (Hebridean gneiss) can be traced stage by stage from spots where it retains its original strike and petrological characters, to others where it acquires the normal strike and mineralogical features of the ordinary Sutherland schists. The old planes of schistosity become obliterated, and new ones are developed; the original crystals are crushed and spread out, and new secondary minerals, mica and quartz, are developed. The most intense mechanical metamorphism occurs along the grand dislocation (thrust) planes, where the gneisses and pegmatites resting on those planes are crushed, dragged, and ground out into a finely-laminated schist (*Mylonite*, Gr. *mylon*, a mill) composed of shattered fragments of the original crystals of the rock set in a cement of secondary quartz, the lamination being defined by minute inosculating lines (fluxion lines) of kaolin or chloritic material and secondary crystals of mica. Whatever rock rests immediately upon the thrust-plane, whether Archæan, igneous, or Palæozoic, &c., is similarly treated, the resulting mylonite varying in colour and composition according to the material from which it is formed. The variegated schists which form the transitional zones between the Arnaboll gneiss and Sutherland mica-schists are all essentially mylonites in origin and structure, and appear to have been formed along many dislocation planes, some of which still show between them patches of recognisable Archæan and Palæozoic rocks. These variegated schists (Phyllites or Mylonites) differ locally in composition according to the material from which they have been derived, and in petrological character according to the special physical accidents to which they have been subjected since their date of origin—forming frilled schists, veined schists, glazed schists, &c., &c. The more highly crystalline flaggy mica-schists, &c., which lie generally to the east of the zones of the variegated schists, appear to have been made out of similar materials to those of the variegated schists, but to have been formed under somewhat different conditions. They show the fluxion-structure of the mylonites; but the differential motion of the component particles seems to have been less, while the chemical change was much greater. In some of these crystalline schists (the augen-schists) the larger crystals of the original rock from which the schist was formed, are still individually recognisable, while the new matrix containing them is a secondary crystalline matrix of quartz and mica arranged in the fluxion-planes. While the *mylonites* may be described as microscopic pressure-breccias with fluxion-structure, in which the interstitial dusty, siliceous, and kaolinitic paste has only crystallised in part; the *augen-schists* are pressure-breccias, with fluxion-structure, in which the whole of the interstitial paste has crystallised out. The *mylonites* were formed along the thrust-planes, where the two superposed rock-systems moved over each other as solid masses; the *augen-schists* were probably formed in the more central parts of the moving system, where the all-surrounding weight and pressure forced the rock to yield somewhat like a plastic body. Between these augen-schists there appears to be every gradation, on the one hand to the mylonites, and on the other to the typical mica-schists composed of quartz and mica. Like the mylonites, the crystalline augenites and micalites present us with local differences in chemical composition (calcareous, hornblendic, quartzose, &c.), suggestive of Archæan, igneous, or Palæozoic origin. They also show similar structural varieties due to secondary physical changes (frilled, veined, glazed, &c.), as well as others due to the presence of special minerals (garnet, actinolite, &c., &c.).

On certain Diatomaceous Deposits (*Diatomite*) *from the Peat of Aberdeenshire*, by W. Ivison Macadam, F.C.S., F.S.C., &c., Lecturer on Chemistry, School of Medicine, Edinburgh.—The material was found below the peat in certain districts of Aberdeenshire, but principally in the basin in which lie Lochs Kinnord and Dawin. After removal of the surface peat-fuel, the lower and more highly mineral portion was cut in blocks and air-dried. The substance then consisted of almost pure Diatomacea bound together by the remains of Spragnum, Equisetacea, &c. Besides being found underlying peat the substance was also obtained on the shores of Loch Kinnord, and the more pure Diatoms were thickly distributed over the bottom of the deeper portions of the lake; these latter, however, from the want of the binding obtained from the marsh plants above mentioned could not be rendered readily available for market. An interesting point regarding these deposits was that whilst in Loch Kinnord an abundant supply of the Diatoms could be obtained, in the neighbouring Loch Dawin scarcely a single Diatom (recent or fossil) was found. This was probably due to the fact that whilst the feeding waters of Loch Kinnord flowed from hills consisting of a coarse and much disintegrated granite, and consequently contained a considerable portion of soluble silica, the Loch Dawin waters were obtained from hornblendic mountains, and held much less soluble silica in solution. The material was principally used for the manufacture of dynamite, and a considerable quantity had been forwarded to the works for this purpose. Unfortunately, however, dynamite had fallen to a great extent out of use, being replaced by the more powerful blasting gelatine, and thus what had at one time appeared as if it would prove an important local industry had entirely fallen away. Other uses, however, could be found for the material, such as the manufacture of ultramarine, for which, from the very small proportion of iron present, the diatomite has more especially to be recommended. As an absorbent it was of fully double the value of the ordinary German varieties of "kieselguhr."

On Some Recent Earthquakes on the Downham Coast, and their Probable Causes, by Prof. G. A. Lebour, M.A., F.G.S.—For the last two years frequent slight shocks, resembling those of earthquakes, and accompanied by rumbling noises, have been felt at Sunderland. Much discussion has arisen as to the cause of these, but that they are due to natural causes is now quite certain. Sunderland stands upon magnesium limestone, from 300 to 400 feet thick beneath the town; the rock is riddled with cavities of every size, some so small as to give a vesicular character to the stone, some large and forming true caverns. These cavities are partly due to the washing out of marly matter, partly to solution of the limestone. Every thousand gallons of Sunderland water contains one pound of stone; in this manner about forty cubic yards of magnesian limestone are yearly pumped up by the Water Company, and of course a much larger quantity is removed by natural channels. This action enlarges the cavities; the sides and roof fall in, thus accounting for the shock. The same explanation applies to the "breccia gashes" which are exposed along the shore. These are fissures filled with breccia. Quite recently similar shocks to those here referred to have been observed at Middlesborough. Pumping the brine from the salt deposits, 1000 to 1200 feet below the surface, may produce cavities into which the rock falls.

Some Examples of Pressure-Fluxion in Pennsylvania, by Prof. H. Carvill Lewis.—The three localities in Pennsylvania described in this paper lie in an area which had been especially studied by the author for some years back and had led him to conclusions similar to some of those recently announced as the result of studies in North-Western Scotland, which have justly attracted widespread attention. (1) a zone of ancient crystalline rocks extends across South-Eastern Pennsylvania, near Philadelphia, which is generally believed to underlie the lowest Cambrian strata and to be of Archæan age. This zone is about a mile wide where it crosses the Schuylkill River, south of Conshohocken, and it is from this point to Westchester, some twenty miles westward, that the present remarks especially apply. Although in many portions exhibiting a distinct gneissic lamination, the rocks of this zone are held by the author to be of purely eruptive origin, consisting of syenites, acid gabbros, trap granulites, and other igneous rocks, often highly metamorphosed. It is the outer peripheral portion of this zone to which attention is here directed. While the rocks are massive in the centre, this outer portion has been enormously compressed, folded, and faulted, with the result of producing a tough-banded, porphyritic *fluxion gneiss* identical with the "milonite" of Lapworth or the "sheared gneiss" of Peach and Horne. So perfect is the fluxion structure that the rock resembles a rhyolite. As in the "banded granulite" of Lehmann, elongated feldspar "eyes" lie in flowing streams of biolite grains and broken quartz, the streams often parting and again meeting around the porphyritic "eyes." Occasional crystalline eyes of hornblende remain, but most of it has been converted into biotite. A point of especial interest is that the feldspar of the eyes is quite colourless and free from inclusions, like the sanidine of recent lavas, while, on the other hand, the feldspars of the inner and massive portions of the zone, out of which this outer portion has been reformed by pressure fluxion, are full of inclusions and have the "dusty" appearance so common in ancient feldspars. The fresh-looking feldspar eyes are therefore believed to have been subsequently formed as a result of a *recrystallisation* of the old material under the influence of *pressure fluxion*. In similar manner the biotite has been made out of the old hornblende, garnets have been developed, and the quartz has been granulated and optically distorted by pressure. The influence of pressure is also seen in certain Cambrian strata in the immediate vicinity, where a sandstone containing cylindrical casts of *scolithus linearis*, apparently identical with the "pipe-rock" of North-Western Scotland, has, like it, been compressed to such a degree that the vertical casts are flattened out and elongated in the direction of lamination to several times their original length. In the same sandstone quartz pebbles have been pulled out and flattened, while sericite has been largely developed along the cleavage planes. The pressure can be shown to have been directed mainly from the south-east. (2) The second locality is in the midst of the Laurentian area of Buck's County, and is known as Van Artsdalen's Quarry. A mass of crystalline limestone is here mingled with an eruptive diorite in such manner as to show that it had actually flowed like an igneous rock, and had caught up inclusions. The results of extreme metamorphism are exhibited in the development in the limestone of graphite, wollastonite, and other minerals. The chemical changes and interchange of elements which might result from a loosening of molecular combinations under extreme pressure and their subsequent "regulation" into new compounds were discussed as among the phenomena of mechanical metamorphism. (3) As an American instance of the conversion of an intrusive diabase dyke into amphibolite schist, analogous to the case recently described by Teall, a long narrow belt of sphene-bearing amphibolite schist in the City of Philadelphia was adduced. This belt with distinctive mineralogical characters cuts across the metamorphic mica schists of the region unconformably, and is believed by the author to be a highly metamorphosed intrusive dyke of Lower Silurian age. The original augite or diallage has been completely converted into fibrous hornblende, and the influence of pressure is shown in the perfectly laminated character of the schist in the close foldings produced, and in the minute structure of the rock. Some interesting details of the latter having been photographed, diagrams constructed from these were exhibited. These showed that the rock was traversed by a parallel series of slips and crushings, and that about such lines of faulting and crushing there was a peculiar arrangement of the lines of hornblende crystals, not very unlike the arrangement of iron filings about the poles of a magnet, such as could not be satisfactorily explained by any theory of aqueous deposition, but pointed to a lamination by pressure.

SECTION D—Biology

On the Cause of the extreme Dissimilarity between the Faunas of the Red Sea and Mediterranean notwithstanding their recent connection, by Prof. Edward Hull, LL.D., F.R.S.—The faunas of the Mediterranean and of the Red Sea are so unlike that if the beds of the two seas were upraised, and their contents examined, naturalists would probably refer them to distinct geological periods. The dissimilarity is greater than was formerly supposed. In Woodward's "Manual of the Mollusca" it is stated that seventy-four species of mollusks are common to the two seas, but Prof. Issel, of Genoa, places the number at eighteen, or about 2 per cent. Equal differences exist if we compare other great groups of life; in fact, as Prof. Haeckel well observes, the fauna of the Red Sea is related to that of the Indian Ocean, the fauna of the Mediterranean to that of the Atlantic. This extreme dissimilarity would not surprise us if it were not for the proofs of recent connection between the two seas. Evidence of old sea margins, up to about 220 feet above the present sea-level, are frequently found along the Nile and in the valleys and plains of Philistria. As many of the marine forms found in these deposits still exist, the date of the submergence may be safely referred to that of the Pliocene; but it continued to a later period, and (in the author's opinion) it to some extent remained to the time of the Pharaohs. The existing fauna probably dates back to Eocene times, when the ocean spread widely over the area in question. In the Miocene period the main outlines of land and sea as we now find them were marked out, the deposits of this age being here small and local. Under the extremely different conditions existing in the two areas, the fauna during and after the Miocene period became differentiated. The connection re-established during and after the Pliocene period was insufficient to destroy these differences, although it allowed a mingling of forms to some extent. The maximum submergence was about 220 feet; but as the summit level between the two seas is about 50 feet, the depth of water would only be about 170 feet at the maximum. Only littoral and shallow-water forms would cross in the adult state; but many forms inhabiting deeper water in the adult state might have crossed when in the free-swimming larval state. When the land again rose, and the marine straits were finally effaced, the different physical conditions of the two seas would again come into effect. The difference of temperature is now very considerable, and probably was much greater during the Glacial period, especially if, as appears probable, the eastern or Levant basin of the Mediterranean were separated from the others; for into this would flow the cold waters of the Black Sea and of Central Europe, whilst the Red Sea would receive warm water, and be itself exposed to the rays of a tropical sun. It would be an interesting subject of inquiry—Which of these faunas most closely resembles that of the original stock?

On the Tay Whale (Megaptera longimana) and other Whales recently obtained in the District, by Prof. Struthers.—Prof. Struthers gave a description of the various parts of the anatomy of the whale. In addition to the Tay whale members of three other whales recently obtained in the district were exhibited for the purpose of comparison, and the analogy of its structure to that of other animals was specially referred to in order to show its identity with the mammal. Prof. Flower joined in the discussion which followed, and remarked that they now had an idea at least as to the origin of the whale: it carried its pedigree in every part of its body. It had been thought that the mammals that live upon land had been derived from progenitors that formerly lived in the sea, and that the mammals may have passed through an aquatic or marine stage before they took to land, but the observations of anatomy showed that this cannot have been the case. There was no doubt that the whale had been derived from a four-footed land mammal. All observations, for example, had shown that at some period of their life whales have a hairy covering, generally in the region of the mouth, that hairy covering being functionless and very often lost even before birth. In the same way whales at an early stage of their existence are furnished with a complete set of teeth, the rudiments of the teeth of the land mammal. The organ of smell, although in a rudimentary state and in some species almost entirely gone, also points to the origin of the whale.

Some Points in the Anatomy of Sowerby's Whale, by Prof. Turner.—Prof. Turner remarked that *Mesoplodon bidens*, or Sowerby's whale, of which he had dissected two specimens, was now for the first time dissected so that the viscera of this whale were seen by any anatomist, or that its tail and paddle, or fin, had been figured. The tail presents a very material difference from the customary tail in the cetacea in having the posterior border smooth instead of notched. Dr. Turner called attention in detail to the intestinal and limb structure of this species of whale, showing the affinity or resemblance of the cetacea to the reptilious and the amphibious, particularly in reference to the corpus. Prof. Flower said he was glad to find that Prof. Turner had found some intention for the muscles of the corpus. For all that they were very rudimentary as compared with the same muscles in other animals, and he thought that he might have to modify his views on this point as he had had to do in regard to many other things throughout life. Prof. Marsh, of Yale College, said the intermediary bone pointed out by Prof. Turner interested him much.

On the Cervical Vertebræ of the Greenland Right Whale, by Prof. Struthers.—The reduced condition of the upper and lower transverse processes was commented on, and the meaning of their different parts explained; also the completely fused condition of the bodies of the seven vertebræ. A nearly similar condition of the neck of the Pilot Whale (*Globicephalus melas*) was demonstrated, showing in the young condition the two body epiphyses on the rudimentary vertebræ. Other specimens illustrated the fibrous condition of the transverse processes in the Narwhal and Beluga.

On the Development of the Vertebræ of the Elephant, by Prof. Struthers.—The point was that in the anterior vertebræ the neural arches meet behind the body, covering it deeply, and shutting it entirely out from forming any part of the wall of the spinal canal.

On the Development of the Foot of the Horse, by Prof. Struthers.—Dr. Struthers called attention to the fact that the epiphysis of the rudimentary metacarpal and metatarsal bones is not at the upper or functional end, but at the reduced end or "button," from which only a slender ligament proceeded. This he considered a most interesting fact, one which completed the chain of evidence of the descent of the horse. There was a reason why the epiphyses should be there in the hipparion and previous forms from which the horse of the present day was descended. The development of the corresponding bones in man, the cetacea, and various other mammals, was given in illustration.

A specimen was shown of a two-toed horse. The valuable researches of Prof. Marsh on the descent of the horse were specially alluded to. Dr. Struthers demonstrated another fact connected with the development of the foot of the horse—that the first phalanx, or pastern bone, has an epiphysis at both ends.

On the Viscera of Gymnotus electricus, by Prof. Cleland.—Independent of its electric organs, this fish has a number of remarkable internal peculiarities. The curious spongy protuberances of the mucous membrane of the buccal cavity are well known to zoologists. The two swimming-bladders are remarkable for their relation to the kidneys; the anterior swimming-bladder being a small structure between their anterior extremities, and the larger posterior swimming-bladder being situated altogether behind their under hinder ends, while the duct of the latter ascends by the left side of the renal outlet, to be joined by the duct of the other bladder before entering the gullet. The pylorus also is remarkably contracted. But the most striking and altogether curious arrangements are seen on the ventral wall of the abdomen. The intestine passes forward the whole length of the abdominal cavity to the vent, and on its under side is a long renal duct as wide as itself, and opening immediately behind the vent; while, opening into this duct close to its outlet, are the ducts of the two ovaries, which lie one on each side, their morphologically anterior extremities placed posteriorly, as if in process of development these organs had been pulled around from their proper sub-vertebral position until completely inverted.

The Spiracle of Fishes in its relation to the Head, as developed in the Higher Vertebrates, by Prof. Cleland.—A very extraordinary mistake can be shown to be prevalent among embryologists, to the effect that the spiracle corresponds with the tympanum and external auditory meatus in the higher vertebrates. This is not the case. The spiracle is pre-oral; the tympanum is post-oral. The apparent sequence of the spiracle with the branchial clefts occurs, as Balfour described it, in the embryo of the dog-fish; but for all that, and although it has rudimentary external gills attached to its margins in the embryo, it is in front of the mandibular arch and above the maxillary lobe. Between the middle and lateral frontal processes is the nostril; between the lateral frontal process and the mandible is the space into the upper part of which the eyeball projects, and from which the lachrymal duct is developed; while between the first and second visceral lobes is the external ear; and it is highly probable that the upper part of the first branchial cleft is homologous with the clefts in front of and behind the lateral frontal process. Thus a certain amount of homology would exist between the spiracle of fishes and the lachrymal duct.

Is the Commissural Theory of the Corpus Callosum Correct? by D. J. Hamilton, M.B., Professor of Pathological Anatomy, Aberdeen University.—The results recorded by the author were obtained by certain special methods of preparation. They went to prove that the corpus callosum is not an inter-hemispherical commissure, as is generally supposed, but that it is in reality the decussation of a particular system of fibres on their way downwards to join the inner and outer capsules. These fibres are not to be confounded with the motor and other direct fibres derived from the cerebral cortex, and which decussate at some point lower down.

The Evidence of Comparative Anatomy with regard to Localisation of Function in the Cortex of the Brain, by Alex. Hill, M.A., M.B. Cambridge.—The object of the paper was to show that the theory of the localisation of function in the cortex of the brain must be submitted eventually to comparative anatomy for proof. The key to the arrangement of the lower parts of the central nervous system is to be found, as the author had elsewhere shown, in its segmental disposition: the grey matter is disposed in clumps the cells of which bear a definite numerical relation to the fibres of body nerves. The problem discussed in the present paper was the relation of the grey matter of the cortex to this lower grey matter, and therefore to the body nerves. Is each region of the cortex equally in relation with all the segments of the "central grey tube"? or is the cortex also divided up into areas, the superficies of each of which varies as the amount of grey matter in the clump of the lower system with which it is related, and therefore as the number of fibres in its associated nerve. For this investigation guides to the delimitation of the cortex are necessary, and no others are available for the purpose if the fissures fail. The homological value of the fissures is, however, established by the study of adult and fœtal brains. They are remarkably constant in their arrangement throughout animals of the same type, and in animals of different type they are very constant with regard to the order of their appearance, their progressive extension and permanent depth. The author of the paper expressed himself content, on account of the precision with which the fissures respond to the ordinary tests of homology, to place himself unconditionally in their hands, and the boundaries of the various regions of the cortex being thus marked out, it remains to devise a system of mensuration by which the superficial area of each region of the cortex may be determined for comparison with the cross-sections of the several nerves. As yet no satisfactory method of measurement has been devised, but even in the absence of exact data important results can be obtained by the observation of the brains of such animals as are conspicuous for excess or deficiency in the development of the muscular system or of one or more of the senses. As examples of such results Mr. Hill exhibited diagrams of the brains of the sheep, cat, pig, dog, and otter, enlarged from tracings of the pictures in Leuret and Gratiolet's Atlas. It was shown that, although it is impossible, as yet, to map out the brain into areas associated with the several nerves, it is quite possible to predict from the appearance of the brain the principal sensory and motor endowments of the animal to which it belonged. In the main Mr. Hill's results confirm those already obtained by Ferrier and other experimental physiologists; they seem, however, to show that they are open to correction in certain important points with regard to the areas allocated to the senses of smell, hearing, and facial sensation.

The Action of Cold on Microphytes.—Prof. M'Kendrick, Glasgow, gave an interesting account of the methods of trying to destroy small organisms like bacteria, not as is commonly done by heat, but by cold. It is known that by means of Coleman's cooling machine meat may be kept from putrefying for a considerable time, but in attempting to sterilise a putrescible solution by means of cold, it was found that, though in some cases putrescence was delayed, in no case were the organisms completely destroyed. Organic fluids were exposed to temperatures more than 120° below 0° F., but on thawing they were found to contain living organisms still. Thus the hope of preserving putrescible matter by means of cold—an important economical result—is, so far as investigation yet goes, destroyed. The organisms under cold seem to be in a nearly solid state, though we cannot call it a crystalline state. In a paste solution the water is crystallised under cold, the paste remaining spongy. Possibly cold may separate from these minute organisms the water they contain, and this water is again absorbed on thawing. Meat under cold becomes very friable, while yet minute fragments of it show the same microscopic constitution of muscle. It is well known that frogs have been found in blocks of ice and been revived. Frogs have been frozen at 20° F. in about half an hour. On thawing slowly the animal, in two instances, completely recovered. When it was frozen for longer than half an hour it did not recover; but, though reflex action was gone, there remained some irritability both in nerves and muscles. It was found also that certain vital functions may be arrested by cold, and thus conceivably higher organisms may be kept vitally inert for an indefinite time. Experiments were also tried on warm-blooded animals. A rabbit subjected to a temperature 100° below 0° F. recovered. No temperature lower than 73° below 0° F. has been obtained in free atmosphere. Prof. M'Kendrick gave a short sketch of the literature of the subject.

The Action of Ozonised Air upon Micro-Organisms and Albumen in Solution, by J. J Coleman, F.I.C., F.C.S.—This paper described a number of experiments conducted by the author in conjunction with Prof. McKendrick, F.R.S., being supplementary to their joint investigation upon the influence of cold on microphytes. Air artificially impregnated with ozone by means of a Ruhmkorff coil, so as to contain a much larger percentage of ozone than any natural atmospheric air, was passed continuously through a 1 per cent. solution of white of egg placed in a glass flask, the inlet and outlet tubes of which were carefully plugged with cotton wool previously to commencing the experiment. It was found that a stream of air containing an amount of ozone equal in weight to the albumen in solution passed through 100 c.c. of the liquid for thirty hours, failed in producing the slightest trace of oxidation, and that the ozonised air passed through the liquid quite unaltered. During the course of the experiment and for six days following the development of micro-organisms ceased, but at the end of that time, and notwithstanding the cotton wool plugs, the liquid became slightly turbid from the presence of organisms. As dilute hydrogen peroxide is without action upon albumen, the conclusion seems inevitable that albumen is practically indestructible by any atmospheric agency without previous splitting up by micro-organisms, and further, that whilst micro-organisms cannot develop, and are probably killed in an ozonised atmosphere, these spores are not easily destroyed by its agency. These results confirm the surmise of the late Dr. Angus Smith that putrefaction is a necessary preliminary to oxidation in all cases of *natural* river purification. Prof. Burdon Sanderson, Dr. W. B. Carpenter and Capt. Douglass Galton all commented upon the practical value and interest of this paper, Capt. Douglas Galton observing that the sooner organic matter of sewage is got on to land the better.

The Use of Graphic Representations of Life-Histories in the Teaching of Botany, by Prof. Bower.—This was a paper referring to a series of diagrams prepared by the author to bring in review the chief facts in the life-history of the moss, fern, equisetum, *Selaginella*, a conifer, and an angiosperm. Prof. Bower pointed out that these diagrams could be extended to include lower forms, and that they are only intended for use *after* the student has mastered the facts in detail in the laboratory. Having described the diagrams and referred to some interesting processes of vegetative reproduction in the mosses and ferns, the author then proposed for discussion a series of questions as to the advisability of employing such diagrams, or of extending their use. The discussion which followed was taken part in by Sir J. Lubbock, Profs. Bailey Balfour (Oxford), M'Nab (Dublin), Trail (Aberdeen), Mr. Marshall Ward (Owens College), and others, and several suggestions were proposed for rendering Prof. Bower's graphic representations still more graphic.

A New Theory of the Sense of Taste, by Prof. J. Berry Haycraft.—The author showed that "quality" in this sense depends upon the nature of the atoms found in the sapid molecule. A study of the periodic law demonstrates that similar tastes are produced by combinations which contain elements such as lithium, sodium, potassium, which show a periodic recurrence of ordinary physical properties. Among the carbon compounds those which produce similar tastes are found to contain a common "group" of elements. Thus organic acids contain the group CO.OH, the sweet substances CH_2.OH. There is no relation between quality of sensation and gross molecular weight, except that substances of either very small or very great molecular weight are not tasted at all.

On the Hybridisation of Salmonidæ at Howietoun, by Francis Day.—During the last eleven years Sir J. R. Gibson-Maitland, at Howietoun, near Stirling, has devoted much attention to this subject, and gone to great expense in order to efficiently carry out the many experiments he has instituted, while he has likewise afforded the author facilities for personally watching many of them, and furnished him with data as well as with specimens. When we consider that the ova of teleostean or bony fishes have, as a rule, to be fertilised by the milk of the males diffused in the surrounding water, it is not difficult to believe that this fluid from the male of one genus might come into contact with the eggs from fish of another species, genus, or even family, and a hybrid offspring be thus occasioned. But the size of the micropyle of the ovum and that of the spermatozooid of the milt must be of conforming capacities, or fertilisation would be a physical impossibility. It would appear from the experiments made that the following conclusions may, with more or less probability, be drawn:—(1) Salmon and trout, trout and char, and different species of char, may interbreed and give rise to fertile hybrids. (2) Hybrids raised from Lochleven trout eggs fertilised by salmon milt, breed in their fourth year, similar to young female salmon kept under the same conditions. (3) The anodromous instinct is not lost in these trout and salmon hybrids. (4) Judging from the period of breeding in the foregoing hybrids, the male element is prepotent. (5) In hybrids raised from Lochleven trout eggs fertilised by the milt of the American char, the male element would appear to be prepotent, if we judge simply by the colour of the offspring. (6) In hybrids raised from American char eggs fertilised by the milt of the Lochleven trout, the female element would appear to be prepotent, if we judge simply by the colour of the offspring. (7) In hybrids raised from American char eggs fertilised by the milt of the British char, the male element would appear to be prepotent, if we may judge simply by the colour of the offspring. (8) In all instances of hybridisation between different species, as between salmon and trout, or trout and char, numerous instances of malformation and great mortality occur among the offspring, but much less when two forms of char are intercrossed. (9) In intercrossing hybrids both the eggs and milt were found to be fertile, but the malformations and mortality very great. The parents, however, at Howietoun are not yet of sufficient age to admit any safe deductions on this head. (10) The age of the parent exercises great influence on the vitality of the offspring, for, when very young, we may expect a large percentage of malformations, as well as dropsy and other diseases of the offspring.

Chinese Insect White Wax, by A. Hosie.—The author began with a reference to the European and Chinese writers who mention Chinese insect white wax, and then proceeded to say that, although the province of Ssu-chuan, in Western China, where he has been stationed for the last three years, is the chief wax-insect and wax-producing country in the Empire, insects and wax are found in other provinces. Mr. Hosie was called upon by the Foreign Office to collect for Sir Joseph Hooker specimens connected with, and all possible information on, the subject of this industry, and he states that the present paper is a revision, with additions, of a Report already published in a Parliamentary paper in February last. He describes the insect-producing country, the tree on which the insects are propagated, the insects themselves, and their transit from the valley of Chien-chang, their breeding-ground, in the west of Ssu-chuan, across the mountains to Chia-ting Fu, the habitat of the wax tree. This tree is then described, and details are given of the treatment of the insects, their suspension on the trees, the depositing of the wax, and of a parasite on the insects. The method of removing the wax from the branches of the tree and of preparing it for market is then explained. The author then detailed the result of an examination of the insects after the wax has been fully deposited, finally passing to the annual quantity of insect white wax produced, its value, and uses.

On the Size of the Brain in Extinct Animals, by Prof. O. C. Marsh.—Prof. Marsh, of Yale College, said that for fifteen years he had directed his attention to the subject of the size of the brain in extinct animals. In every instance he found that the mammals from the lower Tertiary had very small brains. He carried out his investigation into the upper Tertiary, and found that the brain was much larger in the pliocene than in the miocene. All the tertiary mammals had small brains; there was a gradual increase in the size of the brain during this period; and this increase in the size was generally in the cerebral hemisphere or higher portions of the brain. In some groups the convolution of the brain had gradually become more complex. In some the cerebellum and the olfactory lobes had even diminished in size. There was now evidence that the same general law of brain growth holds good for birds and reptiles from the Jurassic period to the present time. The brain of an animal belonging to a vigorous race fitted for a long survival was larger than the average brain of that period in the same group, and the brain of a mammal of a declining race was smaller than the average brain of its contemporaries of the same group. The small animals now existing had proportionally larger brains than the larger animals, and young animals had proportionally larger brains than adult animals. They found some interesting examples which threw light on this question. For instance in the Eocene they had an animal, the oldest known ancestor of the rhinoceros, and it had an exceptionally large brain. Taking all the facts together it seemed as though this brain growth was an important element in the survival of animals. If the animal became large and unwieldly with a small brain, it would be liable to suffer from any change of climate. In other words, in early times the big brain conquered as it is the big brain that conquers in civilisation to-day. Prof. Flower said it was satisfactory to find a case where the facts worked out coincided with previously-formed theories, because that was not always the case, and sometimes the facts or the theories had to go to the wall. In this case they had no such difficulty; and they had to thank the American Government for the way in which it had taken up Prof. Marsh's work and were disseminating it.

On the Systematic Position of the Chamæleon and its Affinities with the Dinosauria, by D'Arcy W. Thompson, B.A.—The author believes that the great anatomical differences which separate the Chamæleon from all other Lacertilia are connected with marked resemblances to the Dinosauria, especially the group Sauropoda. The shoulder-girdle is quite identical with that of (*e.g.*) Brontosaurus, but differs wholly from that of the Lacertilia in the simple form of the scapula and coracoid, the absence of coraco-scapula fenestrations, of clavicle and interclavicle. Equally marked affinities with the Dinosauria may be traced in the carpus and tarsus, sternum, pelvis, and skull. While similarly the comparatively large size of the cerebellum, the absence of a urinary bladder, and the presence of pulmonary diverticula or rudimentary air-sacs, are all foreshadowings of ornithic structure.

The Origin of the Fishes of the Sea of Galilee, by Prof. Hull.—Of the abundant fishes of the Sea of Tiberias nearly one-half of the species are peculiar to the lake and its tributaries, while of the rest only one, *Blennius lupulus*, belongs to the ordinary Mediterranean fauna; two others are found in the Nile; seven other species occur in the rivers of South-Western Asia; and ten more are found in other parts of Syria. Tristram considered that this assemblage pointed to a close affinity of the fauna of the Jordanic basin with that of the rivers of tropical Africa; but what most struck the observer was perhaps the speciality of the species to Jordanic waters, sixteen out of a total of thirty-six species being peculiar. Assuming that the forms which are common to Jordanic and other waters had been distributed in a manner similar to that by which they had to account for the distribution of lacustrine forms in other parts of the world, they had yet to account for the presence of the forms which were special and peculiar. After referring to the formation of the Jordanic basin, Prof. Hull argued that by the subsidence of the floor of the sea along the line of the Jordan valley an inland lake was formed whose waters were first derived from those of the ocean itself, in which were enclosed the fishes, mollusks, and other forms which inhabited these waters themselves. The law of "descent with modification" would come into operation, and they might suppose that throughout the Miocene and Pliocene periods the process of modification in form, colour, and habit gradually proceeded. The fittest forms would survive, and differentiation between those of the outer and inner seas would result in an almost entire specific change. Prof. Hull also read a paper on the cause of the extreme dissimilarity between the faunas of the Red Sea and Mediterranean, notwithstanding their recent connection.

The St. Andrews Marine Laboratory.—Prof. M'Intosh stated briefly the structure and arrangement of the marine laboratory at St. Andrews, and made some general remarks on the work done during the last nine months there. A great many of our food fishes, he said, were carefully examined in regard to the development of the eggs and the growth of the young fishes. About twenty species were examined in this way. They experienced some difficulty with some of the forms, on account of their voracity, particularly with the cod. They found that a cod of five inches long would swallow a cod of three inches, and if it could not get it all down at once, it would keep it in its throat till the head part was digested, and then draw in the tail. Mollusca were studied chiefly in connection with the development of the mussel, but he might say that very hazy notions were held in regard to it. Some larger forms were also examined, including porpoises and sharks. One porpoise was extremely interesting. He had noticed it for some time in the bay, and that its motions were very peculiar. He could not make out what it was doing there so constantly in shallow water. But some days afterwards a large female was caught in the salmon nets, and they found that it was a female giving milk. Its milk was of a most interesting kind, and formed the subject of examination and analysis by Prof. Purdy. It was as dense as cream, and of a deep yellow colour.

On a Chemical Difference between Living and Dead Protoplasm, by Dr. Oscar Loew, of Munich.—Protoplasm, it was found, contains certain aldehyd groups, which account for the extreme mobility and readiness of change in living protoplasm. These aldehyd groups can be reduced by very dilute alkaline solutions of silver salts. *Spirogyra*, one of the lower *algæ*, acts on this solution in a peculiar way. Living protoplasm reduces the salt, while dead protoplasm does not. The specific gravity of the protoplasm of *Spirogyra* was increased, and was found to contain silver deposited in its interior. Argyria, or the effect of nitrate of silver on the human subject in certain diseases, was found in these *algæ*. Thus was shown a specific chemical difference between living and dead protoplasm. Ordinary poisons, such as prussic acid and strychnine, have no such striking effect on lower organisms, but a poison to all protoplasm is hydroxylamyl. Prof. Burdon-Sanderson said that this investigation had more importance than might at first appear, for it had arisen out of the epoch-making paper of Pflüger. Pflüger concluded that there must be a chemical change in the transition from living to dead protoplasm, and Dr. Loew took up the question as to what exactly this change was. His investigations are an important step in deciding this most important question. Prof. Stirling said this gave us a new test for living protoplasm. The chief thing to settle was what exactly causes reduction of the silver.

Digestion of Proteids in Plants, by Sidney Martin, M.D. (Lond.), B.Sc., M.R.C.P.—Of proteolytic ferments occurring in plants two kinds have been described—one acting like animal pepsin, and occurring in carnivorous plants, in the seeds of vetches, hemp, flax, barley, and malt, and the fruit of the fig, *Ficus cerica;* the other acting like animal trypsin (pancreatin) and occurring in the juice of the green fruit of *Carica papaya* (the papaw tree). The use of these ferments in the plant economy has only been surmised by testing their action on animal proteid, from which they form peptones. It is a question whether they form peptones from the proteid occurring in the individual, and from two considerations. It is doubtful whether a true peptone exists in plants—by which I mean a proteid soluble in water, and not precipitated by boiling, nitric acid, or acetic acid and potassic ferrocyanide. Vines (*Journal of Physiology*, vol. iii.) concludes that the body called vegetable peptone is hemialbumose (Meissner's α-peptone). It is also evident that the action of these ferments on the proteids will be slow in comparison to the action of animal proteolytic ferments; thus there might appear the proteids intermediate between albumen and peptone, which Kühne and Chittenden call *albumoses* (*Zeitschrift f. Biologie*, Bd. xx.). These questions I attempted to settle in the case of the papaw juice. I first of all extracted the proteids, which consisted of a *globulin*, corresponding to animal paraglobulin; two albumoses, which I propose to call α- and *β-phytalbumose.* The β form is precipitated; the α form is not thrown down by boiling; a vegetable *albumen* corresponding to egg-albumen. The effect of pure papain (the proteolytic ferment of the papaw juice) was tested on each of these bodies, but from none of them was a true peptone formed; only a body corresponding to Meissner's *b*-peptone. The very slow proteolysis explains the limitation of the formation of the final products of proteid change. Leucin and tyroin were formed. Full details of methods and results will be found in the forthcoming *Journal of Physiology*, September 14, 1885.

On the Application of the Anatomical Method to the Determination of the Materials of the Linnean and old Herbaria, by Prof. L. Radlkofer.—Prof. Radlkofer spoke generally of the anatomical method of botanical study, and dwelt on the results that had already been accomplished by it. With the aid of the anatomical system he advocated an extensive review of the herbaria of the country with reference to the writings of their former possessors. These herbaria should henceforth not merely be preserved; there should be the diffusion of new light on their contents so as to become useful to every one in a scientific sense, even to those who are unable to look through them. At some length he demonstrated the value of anatomical characters in systematic botany, and concluded with an appeal to all English botanists to direct their attention and their influence to the accomplishment of the work. In the accomplishment of this the British Association might, perhaps, give substantial assistance.

Notes on Experiments as to the Formation of Starch in Plants under the Influence of the Electric Light, by Mr. M. Ward, of the Owens College, Manchester.—The experiments, Mr. Ward said, were made not so much to determine a point already determined generally—that plants can be grown under the influence of the electric light—as to discover how far the electric light can be used for teaching purposes and investigations in the laboratory so to speak as an artificial sunlight. It would obviously be of enormous advantage to the vegetable physiologist if experiments could be easily performed under the influence of electric light. He explained the experiments he had made in the laboratories at the Owens College, Manchester, and at the residence of Mr. W. Crossley, of Bowden (who kindly placed a powerful arc lamp at his disposal), on this interesting subject, and described the means that had been employed in devising and conducting the experiments. Under a powerful arc light the results had been fruitful; but small clusters of Swan lamps had yielded no satisfactory results, at any rate at low temperatures. The subject requires still further examination, however, and Mr. Marshall Ward intimated that he intended to carry on the experiments, so that at a future date he might be able to convey more detailed information than could be given in a paper of a preliminary character. The plants employed were hyacinth potato, Algæ, *Faba*, *Phaseolus*, *Dicentra*, and the vine, and some interesting remarks on methods, &c., were made in the discussion which followed.

On the Coloration of the Anterior Segments of the Maldanidæ, by Allen Harker, F.L.S., Professor of Natural History, Royal Agricultural College, Cirencester.—The author, while studying the circulation and respiration of annelids at the zoological station at Naples, had been specially interested in the Maldanidæ, from their partially tubiculous habit and the brilliant coloration of their anterior segments. The bands of colour usually ornament the anterior segments, beginning with the second or third, and continuing to the ninth; but the distribution of the coloured bands differs widely in the different species. The colour in living or freshly-killed specimens is of a rich rose madder colour, shading off in each segment to a brighter rose-pink hue. Quatrefages attributed a physiological value to these coloured bands, describing them as being connected with the respiratory function. In connection with the whole subject of cutaneous respiration in annelids, it appeared important to settle this question, and the author made sections of the anterior segments in the Maldanidæ, and finds the colour to be due to a special pigment, whose behaviour under various reagents he described. On the other hand the author has studied the blood-vessels and their distribution in the living chætopod, and is satisfied that it extends equally in those portions of the cuticle which are uncoloured as in those which are. The coloured bands do not appear, therefore, to be in any way connected with the function of respiration.

SECTION E—GEOGRAPHY

The Indian Forest School, by Major F. Bailey, F.R.G.S., Royal Engineers, Director of the School.—It is only within the last twenty-five years that a special State department has administered the Indian forests. The staff was at first composed of men who had received no professional education, but they were able to do all that was then needed, and they accomplished work of great value. But as a result of their work the State became possessed of large forest areas, from which a permanent supply of produce had to be secured, and which had therefore to be managed systematically. At this time nothing was known of systematic forestry in England or in India, and an arrangement was made in 1866 under which candidates for the Indian Forest Service were trained on the Continent. The arrangement with the French Government is still in force, but it has now been decided to undertake the instruction in England. Great progress has been made in Indian forestry, which is mainly due to the professionally-trained men with whom the Forest Department has been recruited, but up to 1869 nothing bad been done towards the education of the subordinate ranks. As work requiring professional skill became necessary over large areas, it was found that the "divisions" must be broken up into a number of smaller executive charges under natives of the country, and that they must receive a professional education. In 1869 Mr. Brandis made proposals to organise the subordinate grades and to train men at the Civil Engineering Colleges, and several other attempts were made in the same direction, but without marked success. In 1878 Mr. Brandis proposed to establish a Central Forest School, and his proposals were accepted by Government. The chief object of the School was then to prepare natives of India for the executive charge of forest ranges, and to qualify them for promotion to the superior staff, but it was hoped that the school might ultimately be used to train candidates for the controlling branch. The chief forest officers of provinces were to select candidates and send them to be trained at the School. None but natives of India were to be admitted. A number of forests near Dehre Dun were grouped together as a training ground and placed under a separate conservator, who was also appointed director of the school. A board of inspection was appointed. The first theoretical course was held in 1881, and they have been held every year since then. The present system is that the candidates, who must be in robust health, are selected by conservators of the forest or by the director of the school. They must serve in the forests for at least twelve months before entering the School. Candidates for the ranger's certificate must have passed the entrance examination of an Indian University on the English side; candidates for the forester's certificate pass a lower examination. The course of training for these two classes extends over eighteen and twelve months respectively. Men who gain the certificates return to their provinces, and are employed there. The course of instruction for the ranger's class embraces vegetable physiology, the elements of physics and chemistry, mathematics, road making and building, surveying, sylviculture, working plans, forest utilisation, forest botany, the elements of mineralogy and geology, forest law, and the elements of forest etiology. The course for foresters is much more simple. The preparation of manuals is in progress, and a library, museum, chemical laboratory, observatory, and forest garden have been established. The period of probation in the forest before entry into the School has a twofold object: firstly, to enable the theoretical course to be understood; secondly, to eliminate men who are unsuited to a forest life before time and money have been spent on their training. As a rule, the students are *employés* of the Forest Department, and they draw their salaries and maintain themselves while at the School. No instruction fees are charged. It would not at present be possible to get condidates whose maintenance and education are entirely paid for by their friends. Nine men who have left the School have appointments of from 125*l*. to 200*l*. a year, and this ought to draw eligible candidates. Conservators of forests say that the men trained at the School are markedly superior to their untrained comrades. The area of reserved forests has largely increased of late, and the prospects of the students are very good. During the session of 1884 there were forty-six students of all classes at the School, of whom eight were from Madras, and seven from native States, the chiefs of which have been induced by the establishment of the school to take measures for the protection of their forests. The School has now been made an imperial institution, and this is a great advantage in every way. The expenses of the School in 1884 are said to have been 1911*l*.

On Journeyings in South-Western China, by A. Hosie.—In the autumn of 1881 Mr. Hosie was appointed Her Majesty's Agent in Western China, and reached Ch'ung-ch'ing, in the province of Ssŭ-ch'uan, in January, 1882. From this point he made three journeys in South-Western China. In the spring of 1882 he proceeded through Southern Ssŭ-ch'uan and Northern Kuei-chou, the Chinese "Switzerland," to Kuei-yang Fu, the capital of the latter province, whence he journeyed westward in the footsteps of Margary to the capital of Yünnan. From Yünnan Fu he struck north-east through Northern Yünnan, following for days here and there the routes of Garnier and the Grosvenor Mission. At last he descended the Nan-kuang-River and reached the right bank of the Great River, the local name of the Upper Zangtsze, at a point below Hsü-chou Fu, an important city at the junction of the Min River and the Chin-sha Chiang, or River of Golden Sand. Here he took boat and descended the Great River to Ch'ung-ch'ing, his starting-point. In February, 1883, Mr. Hosie again left Ch'ung-ch'ing, and proceeded north-west to Ch'êng-tu, the capital of the province of Ssŭ-ch'uan, by way of the brine and petroleum wells of Tzŭ-liu-ching. From Ch'êng-tu he journeyed west and south-west through the country of the Lolos, skirting the western boundary of Independent Lolodom. From Ning-yüan, locally called Chien-ch'ang, and lying in a valley famous, among other things, as the habitat of the white-wax insect, he passed south-west through the mountainous Cain-du of Marco Polo, inhabited in great part by Mantzŭ tribes, and struck the left bank of the Chin-sha Chiang two months after leaving Ch'ung-ch'ing. From this point Ta-li Fu, in Western Yünnan, was easily reached. From Ta-li Fu Mr. Hosie jurneyed eastward to Yünnan Fu, which he had visited the year before, and then struck north-east through Western Kuei-chou to the Yung-ning River, which he descended to the Great River. Lu Chou, an important city at the junction of this river with the T'o River, was soon reached, and the Great River was again descended to Ch'ung-ch'ing. This journey occupied four months. In June, 1884, Mr. Hosie again left Ch'ung-ch'ing, and from Ho Chou, a three days' journey to the north of that city, he struck westward through a beautifully cultivated and fertile country to Chia-ting Fu, on the right bank of the Min at its junction with the T'ung River. Chia-ting is famous as the great centre of sericulture in Ssŭ-ch'uan, and as the chief insect wax-producing country in the Empire. A day's journey west of Chia-ting is the famous Mount O-mei, rising 11,100 feet above the level of the sea. This mountain, which is sacred to the worship of Buddha, Mr. Hosie ascended in company with crowds of pilgrims. He then proceeded south, skirting the eastern boundary of Independent Lolodom, to the River of Golden Sand, the left bank of which was struck at the town of Man-i-ssŭ, between forty and fifty miles above P'ing-shan Hsien—the highest point reached by the Upper Yangtsze Expedition in 1861. From Man-i-ssŭ Mr. Hosie descended the Chin-sha Chiang and the Great River to Ch'ung-ch'ing.

Antarctic Discovery, by Admiral Sir Erasmus Ommanney, C.B., F.R.S.—The object of this paper is to draw attention to the neglect of the Antarctic region as a field for exploration. The author gives a summary of the work which has already been done by Cork, Bellingshausen, Weddell, Biscoe, Balleny, Wilkes, Dumont d'Urville, James Ross, and Nares (in the *Challenger*). The author refers to a paper by Dr. Neumayer on the subject, the substance of which was reproduced in NATURE (vol. vii. p. 21). The author concludes as follows:—I have thus laid before you but a very imperfect description of these voyages; to give the details of the scientific results would occupy a separate paper. But I have endeavoured to demonstrate how large a field remains open for discovery. I think, from all we now know, we may infer that the South Pole is capped by an eternal glacier; and, from the nature of the soundings obtained by Ross, it would appear that the great ice-wall along which the ships navigated was the termination of the glacier—the source from which the inexhaustible supply of icebergs and ice-islands are launched into the Southern Ocean, many of which drift to the low latitude of 42°. The fact of finding the volcanoes of equal proportions to Etna or Mont Blanc creates a zest for further research regarding that awful region on which neither man nor quadruped ever existed. No man has ever wintered in the Antarctic zone. The great desideratum now before us requires that an expedition should pass a winter there, in order to compare the conditions and phenomena with our Arctic knowledge. The observations and data to be collected there throughout one year could not fail to produce matter of the deepest importance to all branches of science. I believe that such an achievement can be accomplished in these days with ships properly designed and fitted with the means of steam propulsion; nor is it chimerical to conceive a sledge party travelling over the glacier of Victoria Land towards the South Pole, after the example of Nordenskjöld in Greenland. Another interesting matter requires investigation, from the fact that all the thermometers supplied for deep-sea temperatures to Ross were faulty in construction, as they were then not adapted to register accurately beneath the weighty oceanic pressure. Moreover, another magnetic survey is most desirable in order to determine what secular change has been made in the elements of terrestrial magnetism after an interval of forty years and more, when taken by Ross. In fact, there exists a wide field open for investigation in the unknown South Polar Sea. This paper will, I trust, be the prelude for others to follow in arousing geographers and this powerful Association in promoting further research by despatching another South Polar expedition, having for its object to secure a wintering station. No other nation is so capable of providing and carrying it out. Even in the Australian colonies there exists the spirit and the means for such a noble enterprise.

Projected Restoration of the Reian Mœris, and the Province, Lake, and Canals ascribed to the Patriarch Joseph, by Cope Whitehouse, M.A., F.A.G.S.—The Berlin Geographical Society has published, in its *Zeitschrift* for May, 1885 (No. 116), the latest map of Egypt, from the Fayoum to Behnesa, and from the Nile to the Little Oasis. The text by Dr. Ascherson gives credit for a considerable area to the topographical observations presented to this society at Montreal. So much of the Reian basin as lies between the Quasr Qerûn and the Quasr Reian has not been visited by any European except the author of this paper (1882, 1883). It is now an accepted fact that there is a depression south of the Fayoum, not less than 150 feet below the level of the Mediterranean, with a superficial area at the level of high Nile of several hundred square miles. It is irregular in shape, curving like a horn from a point near Behnesa to the ridge which separates it from the Fayoum. In the southern part are two, and perhaps three, patches of vegetation, wild palm-trees, and ruins of Roman and early Christian date. This part was visited by Belzoni, May 22, 1819; Caillaud, November 24, 1819; Pacho and Müller, 1823–24; Sir G. Wilkinson, 1825; Mason Bey, 1870; and Ascherson, March 27, 1876. Dr. Ascherson determined by aneroid observations that his camp was 29 metres below the sea. Caillaud found ruins about +38m., or about the level of high Nile in the valley on the same latitude. The aneroid, theodolite, and other observations of March 6 and April 4, 1882, and April, 1883, by the author of this paper, established a depth of −175 to −180 English feet. The greatest depth is probably under the western cliffs south of the Haram Medhûret el-Berl. No previous explorer had conceived it possible that this might have been a lake within historic times. The level of the ruins, as determined by Caillaud, shows that the ancient station of Ptolemais might have been, as represented in the text and maps of Claudius Ptolemy, on a horn-shaped lake about 35 miles long and 15 wide, with a maximum depth of 300 feet, fed by a canal, partly subterranean, from Behnesa, as well as by a branch of the present Bahr Jûsuf communicating with it through the Fayoum. The lower plain of the Fayoum had been, at that time, fully redeemed, and the present Lake of the Horn reduced to such insignificant dimensions as to be unnoticed. The restoration of the Reian basin of Lake Mœris and the drainage by evaporation of the Birket el-Querûn would be a repetition in modern times of the best results reached in the Greco-Roman period, perhaps 3000 years after the first effort to utilise these two unique basins for storage and drainage.

On Batho-hypsographical Maps, with Special Reference to a Combination of the Ordnance and Admiralty Surveys, by E. G. Ravenstein.—The batho-hypsographical map, which exhibits the vertical configuration of the solid surface of the earth, above as well as below the ocean levels, is a product of modern times. It was Gerard Mercator who first inserted soundings upon a chart in 1585, but nearly two centuries passed away before Cruquins, in 1728, introduced the fathom-lines with which we are all familiar. Buache, and after him Ducarla, first suggested the introduction of contours upon maps, and their idea was realised in 1791 by Dupain-Triel on a map of France. The combination of these two descriptions of contoured maps we owe to modern German geographers, and more especially to Berghans, Von Sydow, and Ziegler. Cartographers, in effecting this combination, had hitherto quite lost sight of the fact that the heights on maps are referred to high or mean water, whilst the depths on charts represent soundings reduced to low water. This rough method gave satisfactory results when dealing with maps on a small scale, but a more rigid method would have to be applied when it was desired to combine accurate surveys like those made by the Ordnance and Admiralty Departments. The so-called mean level of the sea was not a suitable datum level, and it would be necessary to carry on tidal and other scientific observations on a far more comprehensive plan than had been done hitherto if a really satisfactory batho-hypsographical map of the British Islands were to become attainable. These various supplementary surveys, tidal observations, &c., it was to be hoped, would expand into a comprehensive scientific survey of the British seas.

What has been done for the Geography of Scotland, and what remains to be done, by H. A. Webster.—After remarking on the unsatisfactory state of the Ordnance Maps, Mr. Webster said that in regard to the depth of our lakes and rivers—and the submerged portion of a valley is geographically as interesting as the sub-aërial portion—absolutely no data are supplied by the Ordnance Survey. Nor, with a few individual exceptions, do they exist in an accurate and trustworthy form anywhere else. It was an open secret that, when this omission was pointed out to the Government by the Royal Societies of London and Edinburgh, the Lords of the Treasury refused, and again refused, to authorise a bathymetric lake and river survey being carried out, either by the officers of the Ordnance Survey or by those of the Hydrographic Department. Such a refusal could not be permanently accepted. It was to be hoped that when the Government was next urged to move in the matter they would be asked for more, and not for less. We required not only a hydrographic survey done once and for all (though that was worth the doing); we required a systematic registration of hydrographic facts throughout the country, in order that the true *régime* both of lakes and rivers may be known in detail and with scientific precision. The ignorant niggardliness of the British Government was in striking contrast to the conduct of those of some foreign countries. In Switzerland, for instance, there was a regular system of inland hydrographic observations, by which the *régime* of all the principal rivers was annually recorded and rendered easily intelligible by a series of graphic bulletins. In regard to a Swiss river we could tell the volume at any period of the year at several important points, and could compare the facts of 1884, for instance, with those of any year in the last two decades. Every one knew what a vast body of interesting data had for generations been accumulating about such rivers as the Po and the Rhone, and many had no doubt heard of the system of hydrographic stations recently established by the Italian Government in the basin of the Tiber. Why should we not endeavour to learn something definite and precise about the character of our own rivers? The investigation was only the natural complement, on the one hand, of the physical structure of the country, and, on the other hand, of its meteorology. Our Scottish Meteorological Society had now succeeded in establishing meteorological stations throughout the country; let hydrographic stations bear them company along our principal rivers. Rainfall and river discharge were mutually illustrative.

On Overland Expeditions to the Arctic Coast of America, by John Rae, M.D., F.R.S.—The following table shows the approximate amount of geographical work done by the expeditions under—

			G. M.		G. M.	G. M.
1821.	Franklin & Richardson ...	on foot ...	35	in canoes	415	450
[1] 1826.	,, ,, ...	,, ...	90	in boats	955	1045
				Total ...	...	1495
1834.	Back	in boat / on river ...	120	in boat / on coast	105	225
1837. [2] 1838. 1839.	Dease & Simpson (H. B. Co.)	on foot ...	95	in boats	722	817
1847. [3] 1851. 1853-4.	Rae (H. B. Co.)	sledging / on foot ...	1123	in boats	369	1492
				Grand total	...	4029

A Word or Two on the Best and Safest Route by which to attain a High Northern Latitude, by John Rae, M.D., LL.D., F.R.S., F.R.G.S., &c.—The plan proposed is that the route by the west shore of Spitzbergen should be taken by one, or perhaps two, steamers similar to the fine vessels used in sealing and whaling at the present time. That after forcing the ice "pack" at the north-west end of Spitzbergen, a north-east course towards Franz-Josef Land should be followed. That a depôt of coals should be placed at a convenient harbour in North Spitzbergen. Extracts are given from Parry's "Narrative," 1827, pp. 101 and 148, showing how open and small the ice was in latitude 82° 45′ N. The southern drift of the ice that so obstructed the advance of Parry's boats will be no great impediment to a powerful steamer, whilst if she gets helplessly fixed in the pack she will drift homewards with it. No well-equipped and powerful steamer has tried this route.

[1] Actually two expeditions—one east, the other west.

[2] Dease and Simpson had to pass over about 500 miles of previously traced coast before getting to new ground, but Franklin and Richardson were on new ground at once on reaching the coast.

[3] Of the coast, &c., traced by Rae, 1123 miles were done by sledging, believed to be the most laborious of Arctic work.

JAPANESE TATTOOING

THE last number (Heft 32, May, 1885) of the *Mittheilungen der deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens* is almost wholly occupied by a paper of a most exhaustive character by Dr. Baelz, a physician in the service of the Japanese Government, on the physical qualities of the Japanese. A previous paper by the same writer gave the results of his investigations into Japanese skeletons. For the purposes of the present paper he obtained numerous anthropometrical measurements—about 2500—based on a scheme which included seventy-nine measurements in the case of each individual. It is noticeable that Broca confined himself to little more than a third of this number, Virchow's scheme contemplated thirteen, and at the most thirty-eight, Weissbach sixty-seven, and Quetelet, in his anthropometry, gives eighty-two measurements. The skeleton plan of the paper is as follows: 1. Skin and hair: the colour of the skin and its cause, artificial colouring, including tattooing, the characteristics and nature of the hair; 2. The *physique* in general, including the carriage and gait of both sexes, weight, size, and growth; 3. Measurements of the body and limbs. In the discussion of the results set forth in this section the author expresses the opinion, based on his own investigations, that in general the value of these anthropometrical measurements is much exaggerated by anthropologists and ethnographers.

The tattooing of the skin by Japanese, generally those of the lower classes, has attracted much observation from Europeans, due partly to the extraordinary elaboration and artistic skill displayed, partly to the fact that the occupations and customs of the class in which tattooing is most practised are such as to render it necessary frequently to wear none but the most indispensable garments. This subject has never, so far as we are aware, been examined with so much thoroughness and care as by Dr. Baelz. He says that among the various peoples which have, in the course of centuries, reached a high standard of culture the Japanese are probably the only race which have retained generally the practice of tattooing and have brought it to a state of highly artistic development. Up to a few years ago the practice was so widespread that in Tokio alone there are estimated to have been, possibly still are, 30,000 men who were tattooed. This decoration is not confined, as in Western countries, to a small part of the body, but it covers the whole back and a considerable part of the limbs. The head, neck, hands, and feet are never tattooed, a circumstance of importance in explaining the practice. It was confined to the lower classes; amongst the better classes it was considered unworthy to disfigure the body in this way. It was widely spread amongst the workmen in great towns and coolies, and even to-day it is exceptional to find an old man of either of these occupations who is not tattooed. The objects illustrated were various: amongst the most common were large dragons, lions, battle scenes, beautiful women, historical occurrences, flowers, &c. Dr. Baelz states that he never saw obscene pictures tattooed. The colours employed are black, which appear blue, and various shades of red. The first is obtained from Indian ink, the usual Japanese writing material, the red from cinnabar. When a man wishes to undergo the process he looks out in a popular picture-book some illustration which takes his fancy, or he evolves something from his own imagination, and goes with it to the artist. The latter makes his arrangements, and sketches the picture on the skin. If he is skillful at his calling he sketches the merest outline, and straightway introduces all the details; but if he is not so confident in himself he first draws the whole picture on the skin. There is no special ceremony attending the work as in some of the South Sea Islands, nor is there any religious signification whatever in the process. The artist uses for the purpose exceedingly fine, sharp sewing needles, fixed firmly, four, eight, twelve, twenty, or forty together, in a piece of wood. They are arranged in several rows; when there are forty they stand in four rows of ten each. The points are quite even, except when it is desired to produce a light or dark shading, when the needles are arranged in corresponding lengths. This combination is said to be especially painful. The skin, at the place where the puncturing is going on, is stretched between the thumb and first finger of the operator, who holds between the third and fourth fingers of the same hand a writing brush with ink or cinnabar, as may be required, on it. He holds the wood containing the needles in his right hand, and, having put the colour on them, he rests the hand on the thumb of his left hand, and then proceeds with extraordinary rapidity to puncture the skin, stopping every now and again to put on the fluid anew. Dr. Baelz counted on one occasion ten punctures per second, and as there were ten needles the person being tattooed received one hundred punctures per second. The wonder is that with such speed excellent pictures, with various degrees of shading, can be produced, but such is the fact. A skillful operator can in this way puncture the back or breast and stomach of a grown man in a day. A few hundred thousand punctures are necessary for this purpose. The patient, if he may be so styled, does not suffer so much pain as might be expected. The punctures are not very painful, they tickle rather than hurt. No blood is drawn; a circumstance which shows that the needles do not reach the cuticle, and which also explains the slight pain of the operation, and the possibility of enduring it. This, however, is not the case always, for in many parts of the body where the skin is tender, or where a deeper shade is required, some clammy blood comes slowly to the surface, and the operation becomes painful. This occurs most frequently at the knees and elbows. To be well tattooed, therefore, is taken as a sign of manly vigour and endurance. As soon as the sitting is over the punctured parts are bathed with warm water, which produces a slight pain. The colour then comes out more clearly than before, and the patient can do as he likes. No special diet is ordered. A few hours after the operation he often has a slight feverish feeling, but this soon leaves him. After about three days the skin scales off like bran, but the tattooed parts are never irritable or sensitive, and the man goes about his work as usual. There are cases in which women have been tattooed, but these are very rare. The women are mostly dissolute who allow this to be done; but it is said that the colours come out with great clearness and beauty on the comparatively fair skins of women. Recently tattooing has been prohibited by law under the impression that it is a barbarous custom unworthy of a civilised people. But Japanese tattooing is so superior to that of all other nations that European sailors are said to look forward to it as the principal advantage in a visit to the land of the Rising Sun.

This being the method in which the practice is carried out, Dr. Baelz comes to discuss its origin and meaning. The oldest reference we have to tattooing in Eastern Asia states that a Chinese prince, about three thousand years ago, who was nominated heir to the throne against his will, had himself tattooed in order to render his succession impossible. But at the present day the practice in China and Korea has fallen into desuetude, while in Burmah it still appears to be in vogue. In 1872, a man was exhibited in Europe who had been a prisoner amongst the Burmese, and who was tattooed from the crown of the head to the sole of the foot. The practice is still prevalent amongst the South Sea Islanders and the American Indians. In his work on the origin of writing, Wuttke seeks to show that tattooing is a kind of writing; but however correct this theory may be in the case of the tattooed peoples known to him, it certainly does not hold good in the case of the Japanese. The signification of the practice, says Dr. Baelz, amongst the latter is quite distinct from that which it has amongst other peoples. In the first place, amongst the South Sea Islanders and the Indians, tattooing has a religious, a symbolical meaning; it is a ceremonial, frequently a sacred process. There is nothing of this in Japan—neither ceremony, nor other peculiar meaning; it is done for cosmetic purposes and for no other. Again, amongst other peoples tattooing was a species of distinction; it marked the heroes, leaders, chiefs, of the tribe. In Japan it marks a man of the lower classes. Elsewhere, also, the uncovered parts of the body, such as the face, neck, hands, &c., are the favourite spots for tattooing; in Japan it is only the portions usually clothed which are tattooed. It is noticeable that amongst the Ainos the tattooing takes place on the exposed parts of the body, and that it is largely practised by women. two circumstances which distinguish it from the practice amongst the Japanese, and in which the Ainos resemble other northern peoples such as the Esquimaux, the Ostiaks, and others. In answer to the question, What meaning has the practice amongst the Japanese, as distinct from other races? the author replies that in Japan tattooing is a garment, a decoration. Various proofs of this statement are advanced, amongst them being the following: only those parts of the body are tattooed which are usually covered; all workmen do not tattoo themselves, but exclusively those whose work causes excessive perspiration, and who can, therefore, work best in a semi-nude state, such as runners, grooms, bearers, &c., and amongst these the practice prevails only with those who have connection with large towns, where nudity would be objectionable. Their garments are tattooed on their bodies, and they appear clothed without clothes before the public. The peasants are never tattooed. Again, the colours of the tattooing corresponds with that of the dress; it is the same dirty, dark blue. This theory never suggested itself to the Japanese: they thought that it must have come from China, and that it was a species of punishment. It was, it is true, at one time the custom to tattoo marks into criminals, but this was confined to a ring on the elbow. It would not explain the spread of the practice amongst certain classes in certain directions. Dr. Baelz's theory that it is merely a substitute for dress, and as the wearing of clothes is now compulsory, tattooing has lost its meaning. As for its origin, the peoples around the Japanese, the Ainos and the Loochooans, have practised it; and the Japanese navigators who travelled far and wide in the Eastern seas in the sixteenth century might well have seen it elsewhere. The Japanese discovered, says Dr. Baelz, that man can paint a figure on his skin which the rain cannot wash away, the sun wither, or even all-devouring Time destroy, and with their instinctive artistic skill they gradually developed and perfected the original rude figures in idea and execution. At first few only wore this blue skin-dress, but these few appeared to their companions decorated and clothed (a tattooed person does not appear actually naked), and as such a garment was cheap and lasting, and every man could have it according to his own fancy, tattooing became the fashion.

It may be added here that among the Igorrotos of the mountanious districts in the north of Luzon tattooing is also exceedingly elaborate, although it consists rather of a series of lines, curves, &c., than of one large, elaborate picture. Dr. Meier, in a paper read not long since before the Anthropological Society of Berlin, described the Igorrotos as tattooing the hands, arms, breast, and also part of the legs. The back is untouched except by one tribe. A picture of the sun, as a number of concentric circles on the back of the hand, is the commonest object represented. The process takes place at puberty, and is a long one, as the punctures (which are made with a three-pointed instrument which is clumsy in comparison with the Japanese needles) become inflamed and take a long time to heal. The tattooing of the Buriks, a tribe of Igorrotos, takes three or four months to complete.

It may not be out of place here to refer to Dr. Baelz's account of the Japanese use of moxa, which, like tattooing, comes into his section dealing with the skin. On the bodies of almost every Japanese, and sometimes on every part of the body, one sees round white spots. These are the moxa spots, produced by burning the flesh with a species of plant, with the object of curing some affection. This is a universal popular specific in Japan, which is its home, although moxa is to be found used elsewhere. It was introduced from Japan to Europe by the Portuguese and Spaniards, and the name is Japanese. In May the leaves of the *Artemisia Chinensis* are powdered and dried, and the mass cut into small blocks or pieces. One of these is laid on the body and set on fire, burning slowly away. At first it naturally produces a sore, more or less deep, according to the intensity of the heat; soon this heals, leaving the scar for ever. The belief in the efficacy of this process is universal, and, Dr. Baelz thinks, not altogether misplaced, for the moxa acts much as our blisters do. Moreover, from the accounts of those who have gone through the cure, it is by no means so painful as one would anticipate from the heroic nature of the remedy.

SCIENTIFIC SERIALS

American Journal of Science, August.—Origin of coral reefs and islands, by James D. Dana. The arguments recently raised by Dr. A. Geikie against Darwin's theory of subsidence as an explanation of the formation of *atolls*, or barrier reefs inclosing a lagoon, are discussed and shown to be largely based on misunderstandings of the facts. It is pointed out that local elevations within the sinking area are not evidence against a general subsidence, such local disturbances and faults being almost necessary concomitants of subsidence. The conclusions as to changes of level in the large Pacific groups south of the equator agree mainly with Darwin's views, and the subsidence indicated, according to him, by *atolls*, is shown to be real, not an apparent sinking due to change of water-level.—On the meteorite of Tomatlán, Jalisco, Mexico, by Charles Upham Shepard. The striking peculiarity of this stone, which fell in August 1879, is the prevalence everywhere of octahedral crystals of nickeliferous iron. The specific gravity of the two fragments examined was 3·47—4.43.—On the widespread occurrence of allanite as an accessory constituent of many rocks, by Joseph P. Iddings and Whitman Cross. From its mode of occurrence and association the authors conclude that allanite must now be added to the group of primary, accessory rock constituents, similar to zircon, sphene, and apatite, though much rarer than any of these. In some regions it appears to be quite uniformly distributed through certain types of rock, such as the porphyrites and allied porphyries of the Ten Mile District, Colorado.—Crystals of analcite from the Phœnix Mine, Lake Superior Copper Region, by Samuel L. Penfield. These crystals, which occur thickly grouped together on calcite and native copper associated with tabular crystals of apophyllite, are of all sizes from minute particles up to one centimetre in diameter. The small ones are simply tetragonal trisoctahedrons of the form (211), 2 – 2; the larger ones are of the same form, but with the planes differently arranged.—On a differential resistance-thermometer, by T. C. Mendenhall. This instrument has been devised and constructed for the study of certain problems connected with meteorology, especially the observation of soil and earth temperature, and the use of which would not demand greater skill than that of the ordinary meteorological observer. It consists essentially of a mercurial thermometer, not unlike ordinary forms, except that the bulb is greatly enlarged, so that the stem may have a diameter of about a millimetre, still leaving the scale tolerably open. By its means observations may be taken in less than a minute, no time being consumed in the preparation of liquids of known temperature at the observing station, as in the use of the thermo-junction on the resistance coil.—Impact friction and faulting, by George F. Becker. The author discusses the phenomenon of "step faults," as described in Mr. Geikie's "Text-Book of Geology," p. 532, which he concludes to be not merely local, but of general occurrence.—A standard of light, by John Trowbridge. Objections are raised to the standard adopted at the Paris Conference of 1881–4—that is, the light emitted by a surface of platinum at the point of solidification. A more satisfactory standard might be an incandescent strip of platinum radiating a definite amount of energy, this energy being measured at a fixed distance, which will best agree numerically with the absolute system of measures now universally adopted in heat and electricity.—On hanksite, a new anhydrous sulphato-carbonate of sodium from San Bernardino county, California, by W. Earl Hidden. This new Californian mineral has a density of 2·562, hardness 3·—3·5, and is readily soluble in water, yielding an abundant precipitate of barium sulphate when barium chloride is added to the solution. The author names it "hanksite," after Prof. Henry G. Hanks, whose name is so intimately associated with the mineralogy of the Pacific coast.—Mineralogical notes, by Edward S. Dana and Samuel L. Penfield. The chief subjects of this paper are the analysis of a large crystal of hanksite from California and an artificial crystallised lead silicate from the Desloge Lead Company, St. François County, Missouri.—On the amount of moisture which sulphuric acid leaves in a gas, by Edward W. Morley.—Local deflections of the Drift Scratches in Maine, by G. H. Stone. Traces of these indications of secondary glaciation have been observed, especially in the Sebasticook Valley, the Belfast and St. George River districts.—Successional relations of the species in the French Old Tertiary, by Otto Meyer. In these, as well as in the corresponding American formations, many animal and vegetable species can be traced along through the succeeding strata, the latter being apparently connected by descent with the earlier forms. The paper is accompanied by a comparative table of Lower, Middle, and Upper Eocene and Oligocene forms illustrating this principle.

The American Naturalist for August contains notices of some human remains found near the City of Mexico, by Mariano de la Barcena.—Evolution in the vegetable kingdom, by L. F. Ward.—The relations of mind and matter, by Charles Morris.—Affinities of Annelids to Vertebrates, by E. A. Andrews.—The use of copper by the Delaware Indians, by J. C. Abbott.—Notes of recent literature, &c.

Bulletin de l'Académie Royale de Belgique, June.—Note on some derivatives of tetrabromuretted hydrocamphene, by M. De la Royère.—On certain developments of algebraic series; the general formulas of these developments and their application to special cases, by M. J. Deruyts.—Researches on the action of a beam fixed at both ends and subjected to a movable overcharge, by M. G. Leman.—Questions of indeterminate analysis, by M. E. Catalan.—Note on the motions of the human brain, by M. Léon Frédéricq.—A new process of vivisection for the physiological study of the thoracic organs, by the same author.—On the optical properties of Ludwigite ($R_4FeB_2O_{10}$), by M. A. F. Renard.—Determination of the coefficient of compressibility for some fluids and of the variations of this quantity under different temperatures, by M. P. De Heen.

Rendiconti del Reale Istituto Lombardo, July 23.—On the causes and treatment of certain ophthalmic affections (preliminary note), by Dr. R. Rampoldi.—An exposition of the third paragraph of Riemann's memoir on the theory of the Abelian functions, by Prof. Giulio Ascoli.—Further researches on the neutralising agents of the tubercular virus, by Prof. G. Sormani and Dr. E. Brugnatelli.—Toxico-chemical affinities and differences of gelseminina and strychnine, by Dr. C. Raimondi.—On the phenomenon of etherification by double decomposition, by Prof. G. Bertoni.—The mental infirmities and last days of Torquato Tasso, by Prof. A. Corradi.—Note on an artistic palimpsest of the fourteenth century, by Prof. G. Mongeri.—Meteorological observations made in the Brera Observatory, Milan, for the month of July.

Rivista Scientifico-Industriale, July.—On the solar spots, their origin, nature, and harmless character, by Prof. Annibale Ricco.—Application of the telephone to the study of vibrating columns of gas, by Prof. Fossati.—A contribution to the study of etherification by double decomposition, by Prof. Giacomo Bertoni.—Geological constitution of Mount Vincigliata in the Fiesoli range, by C. del Lungo and R. Cocchi.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 28.—M. Bouley, President, in the chair.—Equilibrium of the moon, by M. F. Tisserand. In this paper calculations are submitted in support of M. Ch. Simon's theory, supplemented by M. Poisson, that, neglecting the excentricity of the lunar orbit, the axis of rotation is displaced in the interior of the moon in such a way as constantly to oscillate in the plane perpendicular to the main axis directed towards the earth.—Note on earthquakes, by M. A. d'Abbadie. The author gives an account of the seismic movements observed by him last winter in Egypt, where the seismograph was exceptionally active. He urges a systematic study of these phenomena in France, such as has already been commenced by M. E. de Rossi in Italy, and by Mr. Milne in Japan.—Researches on the nitric cellulose substances (gun cotton, &c.), by M. Ch. Er. Guignet. The constituents and properties are described of the four distinct nitric cellulose bodies hitherto determined, all of which may be regarded as derivatives of the cellulose $C_{48}H_{40}O_{40}$, where 4eq., 6eq., 8eq., or 10eq. of water are replaced by the same number of equivalents of hydrated nitric acid.—Memoir on the treatment of phylloxera by means of the organic sulphurs and the polysulphides of ammonium obtained by dissolving powdered sulphur in the night-soil of cesspools, by M. J. Jullien. This treatment is described as inexpensive, thoroughly efficient, and applicable to every description of soil.—Note on an unpublished document by Sergio Venturi, dated February 26, 1610, on the invention and the theory of the telescope, recently edited by M. G. Govi. This letter, addressed by the writer to the Marquis John Baptist Manso at Naples, is specially interesting as being anterior to the earliest publications of Galileo on the telescope which had just been invented by Lippersheim in Holland.—Note on the separation of liquefied atmospheric air into two distinct fluids, by M. S. Wroblewski.—Description of two new types of condensing hygrometers, by M. Georges Sire. The essential character of these hygrometers is that the moisture is precipitated on a bright metallic surface without solution of continuity. Perfect equality of temperature is secured in both instruments by the agitation of the volatile fluid and the thinness of the walls of the cylindric tube.—Genesis of the crystals of sulphur in square tables (five illustrations), by M. Ch. Brame. The author's experiments on the genesis of the square tables of sulphur show the direct passage from the curve to the straight line in the development of these crystals.—Morphology of the mandibule of the hymenoptera, by M. Joannès Chatin. This organ of the hymenopteræ is shown to be perfectly analogous in all its parts to that of the grinding insects.—Note on the application of thermo-chemistry to the explanation of geological phenomena, continued; iron ores, by M. Dieulafait.

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