THURSDAY, MARCH 23, 1876

FRENCH AND SWISS TROGLODYTES

Reliquiæ Aquitanicæ; being Contributions to the Archæology and Palæontology of Perigord. By Edouard Lartet and Henry Christy. Edited by T. Rupert Jones, F.R.S. (London: Williams and Norgate, 1875.)

Excavations at the Kesslerloch near Thayngen, Switzerland. By Conrad Merk. Translated by John E. Lee, F.S.A., F.G.S. (London: Longmans, Green, and Co., 1876.)

ALTHOUGH the term Aquitaine employed in the title of this work is used in its widest sense as embracing the whole country between the Loire and the Cévennes, the prehistoric researches recorded in the seventeen quarto numbers of it, which have appeared periodically, commencing in December 1865, are confined to the Province of Perigord, and chiefly to the valley of the Vezère, a tributary of the Dordogne.

Here the river, which has cut its way deeply into the cretaceous rocks of the district, has formed a narrow tortuous valley, bounded on either side at intervals by cliffs rising to a height of 300 feet in some places. Above this the surrounding country forms an extensive plateau, varying in altitude, but rarely rising to any great height above the summit of the valley.

Owing to the different degrees of hardness of the calcareous rocks which form the precipitous sides of the valley, the weathering of the face of the cliff has been very unequal, the softer portions yielding to the action of the atmosphere have formed deep grooves, and in places, caves as much as 30 feet in depth have been formed, extending some of them, for a hundred yards or more along the sides of the cliff. As these caves afford convenient places of shelter, they have been occupied as residences by the inhabitants of the valley at many different periods, but more particularly by a race of prehistoric Troglodytes, who form the subject of the present work.

The presence of these people is indicated by successive layers of *débris* beneath the present floors of the caves denoting successive periods of occupation, and separated from each other in some places by a coating of stalagmite of considerable thickness. The small distance of some of the caves above the river proves that the latter can have deepened its course but little, if at all, since the caves were occupied by prehistoric men; the cave of La Madelaine, in which numerous works of art of the Troglodytes have been found, is but little above the level of extraordinary floods of the river at the present time, whilst those of Le Moustier and Les Eyzies are 90 and 100 feet respectively above the river. The position of the caves, consequently, affords little or no evidence as to the age of their contents, which has to be determined in two ways, firstly, by the associated animal remains; and secondly, by the nature of the relics of human workmanship. From both of these sources we derive proof of the greater antiquity of the Le Moustier cave than those of La Madelaine, Les Eyzies, and Laugerie Basse, in the same valley.

Comparing the fauna of these caves with that of other well-known finds of the prehistoric era elsewhere, we find that the following sequence has been established. Summarising briefly, and omitting for the sake of clearness many details which ought, nevertheless, to have weight in a full consideration of the subject, the following are the animals, the remains of which are most prevalent in the different prehistoric periods. In the Drift, the mammoth, rhinoceros, horse, and ox, are the predominant animals, and the reindeer appears but sparingly. In the cave of Le Moustier the mammoth and reindeer are both found, but the latter is still found sparingly. In the other caves of the valley the same fauna is found, but the remains of the reindeer are abundant, and these caves are consequently attributed "par excellence" to the reindeer period. In the kitchen middens of Denmark both mammoth and reindeer are absent, and the class of domestic animals is represented only by the dog. In the oldest of the Swiss lake villages the mammoth and reindeer are also absent, although they existed formerly in the neighbourhood, as shown by the contents of the caves, and domestic animals are abundant. Both mammoth and reindeer are wanting in all the tumuli and other prehistoric monuments of the Celtic period, in Gaul, showing that they must have disappeared from this part of Europe before that time.

Turning now to the relics of human industry, we find a corresponding sequence in the different ages. In the Drift, none but the large, rude, flint tools known as the Drift type are found. In the cave of Le Moustier these large rude tools are also found, and here only amongst the caves of the valley, and they pass gradually into another form known as the side tool or scraper, which is also wanting in the later caves, where they are replaced by lance heads of finer make and finish. In these also, carved harpoon heads of bone begin to appear, and engravings of the mammoth and reindeer, scratched by the hand of man on fragments of horn and bone. No pottery or ground axes are found in any of the caves, nor was the art of spinning known. In the Danish kitchen middens, ground axes are found, though rarely; pottery is frequent, and the art of spinning in some form appears to have been introduced. In the oldest of the Swiss lake habitations, ground axes and pottery are abundant; spinning, weaving, and the cultivation of wheat was well known.

From the study of their arts we are led naturally to inquire into the physical peculiarities of the inhabitants of the caves; on this point, however, our evidence is somewhat meagre. Skulls of a brachycephalic type, and others approaching to that form, had led Dr. Pruner-Bey to attribute the inhabitants of France of the reindeer period to a Mongol origin, but in these caves we are introduced to a race of men whose form of cranium is decidedly dolichocephalic. In the valley of the Vezère at Cro-Magnon not far from Les Eyzies, a cave was discovered and explored by M. Louis Lartet, which contained the remains of four individuals. These remains were situated at the back of the cave, above a series of deposits which marked successive periods of the occupation of the cave, and the whole cave had been filled up by a talus which had fallen from above. The animal remains found in the relic beds of the cave consisted of bear, mammoth, lion, and horse. Reindeer was also found but in small quantities, and this circumstance, coupled with the absence of carved or engraved bone, led the explorers to attribute the find to the earliest cave period. The position of the human remains, however, above the relic beds would, as Mr. Boyd Dawkins has shown in his work on "Cave-Hunting," be sufficient to throw doubt on their contemporaneity with the other relics of the cave were it not that skeletons have been since found in other caverns in the valley, and more particularly in that of Laugerie Basse, in positions which make it certain that they are of the age of the works of art found with them, and these skeletons correspond in their osteological peculiarities with those of Cro-Magnon. In both places the skulls are dolichocephalic, and both afford instances of men of large stature having platycnemic tibias, one of those from Cro-Magnon being, according to Boyd Dawkins, the extremest case of platycnemism on record. We have therefore good grounds for believing that markedly different types of mankind existed in the south of Europe during the reindeer period. This result has been held by polygenists to afford satisfactory confirmation of their views, but we may be permitted to doubt the validity of such conclusions. If, as has been suggested by Prof. Huxley, this part of Europe was occupied in the earliest times by a race of Melanochroi, consisting of a mixture of the dark long-headed race of the south with the fair and presumably short-headed race of the north, it is evident that types as divergent as any that are to be found at the present time must have existed amongst the earliest known inhabitants of this region. A long previous period of geographical separation under different climatic conditions would be sufficient to give permanence to varieties as distinct as any that have been brought to light by the researches of Anthropologists. We are far from believing that the reindeer period has carried us more than a short way towards the origin of the human race.

Since the explorations of Messrs. Lartet and Christy were brought to a close, another chapter has been added to the history of the reindeer period by the discovery of Mr. Conrad Merk in the cave of Kesslerloch, near Thayngen, in Switzerland; the value of this discovery is greatly enhanced by its vicinity to the relics of the later inhabitants of the lakes. Had the lake habitations been occupied at the same time as the cave, evidence of connection must undoubtedly have been found, but the contents of the cave point undeniably to a period contemporaneous with the remoter Troglodytes of the Dordogne. Amongst the fauna the presence of the mammoth, rhinoceros, cave-bear, lion, and reindeer are alone sufficient to warrant this conclusion, whilst at the same time the works of art show a most remarkable resemblance to those of the French caves, and an equally marked contrast to those of the oldest of the Swiss lake villages. The carved harpoon heads of bone, the absence of pottery, the presence of deer-horns perforated with large holes bored from both sides, the use of which is unknown, and above all the engravings of animals, especially the reindeer, upon the horns of those animals, show that a condition of culture corresponding to that of the Dordogne people must have existed here.

Opinions differ as to which of the two localities have produced the highest types of art; the difference of style observable in the engravings is such as might be expected to exist amongst remote tribes, but the resemblance, when compared with the productions of other races of savages is no less remarkable.

One of the engravings, attributed to the cave at Kesslerloch, calls for a few remarks. Of the genuineness of the relics discovered in this cave, no doubt has been entertained, with the exception of two. One of these, said to have been found by a workman in a heap of rubbish after the excavations had been completed, and under circumstances which gave rise to suspicion, represents a fox drawn front view, with the hind quarters foreshortened. The specimen has been placed in the Christy collection in Victoria Street, not as a genuine relic of the cave, but for convenience of future reference. It is worthy of observation that in all the genuine engravings from the caves of both places the animals are invariably drawn with a side view, and generally following each other in the same direction, much as a child might have drawn them, and the same peculiarity is often to be noticed in the bone engravings of the Esquimaux. The forger of Kesslerloch was no doubt not aware of this, or a feebler exercise of his artistic talent would have served him in better stead. He has, however, done good service by drawing attention to the fact that the fore-shortening of a figure represents a phase of art at which the men of the reindeer period had not arrived. Surprise has been expressed by many at the truth and freedom of some of these designs, appertaining to so remote a period of man's history; but when we consider how early the power of drawing animals is shown by many of our own children, and how much pleasure they take in exercising it, we need not wonder that a great development of the faculty of imitation should be found to exist side by side with the proofs of a low condition of culture. Upon the whole we see nothing in these or any of the prehistoric discoveries of our time to weaken our faith in a slow but continuous progression from lower to higher forms of art and industry.

THE BOTHKAMP SUN OBSERVATIONS

Beobachtungen angestellt auf der Sternwarte des Kammerherrn von Bülow. Heft III. Edited by Dr. O. Lohse.

WHOEVER knows the good work that has been done at the Solar Observatory at Bothkamp will hear with regret that the observatory has ceased to exist. It seems that the work was discontinued as soon as Dr. Vogel left it to take his place in the new observatory of Berlin. The history of M. von Bülow's observatory is a fresh proof that work which requires long and continued observations cannot be made dependent on the generosity of a single man, but must be carried on by the State; yet everybody will join in Dr. Lohse's hope that the proprietor of the observatory, to whose liberality we are indebted for the observations made during many years, by Dr. Vogel and Dr. Lohse, and for their publication, will decide to continue his generous and useful work at a future time.

In two previous parts Dr. Vogel has given us the results of his observations, and we are promised a fourth part containing some further researches of his. The third part, which has just appeared, contains the work done by Dr. Lohse.

The paper consists in great part of tables containing his observations. The list of sun-spots at the end of the publication and the various extracts from the note-book will prove very useful to those who are engaged in researches of a similar kind. The observations seem to have been conducted with great care, and Dr. Lohse gives us in every case the exact method by which the measurements have been made.

If we endeavour to review a work which is not being continued, at least for the present, we rather turn to the actual results of the observations than to a mere list of accumulated facts. This list, no doubt, may prove hereafter to be the most important part of the work, yet it is only made important by those who discuss the observations. The more doubtful and hypothetical part, containing the conclusions, is therefore the better test for the moment, for we must not forget that without a guiding idea a mere tabular arrangement of facts is useless.

One of the most curious results of Dr. Lohse seems to be the discovery of a period of fifty days in the eruptive activity of the sun. Dr. Lohse took from the drawings of protuberances published by the Spectroscopic Society of Italy, the area of the protuberances as shown in the drawings for each day, and made a curve in which the times of observation formed the abscissæ and the area of the protuberances the ordinates. This curve first shows maxima and minima corresponding to maxima and minima of sun-spots. It next shows a short period of fifty days. During the years 1871, 1872, and the beginning of 1873, this period was well marked. From the middle of 1873, however, the whole solar activity became so small, owing to its chief periodicity of eleven years, that these secondary maxima cannot any more be distinguished.

We turn now to the spectroscopic observations, in which Dr. Lohse was led to somewhat similar conclusions as Mr. Lockyer. It is a well-known fact, that while nearly all the elements standing at the positive end of the electro-static series are found in the sun, we have as yet obtained no decided evidence of the more electro-negative elements. On the other hand, it is not probable that the sun should not contain so many bodies which play an important part in our world. Both Mr. Lockyer and Dr. Lohse came to the conclusion that we must look in the outer and cooler layers of the sun's atmosphere for evidence of the metalloids, but while Mr. Lockyer assumes that they exist as well in the hotter parts of the solar envelope, but under such conditions that we cannot identify their spectra, Dr. Lohse assumes that they do not exist except in the outer layers of the corona. Dr. Lohse is thus forced to assume a force in the sun which drives all the more electro-negative elements away from its centre. This is an hypothesis which we cannot accept, unless we have independent evidence in its favour, or unless it is the only one which will account for the facts; just as we could not accept Mr. Lockyer's hypothesis, if we had no evidence of changes in spectra produced by variations of temperature and pressure. Mr. Lockyer's hypothesis has a decided advantage over that of Dr. Lohse, for we have recently obtained such strong proofs of the changes of spectra produced by a variation of temperature and pressure, that we cannot help thinking that, had Dr. Lohse been acquainted with all these recent experiments, he would have come to the same conclusion as Mr. Lockyer. This conclusion, indeed, seems inevitable, if it is once assumed that the metalloids really exist in the sun. It is important to mention that this presence of metalloids in the sun is rendered still more probable by the fact that the red and most likely cooler stars give spectra containing fluted bands.

It is interesting to notice that Dr. Lohse finds many of the unknown dark lines contained in the blue end of the solar spectrum to be reproduced in the spectrum of *α* Herculis, and although weaker in that of *α* Orionis, while they are absent in that of *α* Bootis.

Dr. Lohse does not seem to arrive at any results differing much from those of other observers in his observations on faculæ and sun-spots. It is a matter of regret that he, most likely for the sake of brevity, does not enter more fully into the explanation of his own views. A discussion of ideas described in such a cursory manner is impossible, as such a description is necessarily incomplete.

We hope that Dr. Lohse will have occasion to follow out his researches, and do not doubt that he will be rewarded by most interesting results.

ARTHUR SCHUSTER

OUR BOOK SHELF

The Absorptive Glands of Carnivorous Plants. By Alfred W. Bennett, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas's Hospital. Read before the Royal Microscopical Society, Dec. 1, 1875. With one plate.

MR. BENNETT notices the occurrence in *Drosera rotundifolia*, *Pinguicula vulgaris*, and *Callitriche verna* of peculiar bodies, which at first sight might be mistaken for stomata, and consisting of two nearly hemispherical cells filled with protoplasm. Each of the hemispheres contain a darker nucleus-like spot, and each is surrounded by a thin-walled cell containing chlorophyll. From these hemispherical bodies are developed the papillæ with thin walls and containing chlorophyll. *Drosera* and *Pinguicula* are carnivorous, and Mr. Bennett suggests that *Callitriche* may also be carnivorous, from the occurrence of these peculiar bodies. It seems probable that they are really as Mr. Bennett thinks, absorptive glands, and they certainly bear a strong superficial resemblance to the quadrifid processes found and described by Darwin in *Utricularia* and *Genlisea*. The subject is a very interesting one, and it is to be hoped that further research will throw more light on the matter. It is rather difficult to get a clear idea of the structures from the plate, which seems a little out of drawing, and rather confusing.

W. R. MCNAB

Reseña de las Rocas de la Isla Volcánica Gran Canaria. Por Don Salvador Calderon. (Reprinted from the Anales de la Sociedad Española de Historia Natural. Tomo iv.) Madrid 1876.

IN this work, which is appropriately dedicated to M. Berthelot—to whom we owe one of the earliest descriptions of the geology of these interesting islands—the author gives some valuable information concerning the relations of the different classes of volcanic rocks to one another. He also describes some of the vast "Calderas" or craters so characteristic of this group of islands, and notices the theories which have been proposed to account for their origin. Of especial interest, however, is the account which he furnishes of the nature and composition of the different varieties of volcanic rocks, and the classification which he proposes for them. It would appear from this work of Señor Calderon, that the true or "sanidinetrachytes" have not yet been found in these islands, but that the predominant felspathic constituent of the more acid rocks is always plagioclastic. Hence they are described under the names of Andesite, Trachy-dolerite, and Trachy-diorite. The first of these would appear, from the definition given, to correspond with the well-known lavas of Hungary, the last to resemble the greenstone trachytes or "propylites" of the same country. These trachytic rocks are found to assume at times a vitreous character, thus passing into obsidian; and they occasionally exhibit the perlite modification of structure. The basaltic rocks, noticed by the author, do not appear to offer any features of special interest.

La Biologie. By Dr. Charles Letourneau. Bibliothèque des Sciences Contemporaines. (Paris: C. Reinwald et C^ie^., 1876.)

THIS small work within five hundred and fifty pages gives a concise description, in a popular form, of the phenomena exhibited by living organisms. "C'est une œuvre de vulgarisation," intended for the commencing student and the amateur. Such being the case many important facts have to be omitted, and much has to be embodied in a general form. As in most works many of the broad statements are apt to mislead. It is all very well to say, as does Dr. Letourneau, that the heart is trilocular in the reptiles and quadrilocular in birds, but considering the nature of that organ in the crocodiles, we think its nature in them ought to be mentioned. The title of the work is so all-embracing that we think it can hardly be justified by its contents. Morphology as well as physiology, together with the principles of evolution and classification, are all parts of "biology," nevertheless in the work before us morphology, and the immediate dependents of that science, are not touched upon. A more fitting title would have been "Comparative Physiology, Vegetable, and Animal." Several illustrations are introduced, and these are well selected, most if not all from other works. The descriptions are clear and concise, many too short to be of much service except as a first-book.

Algebra for Beginners. By James Loudon, M.A., Professor of Mathematics and Natural Philosophy, University College, Toronto. (Toronto, 1876.)

THIS work is an elementary one, taking the usual subjects up to and including Quadratic Equations. There is a chapter on Exponential Notation, giving a fair exposition of the Theory of Indices. There is nothing noteworthy in the execution: it is quite on a par with many similar text-books in this country, so that the chief point of interest is the information it gives us as to what instruction is given in the subject to the rising generation in Canada. The use of *mononomial* strikes us as being affected. The work is exceedingly correctly printed. There are but six mistakes, we think, in the whole book, three of which are in the answers (xv. 3, xxxvii. 14, li. 16). Many of the questions are traceable to English sources.

LETTERS TO THE EDITOR

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Coloured Solar Halos

IN his interesting scientific notes taken in the Himalayas, and printed in the last number of NATURE (p. 393), Dr. Arthur Schuster mentions the frequency of the occurrence, in India, of rainbow-coloured rings round the sun, and states that he has only once seen this phenomenon in England. The apparition of a complete iridescent circle is no doubt rarely seen, but I have, since the winter of 1873-74, when I first observed them, so frequently seen fragments of such rings both in Switzerland and in England, that their non-occurrence, when thin white clouds are near the sun, seems to me to be the exception rather than the rule. In this country, and generally at low elevations, they are not easily detected by the unassisted eye, but in the high Alps both in summer and winter I have rarely failed to see them, when the sun and a thin white cloud were at the necessary distance from each other; they are, however, much more easily observed when the eye is protected from the glare by the neutral tinted glass which is frequently used for snow spectacles. The first and most vivid iridescent halo I ever saw, appeared projecting from the side of a mountain from behind which the sun was about to rise, near the summit of the Fluela pass, and about 7,000 feet above the sea. This was in the winter of 1873-74, and the thermometer stood at 19° Fahr. Last August and the first half of September I saw them almost daily on the Riffelberg and at Pontresina, and I have repeatedly noticed fragments of iridescent rings during the past autumn and winter in crossing Kensington Gardens about 9.30 A.M. In London, however, the blue and green rays are rarely visible, owing no doubt to their absorption by the murky atmosphere, whilst the orange and red rays easily reach the eye. On Sunday last, with snow upon the ground, I saw, through neutral tinted glass, the orange and red of the halo as the thin edges of clouds approached, or receded from the sun, and on Monday I distinctly saw the green also.

I hold these coloured halos to be a decisive proof of the frozen condition of the clouds in which they appear; firstly, because the cloud seen on the Fluela pass, when the thermometer was 13° below the freezing point, must have been frozen; and secondly, because I have repeatedly seen a portion, at least, of the lower half of the iridescent circle in the high valleys of Switzerland by looking along a field of snow sloping upwards towards the sun, and when the thermometer indicated temperatures varying from $-15^{\circ}\cdot 5$ Fahr. to $+23^{\circ}$ Fahr.

It would be worth while to have the occurrence or non-occurrence of these halos daily recorded in our meteorological observatories, as indications of the temperature of the air at great altitudes. E. FRANKLAND

On the Evidences of Ancient Glaciers in Central France

IN NATURE, vol. xiii. p. 31, Dr. J. D. Hooker gives some notes of traces of ancient glaciers in Central France, especially in the Mont Dore, and in a following short letter (p. 149 of the same volume), in reference to this notice of Dr. Hooker, the late Mr. G. Poulett Scrope, the celebrated describer of the volcanic regions of that country, calls in question the exactness of Dr. Hooker's observations. Dr. Hooker in a subsequent letter (p. 166) insists upon the correctness of his views, which he seems to believe original and never before advanced. Neither Dr. Hooker nor Mr. Poulett Scrope seem to have known that I have already, in a paper published in the *Ausland* (1872, Nos. 20 and 21, pp. 460 and 512) entitled, "Erosions und Gletscher wirkungen im Mont Dore, &c." described the traces of glaciers to a still greater extent than even Dr. Hooker does. Not only did I name the place in question (which is situated just at the entry of the Gorge d'Enfer, upper valley of Mont Dore) and describe it as an ancient frontal moraine of a glacier, but I have also given the view of the late Prof. Lecoq (who was never an Abbé as Mr. Poulett Scrope seemed to believe), who says in reference to this locality, *that if ever a glacier had existed in Mont Dore it must have been in this valley.* But besides this point, which in itself is decisive, I noticed a great number of other localities affording examples of polished rocks, transported and rounded blocks, stone lines, and other evident traces of glaciers, which I will not re-enumerate, as they may be found in my above-mentioned paper.

It is quite clear that Mr. Poulett Scrope was in the wrong in denying that those signs in the Mont Dore are the effects of glacial action, but on the other hand, I must, in justice to myself, courteously remind Dr. Hooker that I have the priority in describing those marks as glacial traces which Lecoq interpreted as water-flood traces. I may say in conclusion that this learned geologist of Central France (Lecoq) personally turned my attention to those phenomena while visiting the Auvergne in 1867, and seemed inclined to accept my interpretation.

Breslau University, Prussia, March 10 A. VON LASAULX

The Uintatherium

IN the abstract of my lecture published in NATURE, vol. xiii., p. 387, it is stated that "the first discovered evidences of the existence of animals of this group were described by Leidy, in 1872, under the name of *Uintatherium*."

Intricate questions of priority, such as those in which the nomenclature of many of the recent American palæontological discoveries is unfortunately involved, cannot be discussed and settled in brief abstracts; but I see that the above statement conveys a wrong impression, which I shall be glad to correct. Bones of some of these animals were discovered by Prof. Marsh and Lieut. Wann, of the Yale College exploring party, near Sage Creek, Western Wyoming, in September 1870, and described by the former in the following year (*American Journal of Science and Arts*, July 1871, p. 351), though referred provisionally to the genus *Titanotherium*. There seems, however, to be no doubt that Leidy's name, *Uintatherium* (*Proceedings of the Academy of Natural Sciences*, Philadelphia, 1872, p. 169; read July 30, published August 1), was the earliest of the new generic designations applied to any of the group, and therefore ought to be adopted for the whole, until it is clearly shown that any sufficiently important distinctions exist between them to warrant their separation into different genera.

March 18 W. H. FLOWER

Morell's "Euclid Simplified"

IT is only quite recently that my attention has been directed to the review of "Euclid Simplified" in NATURE, vol. xiii. pp. 201–204. I shall endeavour to condense my reply to the criticisms contained in that review as much as possible, taking them in the order in which they occur, which will simplify the controversy.

And firstly, it is objected that "the title 'Euclid Simplified' is a misnomer, for the method of Euclid (the geometer) is departed from altogether." I reply by explaining that by far the greater part of the theorems and problems, and also the method followed throughout in "Euclid Simplified" are taken directly from Amiot's "Éléments de Géometrie" (15th edition, 1873). In his preface to another work, "Leçons Nouvelles de Géometrie Élémentaire" (1865), Amiot says: "Les éléments de géometrie que nous venons de réimprimer et cette séconde édition des Leçons nouvelles de géometrie, sont deux ouvrages différents. Le premier n'est que l'exposé de la géometrie des anciens; le second est un essai de géometrie générale, c'est-a-dire qu'il comprend *non seulement les éléments* d'Euclide, mais encore les principes de la géometrie moderne, qui est resumée et, pour ainsi dire, personnifié dans les travaux de M. Chasles, notre géometre par excellence." I infer that in adopting and following Amiot's "Elements," I have followed the ancients and Euclid, though shortened and simplified.

At a subsequent part of the review the writer is exposed to severe animadversions for his intention to produce what is represented to be an epitome of the brilliant discoveries of M. Chasles. This matter can also be set at rest by referring to the extract from the preface of M. Amiot, previously given. Mr. Morell has only projected a compilation and translation from Amiot's "Leçons Nouvelles," and from Rouché and De Comberousse (1ere Partie. Géometrie Plane. Appendice), also treating of modern geometry.

Passing from the title to the contents, I admit that the typographical errors are unfortunately numerous, nor is it possible to avoid this except by employing the best and most expensive printers. The misprints *maner* and cord, the omission of the word "side" before "of the equilateral triangle," and the passage relating to the quadrilateral $ABCD$ must be referred to this category. The latter passage is translated from Legendre (edition 1868 [not 1872], p. 78), and requires the fourth side AD to be added, which has been omitted by the printer. For "without changing" read also "thereby changing"—in this case I confess an oversight of the writer.

I proceed next to meet the strictures of the reviewer relating to Gallicisms and the use of terms new to boys. In defence I might point to the Hellenisms and Latinisms in our School Euclid, and affirm that Gallicisms are more nearly akin to modern English.

I content myself with pointing to the employment of terms, condemned in "Euclid Simplified," by writers of approved excellence, including Gerard's "Elements of Geometry." It is objected that I write, p. 168, "The centre of similitude is the meeting-place." I find at p. 36 of Mr. Gerard's "Elements of Geometry," "The meeting point of two lines." . . . Again the terms "perpendicular to the centre, perpendicular to the middle," censured in "Euclid Simplified," ought to be taken in connection with the ensuing words: "to the centre of the straight line AA'" and "to the middle of AB." Thus amplified, the terms agree with those used by Mr. Wormell—"perpendicular to DE at its middle point C." "The perpendiculars to the sides of a triangle at their middle points." ("Modern Geometry," pp. 78–81.)

Before I dismiss this question of terminology, I wish to suggest that recent works on geometry in high repute, especially those I have just named, introduce very fully terms with which boys are not at all acquainted, and which are new in English. I briefly enumerate a list of these new importations: Escribed, exscribed, explements, intercepts (used as a noun), circumscriptible, intangence, bisectrix, extangent, median, a plane lune, octant, and many more which cannot be introduced here for want of space.

Considering the further criticisms, I beg to explain that no notice of the Association for the Improvement of Geometrical Teaching was inserted in the preface because absence from England and ill-health had severed me from all knowledge of its proceedings and of its Syllabus.

If the enunciations are loosely and inelegantly worded, Amiot must bear the blame which attaches in a greater degree to our translations of Euclid.

Further, the objection made to my use of the terms "capable angle" must extend to the use of the same term in Gerard's "Elements," p. 310.

In the definition of the parallelogram the printer has omitted "and parallel," words which I find in my MS. The term lozenge is used as synonymous with rhombus by Wormell ("Elementary Course of Geometry," p. 65), and Gerard, p. 235. The definition of the circumference is that of Amiot ("Elements," p. 40) and Gerard (p. 76). That described by the reviewer as the common school-boy definition is Wormell's, p. 28. The expression "a circumference is generally described in language by one of its radii" is thus given in Amiot: "On designe ordinairement une circonférence par l'un de ses rayons." I shall pass over the criticisms about "the" and "a" as too minute, also the remark about major and minor arcs met by Def. 36. Problem VII. shows any boy of ordinary intelligence how to bisect a line.

Derivation in notes is not treated syntactically, and can also be dismissed. But the remarks of the critic about the use of R as meaning right angle are met by referring to Wormell's (p. 173) use of GCM as greatest common measure. The term pentedecagon is used by Gerard (p. 202). The proof of the ratio of two rectangles $\frac{R}{R'}$ is Legendre's; and at p. 67, after showing that $\frac{R}{r} = 4$, he adds: "Ainsi le rectangle R contient quatre fois le rectangle pris pour unité" (*i.e.*, r). This conclusion in my book is criticised.

The reasoning to Theorem VI. (p. 148), which is called defective in the review, only errs by excess of proof. I have little more to add. The "Essentials of Geometry" are almost entirely a translation of a useful Spanish work by noted mathematicians.[1] The 205 exercises are throughout from Amiot, and as these 205 exercises are *literally* all from Amiot, it is a serious charge to say, like the reviewer, that many of them are objectionable in geometry. In Exercise 30 "a" quadrilateral is a misprint: read "this."[2] J. R. MORELL

"Weight" and "Mass"

THE correspondence which has recently appeared in NATURE on this subject has great interest for those engaged in teaching Physics. I confess I regretted to learn that "gravity" had been diverted from its long recognised meaning in science—that pointed out by Mr. Stoney—at Glasgow, to be employed for one of the meanings of the word "weight." The symbol "g" is "gravity" represented by its initial letter, so that if the meaning of the word be changed, consistency would require that the symbol should be altered. I find, practically, no difficulty in restricting the word "weight" to the sense of force, insisting on the use of the phrases "mass of so many pounds, ounces, or grammes," and "force equal to the weight of a mass of so many pounds, grammes," &c.; for which, after some time, I allow the use of the phrase, "*the* weight of so many pounds."

On another point of nomenclature I would suggest that those who, like myself, think it necessary to use the British units coordinately with the metric, should adopt some analogue to the

[1] Their names will be given when I recover the book or get another copy.

[2] The work of Mr. Wormell to which reference is made in this letter is (with one exception) his excellent "Modern Geometry," published by Murby.

dyne. I use *vis* (pl. *vires*) to express the absolute unit of force in the F. P. S. system of units, with the multiples *decemvires*, *centivires*, *millivires*. Thus nine *centivires* is very closely equal to the weight of twenty-eight pounds in this country.

I should add that the distinction between "weight" and "mass," generally recognised, but not uniformly insisted on in practice, is clearly pointed out in Prof. Everett's useful tables.

University Hall, March 18 J. J. WALKER

The Dry River-beds of the Riviera

THOSE who have visited the Riviera of Piedmont will remember as one of its most remarkable features the broad stony river-beds, sometimes with a meagre rill trickling down a narrow channel in the middle, sometimes entirely dry, but never with any body of water sufficient to account for the immense bed; the Paglione at Nice, with its bed spanned by a bridge of three broad arches, and with a stream never more than four or five feet wide and a few inches deep, is a specimen of what I mean. Can any of your scientific readers tell me what and when was the change of climate which caused what must once have been large rivers to shrink into mere rivulets? To all appearance it must have been within historical times, as the river-beds are distinct and still bare, without any encroachment of vegetation. Probably the simplest way of accounting for the phenomenon would be, by showing that there has been a great diminution in the snow lying on the Alpes Maritimes, which are drained by these rivers. It is remarkable, too, that in many of the narrow valleys running up into the hills, now quite dry, there are evident traces of torrents and waterfalls apparently in recent times. R. E. BARTLETT

Nice, March 7

The Ocelli in Insects

AT vol. xiii, p. 168, H. Müller calls the attention of entomologists to a subject which has interested other entomologists before—the function of the ocelli in insects. With due deference to a suggestion made by such an authority, it seems to me that the size of the ocelli in hymenopterous insects is not dependent on their nocturnal habits. Why in hymenoptera more than in other orders? Indeed, it may be doubted whether in some insects the ocelli are organs of vision at all, or at least whether they are of any practical use as such in the imago. Their number, as well as size, differs in different species of the same order, seemingly without regard to their habits, whether diurnal or nocturnal, and in many moths they are so completely concealed by the scales that it is necessary to divide the head to ascertain whether they are present or absent, so that it is difficult to understand how they can be of any service as organs of vision. May they not in the imago, in such cases, be merely functional remnants of larval organisations. C.

Colorado, Feb. 15

The Recent Storm

YOUR meteorological readers will probably guess that I have made an error of an inch inadvertently in the barometer readings of Sunday week. Also the last line should contain "nine hours" in place of seven. T. S. USBORNE

Staplehurst, Kent, March 21

OUR ASTRONOMICAL COLUMN

STRUVE'S COMPANION OF PROCYON.—Mr. Otto Struve, in his remarks at the Royal Astronomical Society, in May, 1874, upon the later Pulkowa observations of the faint companion to Procyon, which he discovered on March 19, 1873, and which has been supposed to account for the anomalous motion of the latter, established by the researches of Prof. Auwers, referred to the circumstance of the small star not having been up to that time perceived with the 26-inch refractor of the Washington Observatory. Admiral Davis, the present superintendent of this establishment, has communicated to the *Astronomische Nachrichten*, the particulars of observations principally instituted for the purpose of confirming the existence of Struve's companion. The observations were commenced in November 1873, and have been continued to the beginning of the present year. On no single occasion have Professors Newcomb and Holden, the usual observers, or any one who has examined the star with the 26-inch refractor, been able to detect a companion in the position assigned by the Pulkowa measures. Close faint stars have, however, been remarked in other position-angles, about three of which it is stated no doubt is entertained :—

1. Position about 10°	...	Distance	6″
2. „ ... 36°	...	„	8″·8
3. „ about 50°	...	„ less than	10″

And it is said to be quite possible there may be one or two more. No. 2 is the most readily visible.

Mr. O. Struve's measures gave the following mean results :—

1873, March 28 ...	Position 90°·24 ...	Distance 12″·49
1874, April 10 ...	„ 99°·60	„ 11″·67

How then is the contradictory character of the Pulkowa and Washington observations to be accounted for? It can hardly be, as suggested by Mr. Struve, that "the surpassing brilliancy of the principal star may have hindered the recognition of the small companion in its neighbourhood," since notwithstanding it does not appear that a smaller aperture than 22 inches was employed during the Washington observations, three closer companions were considered to be certainly in existence. There remains the supposition of variability of light of the Pulkowa companion, if difference of atmospheric circumstances be ignored as inadequate to explain the want of success of other observers in detecting it.

Nothing more is heard of the Smythian *orange-tinged* eighth magnitude distant from Procyon in 1833, 145″ on an angle of 85°. As is well known, the only observation confirmatory of the existence of this star is that by Mr. Isaac Fletcher, M.P., early in March, 1850, which gave for the position 84° 19′; most unfortunately the distance was not measured, because there is a star of similar brightness on very nearly the same angle but at a distance of about 330″ measured by Capt. Jacob, Mr. Powell, and the late Lord Wrottesley. Anyone, however, who reads Mr. Fletcher's letter to Admiral Smyth, printed in "Sidereal Chromatics," p. 69, will see that there is little doubt the object observed in 1850 was the same that was measured, or rather estimated, as to position in 1833, the difference of distance not admitting of a mistake on the part of an experienced and careful astrometer. The more distant star was judged to be blue by Mr. Powell; the orange-tinge recorded in "the Cycle" is a characteristic of a large number of the known variable stars.

THE TOTAL SOLAR ECLIPSE OF 1883, May 6.—In this eclipse, in which the duration of totality where the sun is near the meridian will exceed five minutes, the course of the central line appears to be a most unfavourable one for observation, being almost entirely a sea-track. The elements are very approximately as follows :—

Conjunction in R.A., May 6, at 9h. 44m. 42s. G.M.T.

R.A.	43°	30′	52″	
Moon's hourly motion in R.A.		38	23	
Sun's „ „ „		2	25	
Moon's declination	16	11	32	N.
Sun's „	16	37	53	N.
Moon's hourly motion in decl.		7	26	N.
Sun's „ „ „		0	42	N.
Moon's horizontal parallax		60	52	
Sun's „ „		0	9	
Moon's true semi-diameter		16	35	
Sun's „ „		15	51	

Hence the central and total eclipse begins upon the earth in longitude 156° 1′ E. of Greenwich, and latitude 34° 43′ S., and ends in longitude 86° 44′ W., and latitude 13° 41′ S.; the eclipse is central with the sun on the meridian in 147° 4′ W., and 9° 11′ S. The following are also points upon the central line :—

Long.	Lat.	Long.	Lat.
179° 51′ E. ...	25° 43′ S. ...	139° 51′ W. ...	6° 53′ S.
168 19 W. ...	19 52 S. ...	137 44 W. ...	6 24 S.
160 49 W. ...	15 49 S. ...	119 52 W. ...	5 51 S.
140 46 W. ...	7 8 S. ...	108 12 W. ...	7 51 S.

By a direct calculation for a point 140° 46′ W., 7° 8′ S. in the longitude of the Marquesas, totality is found to commence at 0h. 39m. 30s. local mean time, duration 5m. 15s., the sun at an altitude of 64°.

THE MINOR PLANETS.—The four older minor planets, Ceres, Pallas, Juno, and Vesta, are now in pretty favourable positions for observation, and Vesta, which will be in opposition on the 28th inst., is very little below an average sixth magnitude in brightness, and may probably be detected without the telescope by those who are gifted with strong sight and are acquainted with the planet's position with respect to stars in the vicinity. On the 28th it will be a very little to the left of the line joining δ and ϵ Virginis, and nearly equi-distant from these stars, which are of the third magnitude.

Niobe, like Euphrosyne, is occasionally situate at a considerable declination. At the beginning of November next she nearly attains 53° N. in the constellation Camelopardus. An observer who may chance to meet with a small star which he has not before seen at a great distance from the equator, must not too hastily conclude that it belongs to the list of variables.

No. 160 was discovered by Prof. Peters at Clinton, U.S., on the morning of Feb. 21; it has been observed at Marseilles by M. Borrelly.

ON THE ACTION OF LIGHT ON SELENIUM

ON the 18th of last month Dr. C. William Siemens gave a lecture to the members of the Royal Institution on the above subject.

Commencing with a general reference to light as a natural force, he showed how little the potential action of light made itself evident to our senses, as with the disappearance of the light its effects seemed entirely to vanish; he then showed a temporary effect of light by its action on phosphorescent salts, which continue to glow for a long time after the source of light is removed, and drew attention to the permanent effect produced by the decomposition of the salts of silver in photography. He next referred to the radiometer, Mr. Crookes' little machine for illustrating light effects, which he brought forward for the purpose of showing the motive power of light, and closed his introduction by a reference to some experiments which he had made on a fungus that lives in the dark, and which, on analysis, gave no evidence of containing carbon, thus helping to favour the hypothesis *that it is not heat, but the ray of light which breaks up carbonic acid in the leaves of plants in order to separate the carbon.*

Selenium was discovered in 1817 by Berzelius, as a bye product from the distillation of iron pyrites. It is fusible, combustible, and similar to sulphur, phosphorus, and tellurium. If melted (at 217° C.) and cooled rapidly, it presents a brown amorphous mass of conchoidal fracture, and is a non-conductor of electricity; if heated only to 100° C., and retained for some time at this temperature, it becomes crystalline, and is a slight conductor of electricity, the conductivity increasing with battery power, and varying according to the direction of the current, as lately observed by Prof. Adams.

It was on the 12th of February, 1873, that the Society of Telegraph Engineers received a communication from Mr. Willoughby Smith, one of its members, of an observation made first by Mr. May, a telegraph clerk at Valentia, viz. that a stick of crystalline selenium offered considerably less resistance to a battery current when exposed to the light than when kept in the dark; this was corroborated by the Earl of Rosse, who clearly proved the action to be due *solely* to light, and who also showed the effects of the light of different portions of the spectrum, and afterwards by Lieut. Sale, and conjointly by Messrs. H. N. Draper, F.C.S., and R. J. Moss, F.C.S.

About twelve months ago the matter was again taken up by two independent observers, Prof. Adams in this country, and Dr. Werner Siemens in Germany, and it was to the results obtained by the latter, and which have been communicated to the Academy of Sciences of Berlin, that the lecturer's remarks were chiefly confined.

The sensitive selenium plates made by Dr. Werner Siemens, with which experiments were made, are formed of two spirals of platinum wire, laid upon a plate of mica, in such a manner that the two wires run parallel without touching; upon the plate a drop of molten selenium is allowed to fall, and before solidifying, another plate of mica is pressed down; the two protruding ends of wire serve to insert the selenium element in a galvanic circuit. Amorphus selenium when thus tested produces no deflection of the galvanometer, either in light or darkness. If, however, a selenium disc which has been kept for some time at 100° C. and then cooled is inserted, a slight deflection of the galvanometer takes place when it is under the influence of light, but none in darkness. If now a selenium disc which has been kept for several hours at a temperature of 210° C., a point below that of the fusion of selenium, and which has been gradually cooled, is substituted for the other, a considerable deflection under the influence of light will be observed, whilst a hardly perceptible deflection takes place in the dark.

It was also explained, as the result of an experiment, that amorphous selenium did not conduct up to 80° C.; from this temperature to 210° C, its conductivity gradually increased, after which the conductivity again diminished; in cooling it followed the same law, but in a different ratio. The modification prepared by heating to 100° C. only is Dr. Werner Siemens' 1st, or electrolyte modification, whilst the other, prepared by heating to 210° C., is his 2nd, or metallic modification. In the 1st, the conductivity *increases* with rise of temperature; in the 2nd it *decreases;* the 2nd is a much better conductor, but is less stable, and its conductivity increases with the intensity of the light, as shown from the following table, in which is given the effects of different intensities of light on selenium (Modification II.) obtained by Dr. Obach in Mr. Siemens' laboratory at Woolwich on the 14th February, 1876:—

Selenium in	Relative conductivities.		Resistance in Ohms.
	Deflections.	Ratio.	
1. Dark	32	1·	10,070,000
2. Diffused daylight ...	110	3·4	2,930,000
3. Lamplight...	180	5·6	1,790,000
4. Sunlight	470	14·7	680,000

From these experimental results an extension of Helmholtz's theory is derived, viz., that the conductivity of metals varies inversely as their total heat (Helmholtz having only the sensible heat in view), and the influence of light upon selenium is explained by a change in its molecular condition near the surface, from the first or electrolyte into the second or metallic modification, or, in other words, by a liberation of specific heat upon the illuminated surface of the crystalline selenium.

In testing the sensitive selenium plate in the different parts of the spectrum, it was shown that the actinic ray exercised no sensible effect, that the effect increases as we gradually approach the dark red, and that beyond that point the effect again decreases, reaching almost zero in the heat rays; the value of the material then for purposes of photometry is apparent.

Dr. Werner Siemens has constructed a selenium photometer, in which the selenium is prepared so as not to be affected by the changes to which that substance is liable, and which consists of a single sensitive plate mounted upon a vertical axis, upon which it can be turned through a certain angular distance limited by stops. When touching the one stop the selenium stands opposite the normal candle, and when touching the other opposite the light to be measured, the distance upon the former being changed upon a scale until no effect upon the needle of a galvanometer is produced in turning the sensitive plate in rapid succession from the one stop to the other.

The lecture was concluded by the exhibition of a selenium eye, which Mr. Siemens had prepared to illustrate the extraordinary sensitiveness of the selenium preparations. It consists of a hollow ball with two circular openings opposite each other, the one being furnished with a lens 1½ inches in diameter, and the other with an adjustable stopper carrying a sensitive plate, which is connected by wires to a galvanometer and one Daniell's cell. The lens is covered by two slides representing eyelids, the ball itself being the body of the eye, and the sensitive plate occupying the place of the retina. Having placed a white illuminated screen in front of the artificial eye, on opening the eyelids a strong deflection of the galvanometer was observed, a black screen giving hardly any deflection, a blue one a greater, a red a much greater, but still short of that produced by the reflected white light. The eye was thus sensitive to light and colour, and as stated, it would not be difficult to arrange a contact and electro-magnet in connection with the galvanometer, so that intense light would cause the automatic closing of the eyelids. The artificial eye is subject to fatigue, and the lecturer considered that this experiment might be suggestive to physiologists as regards the natural conjoint action of the retina and the brain.

THE LATE COLONEL STRANGE, F.R.S.

LIEUT.-COL. ALEXANDER STRANGE, F.R.S, whose death we last week announced, was the fourth son of the late Sir Thomas Strange, and was born at Westminster on the 27th of April, 1818, and was educated at Harrow. On leaving school in 1834, at the early age of sixteen, he proceeded to India, and joined the 7th Regiment of Madras Light Cavalry, where his natural talents began to develop themselves. He shortly afterwards made the friendship of General Worster, who soon discovered that he had mechanical abilities of the highest order, and who subsequently instructed him in the use of astronomical and surveying instruments, and pointed out to him that nature had intended him for a scientific career. During the next few years he became a devoted student at the Magnetic and Meteorological Observatory at Simla, then under the direction of Major-General Boileau, R.E., at whose recommendation he was nominated, in 1847, by Col. (now Sir Andrew) Waugh, R.E., Surveyor-General of India, to the office of Second Assistant in the Great Trigonometrical Survey, where he found work suited to his talents. He was originally selected on account of his ability as an observer, and for his extraordinary mechanical skill, which in this department was of special value, and was displayed in such a remarkable degree as to call forth the highest commendation from Col. Waugh. In the season 1848-49 he was attached to the party under Capt. (now Col.) Renny Tailyour, R.E., in order that he might acquire a practical knowledge of geodetical operations. Such was the rapidity with which he made himself master of this difficult subject, that in 1850 he was promoted to the grade of First Assistant. Capt. Tailyour was ordered to undertake the triangulation of what is known as the "Karáchi Longitudinal Series," which constitutes the southern flank of that considerable portion of the principal triangulation of the Survey of India known as the North-west Quadrilateral. It commences at Sironj in Central India, and terminates at Karáchi, in Sind. The extent of this arc of longitude is equivalent to 670 miles in length, covers an area of 23,000 square miles, and is one of the largest longitudinal arcs ever measured on the surface of the globe. At the end of the first season, Capt. Tailyour's services being required at head-quarters, Capt. Strange was ordered to take over the entire charge of the Series, and it is on this great undertaking that his fame as an Indian Surveyor rests. After crossing the Desert, over which the triangulation had to be carried nearly 200 miles, the work was carried on with the highest skill across the Plains of Sind, until at length, after much anxiety, and having overcome almost insuperable difficulties, the last angle which completed this great triangulation was measured on April 22, 1853, and the work brought to a successful close.

The remarkable energy and rapidity with which this series was carried on, under many and great difficulties, was reported by the Surveyor-General to reflect on him the highest credit. He was directed to join the Surveyor-General's camp near Attock, where he took part in the verificatory base line. After this he returned to Karáchi with the base-line apparatus, and took a leading share in the measurement of the base-line at that place in the year following. Meantime he had been distinguished with the title of "Astronomical Assistant." In 1855 Strange joined the Surveyor-General's Head Quarters' Office, and in the following year was placed in charge of the triangulation which was being extended from Calcutta southwards towards Madras, along the eastern coast. In April, 1857, whilst conducting the triangulation in the Goomsoor Hills, a notoriously unhealthy tract, he was struck down by jungle fever, and was afterwards ordered to the Neilgherry Hills for the recovery of his health. In the year 1859 he was promoted to the rank of major, and in accordance with the then existing regulations of the service retired from the Survey, on which occasion he received the special thanks of the Government of India.

In January, 1861, he returned to England after twenty-six years' continuous service in India, and finally retired from the army as lieutenant-colonel on the 31st of December, 1861. His career in England was no less brilliant than that in India. In 1861 he was elected a Fellow of the Royal Geographical Society as well as a Fellow of the Royal Astronomical Society. He served on the Council of the latter from 1863 to 1867, and was Foreign Secretary from 1868 to 1873. On the 2nd of June, 1864, he was elected a Fellow of the Royal Society, of which he soon became a distinguished member; he served on the Council from 1867 to 1869.

In the year 1862 the Secretary of State for India in Council sanctioned the provision of an extensive equipment of geodetical and astronomical instruments of the first order, for the service of the Great Trigonometrical Survey of India, consisting of one great theodolite, two zenith sectors, two 5-feet transit instruments, two electro chronographs, two diagonal transit instruments, two 12-inch vertical circles, and three astronomical clocks. The task of designing and superintending their construction was entrusted to Lieut.-Col. Strange, who was also appointed to the post of Inspector of Scientific Instruments to the Indian Government. To enable him to test these valuable instruments as well as the current supply required by the Public Works, Survey, Meteorological, and various other Departments in India, an Observatory was established at the India Store Depôt in Lambeth from designs prepared by himself. This observatory, in its various ingenious details, is a monument of Col. Strange's consummate mechanical genius.

At this Observatory, theodolites, levelling instruments, prismatic compasses, sextants, telescopes, barometers, thermometers, drawing, and mathematical instruments of all kinds were rigorously inspected, compared, and verified under Col. Strange's personal superintendence, and the improved forms of instruments now supplied to the services in India, are in a very large measure due to his efforts, and it must have been a source of gratification to him to find that they were received with almost universal approbation. He devoted much anxious time and thought to the laborious task of testing the magnificent series of instruments above alluded to.

The telescope has an aperture of 3½ inches, with a focal length of 36 inches. The instrument is constructed upon what is known as "the flying micrometer plan," and possesses a great number of peculiarities which are quite unique. It will be found fully described in a paper read by him before the Royal Society in 1872. This is undoubtedly the finest instrument of its kind ever constructed, and will be an enduring monument to his unremitting energy and constructive genius. The zenith sectors were designed for the accurate determination of latitude, and in design are unlike any of their predecessors; being intended for portable instruments the problem was to get the maximum of power out of the minimum of weight, and in this he was eminently successful, for on comparing one of these with the weight of the zenith sector designed by the present Astronomer Royal for the Ordnance Survey of Great Britain it was found to be only about one-half. With regard to the performance of these instruments, Capt. J. Herschel, R.E., F.R.S., who has been employed in determining latitudes in Southern India, in comparing the facility of working the zenith sector and the former astronomical circles of the Great Trigonometrical Survey, states that "the sectors are competent to turn out at least double the amount of work of the same order," adding, "at this rate two or three years' work, would equal in amount the whole results up to the date of the arrival of the sectors, and ten years (a comparatively short period for which to arrange a system of observation on a matter of this magnitude) will see us in a position to look back on the arrival of the sectors as on the commencement of a new era." All the other instruments present evidences of Col. Strange's constructive genius.

Such is the amount of skill and forethought brought to bear upon the design of these exquisite instruments that an observer may select a series of stars differing only five minutes of time in Right Ascension. Each star is observed twice in reversed positions of the telescope at the same culmination, and each of the two reversed observations involves two settings of the telescope in altitude, four microscope, two level and one micrometer reading. To admit of all these operations being performed within five minutes of time, with the deliberation requisite for observations aiming at fractions of a second, demands the highest conveniences of instrumental construction.

After their completion and final testing, they were severally despatched to India, where they have for some years been employed in the Survey Department, unapproachable for manipulative facilities and giving results unsurpassed in accuracy. Indeed, it is not too much to say that these instruments, in the construction of which Col. Strange had the advantage of being so ably seconded by the late Mr. Cooke, of York, and the well-known firm of Troughton and Simms, are the most perfect and powerful geodetical instruments which have ever been constructed or are likely to be constructed for some years to come.

Among his publications which appear in the Memoirs of the Royal Astronomical Society, vol. xxxi., are the following: "On Testing the Vertical Axes of Altazimuth Instruments," "On a Direct Method of Testing and Adjusting the Equipoise of Altazimuth Instruments," "On a Proposed Isolated Flange for Conical Axes." In the Monthly Notices of the Royal Astronomical Society, vol. xxiii.: "On Aluminium Bronze as a Material for the Construction of Astronomical and other Philosophical Instruments;" and in the Journal of the Royal United Service Institution, vol. vi., "Geodesy, especially relating to the Great Trigonometrical Survey of India." He contributed papers on various subjects to the Royal Society, the British Association, the Society of Arts, the Meteorological and other scientific and learned societies.

His scientific activity, however, was by no means confined to these questions, which came before him in his official capacity. In compliance with a request made by her Majesty's Commissioners for the International Exhibition of 1862, Col. Strange served the office of juror. He also performed the same functions at Paris in 1867. "While in the Royal Society," to quote from the memoir in the *Times*, "he insisted upon the accuracy of the measurements used in physical inquiries, in the British Association, and was the clear-sighted and constant advocate of increased instruction in science and the increased utilisation of it in our public departments; and he was among the first to insist upon the national importance of fostering the pursuit of knowledge in those fields which, though unremunerative to the cultivator, are eventually of the highest importance to the nation. To him belongs the whole credit of having initiated in 1868 the movement which resulted in the appointment by her Majesty of the 'Royal Commission on Scientific Instruction and the Advancement of Science,' of which his Grace the Duke of Devonshire was chairman, and the five years' labours of which have but recently terminated. Before he died he had the satisfaction of knowing that the proposals contained in the scheme which he originally propounded to the Commission, and on which nearly the whole of the witnesses were examined, were adopted in the main by the Commission, and recommended for the consideration of the Government. Thus the breadth of his views, and the clearsightedness which he possessed not only combined to render his services to the Indian Government and to the various scientific societies, Councils, and Committees on which he served of the utmost value, but they have left a memorial in the recommendations of this Commission, some day, we hope, to be rendered more lasting by their adoption. He died on the 9th inst. at the comparatively early age of fifty-seven, and the void his death has created in the scientific world will be one very difficult to fill."

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXISTING MAMMALIA[1]

V.

ORDER *Sirenia*. The purely aquatic habits and fish-like form of the animals of this order formerly caused them to be confounded with the Cetacea, but a more intimate knowledge of their structure has shown that they really belong to a widely different type of the class. Their skeleton is remarkable for the massiveness and density of most of the bones of which it is composed, especially the skull and ribs, and the bodies of their vertebræ want the disc-like epiphyses so well marked in the Cetacea. The existing members of the order pass their whole life in the water, being denizens of shallow bays, estuaries, and large rivers, but unlike the Cetacea they are never found in the high seas away from shore. Their food consists entirely of aquatic plants, either marine algæ or fresh-water grasses, on which they browse under water, as the terrestrial Ungulates do on the green pastures on land. They are generally gregarious, slow and inoffensive, and apparently stupid in disposition. Though occasionally found stranded

[1] Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from p. 388.

by the tide or waves, there is no evidence of their voluntarily leaving the water to bask or feed on the shore.

The species now existing are very few, and there is reason to believe that the time is not far distant when they will all become extinct. One species, the *Rytina stelleri*, or Northern Sea-cow, an animal attaining nearly the length of thirty feet, by far the largest known member of the order, from the North Pacific, was totally exterminated by the agency of man during the last century, and the surviving species, the Manatis and Dugongs, being valuable for their flesh as food, their hides, and especially for the oil obtained from the thick layer of fat which lies immediately beneath their skin, rapidly diminish in numbers as civilised populations occupy the regions which form their natural habitat.

The Manatis (genus *Manatus*), found on the Atlantic coasts of America and Africa, are rather fluviatile than marine in their habitat, ascending large rivers almost to their sources, and feeding chiefly on aquatic grasses. The Dugongs (genus *Halicore*) are more distinctly marine, feeding chiefly on algæ. They inhabit the shallow waters, bays and creeks of various coasts of the Indian Ocean, the Red Sea, East Coast of Africa, the Indo-Malayan Archipelago, and north coast of Australia. There is probably not more than one species, but they have been divided into three according to the locality which they inhabit. *H. tabernaculi* from the Red Sea, *H. dugong* from the Indian Seas, and *H. australis* from Australia. These two existing genera present such well-marked distinguishing characters that if they alone were known they might be placed in separate families, but as in so many similar cases our knowledge of the extinct forms, imperfect as it is, goes far to bridge over the distinction between them. It is true that Brandt, a great authority on this group, divides the order into two primary sections—*Manatidæ*, consisting of *Manatus* alone, and *Halicoridæ*, containing all the other genera; but it scarcely seems that these can be considered in any sense as equivalent, especially as one of the distinguishing chracters, the external form of the tail is unknown in the extinct genera.

The Miocene and early Pliocene seas of Europe abounded in Sirenians, to which the generic name *Halitherium*, Kaup, has been given. They had large tusk-like incisors in the upper jaw, as in the existing *Halicore*, though not so greatly developed. Their molar teeth are $\frac{5}{5}$ or $\frac{6}{6}$, anteriorly simple and single-rooted, posteriorly with three roots in the upper jaw, and two below, and with enamelled, tuberculated, or ridged crowns, in which respect they approach nearer to *Manatus*, the molar teeth of the Dugongs being without enamel and single-rooted. The anterior molars were deciduous. Some species, at least had nasal bones, short, broad, but normal in position, whereas in all the existing genera these bones are quite rudimentary. Another and still more important evidence of conformity to the general mammalian type is the better development of the pelvic bone, and the presence of a small styliform femur articulated to the acetabulum, although no traces of any other part of the limb have been discovered. These ancient Sirenians were thus, in dental, cranial, and other osteological characters, less specialised than are either of the existing species, and if the intermediate links could be discovered, might well be looked upon as ancestral forms from which the latter have been derived, but at present the transitional conditions have not been detected. As far as we know, when changes in the physical conditions in the European seas rendered them unfitted to be the habitation of Sirenians, the Halitherium type still prevailed. If the existing Dugongs and Manatis are descended from them, their evolution must have taken place during the Pliocene and Pleistocene epochs, the one in seas to the east, the other to the west of the African continent, which has formed a barrier to their intercommunication. Halitherium remains have been found in many parts of Germany, especially near Darmstadt, in France, Italy, Belgium, Malta, the Isthmus of Suez, &c. Until lately none were known in our own country, probably owing to the absence of the beds of an age corresponding to those in which they are found on the Continent; but quite recently a skull and several teeth have been detected among the rolled *débris* of Miocene formations, out of which the Red Crag of Suffolk is partially composed. The species are not yet satisfactorily characterised. Some of them appear to have attained a larger size than the existing Manati or Dugong. One of these from the Pliocene of Italy and France, having but $\frac{5}{5}$ molar teeth, has been separated generically under the name of *Felsinotherium* by Capellini, by whom it has been fully described. A portion of a skull found in Belgium has been named *Crassitherium*, by Van Beneden, and some compressed teeth, somewhat similar to, but larger than those of the Dugong, discovered in the department of Lot et Garonne, France, have given origin to the genus *Rytiodus* of E. Lartet. *Pachyacanthus* of Brandt, from the Vienna basin, is also, according to Van Beneden, another form of Sirenian, of which, however, the skull is not known. In various Miocene and perhaps Eocene marine formations of the United States of America, remains of Sirenians have been discovered, but mostly in such a fragmentary condition that they afford at present little evidence of the early history of the group in that country. A more satisfactory discovery is that of a nearly complete skull and some bones from a limestone tertiary formation in Jamaica. It is of smaller size than the Manati, and as far as the teeth are concerned, of a still more generalised character than Halitherium, the dentition being apparently

$$i\ \frac{3}{3}\ c\ \frac{1}{1}\ p\ \frac{5}{5}\ m\ \frac{3}{3} = 48.$$

The incisors are small, not developed into tusks, the canines (wanting in all existing Sirenians) are rather longer than the incisors, judging by the sockets, and the molars are bilophodent, and covered with enamel. It has been described by Prof. Owen under the name of *Prorastomus sirenoides*. Unfortunately we have no knowledge of the geological antiquity of the formation in which it was embedded. Lastly must be mentioned the *Eotherium egyptiacum*, Owen, founded on the cast of a brain, with a small quantity of surrounding bone, discovered in the Nummulitic limestone of Eocene age of the Mokattam Hills, near Cairo. The brain is narrower than that of *Manatus*, and resembles *Halitherium*. This is of interest, as the most ancient known evidence of any Sirenian, whose age has been geologically determined.

The few facts we have as yet been able to collect of the former history of the Sirenians leave us as much in the dark as to the origin and affinities of this peculiar group of animals as we were when we only knew the living members. They lend no countenance to their association with Cetacea, and, on the other hand, their supposed affinity with the Ungulata, so much favoured by modern zoologists, receives no very material support. The assumption lately put forth with so much confidence that the Sirenia are the remains of a group of animals, through which the Cetacea passed in their evolution from terrestrial Mammalia, is quite without foundation.

(*To be continued.*)

PROF. HUXLEY'S LECTURES ON THE EVIDENCE AS TO THE ORIGIN OF EXISTING VERTEBRATE ANIMALS[1]

II.

IT was seen in the last lecture that no ultimate answer was obtainable as to the origin of the examples selected from the fish class, any more than is afforded as

[1] A course of six lectures to working men, delivered in the theatre of the Royal School of Mines. Lecture II., March 6. Continued from p. 389.

to the origin of the Anglo-Saxons by showing that they came from Friesland in the sixth or seventh century. The same remark applies to the origin of nearly all fishes, in fact, only one clear case of progressive modification is known in the whole class; this is afforded by the group of the *Pycnodonta*.

These are fish not unlike our John Dory in shape, which appear for the first time in the carboniferous rocks, and become extinct in the older tertiaries; they are distinguished by the possession of rows of large crushing teeth, and in place of a vertebral column had a gelatinous *chorda dorsalis* or *notochord*. The spinal cord above this was embraced by arches of bone, placed at regular intervals along the chorda; and, immediately below these neural arches, were attached the ribs, also bony. In the Carboniferous forms, both arches and ribs are quite distinct from one another, and are simply united by ligamentous fibres to the notochord; but, in the older Secondary species, they become expanded at their ends, and thus tend to embrace the notochord; and, lastly, in the Tertiary pycnodonts this process is carried to such an extent as almost to produce a ring of bone, like the body of a rudimentary vertebra.

Now let us turn to the next group of Vertebrate animals, that of Amphibia (frogs, toads, newts, and salamanders), which are distinguished from fishes by certain very striking peculiarities. Fishes are all capable of breathing the air dissolved in water by means of gills, and—a far more important distinctive character—their limbs always have the character of *fins*, which organs are seen in their simplest form in Ceratodus. In this fish, there is a long jointed cartilaginous axis, running down the middle of the fin, with rows of rays of the same substance on each side of it; the whole is invested by a fold of the integument, the margins of which are beset with horny filaments called fin-rays. In all fishes these elements are to be found, generally in a curiously modified condition; in the bony fishes, for instance, the central axis with its side appendages are broadened out and shortened, the fin-rays becoming at the same time so much larger as to form the main part of the fin.

Some modification of this type of limb is possessed by all fishes which have limbs at all; but the first character, that afforded by the respiratory organs, is not absolute, for there are some fishes which, besides gills, possess an apparatus for breathing air directly. This apparatus, represented by the air-bladder of ordinary fishes, first takes on its new character and becomes a lung in that remarkable genus, Ceratodus, in which it exists as a large cellular structure situated in the upper part of the abdominal cavity, just under the vertebral column, and connected with the gullet by a slit—the glottis—by means of which the fish can pass air from the mouth into the lung. It is not, however, this peculiarity of opening into the œsophagus which constitutes a lung, for the air-bladder of many fishes possesses an open duct of a similar nature; the great distinguishing feature is, that the blood taken to this bladder does not pass into the ordinary venous channels, but is returned immediately to the heart, in a purified condition, by a special vein. In Ceratodus there is no special vessel to carry blood *to* the lung, in other words, although there is a pulmonary *vein*, the pulmonary *artery* has not appeared; but in the Mudfish (Lepidosiren) of Africa and eastern South America, the development of the lung goes a step further, a special pulmonary artery being present, as in all the higher animals. Thus Ceratodus and Lepidosiren are truly *amphibious*, for they can be suffocated neither by removal from water like most fish, nor by immersion in water like the higher animals.

What constitutes the difference between these amphibious fish, and the lowest of the true Amphibia? Not the nature of the respiratory process, for many of the latter group, such as the blind Proteus of the Austrian caves and the North American Menobranchus possess gills throughout life, but the structure of the limbs, which are now, no longer *fins*, but *legs*. A fish requires a broad surface for balancing itself in the water, locomotion being chiefly performed by the tail, but in land animals an apparatus is required capable of raising the body above the ground, and the limbs take on the form of a set of jointed levers. In its simplest form the higher vertebrate limb consists, first, of a single piece of cartilage articulated with the body, then two pieces side by side, then a number of small nodules, and lastly, five series of short jointed pieces; all of these become in the adult state more or less converted into bone. The first or proximal division of the limb is called the humerus in the fore limb, the femur in the hind limb; the next segment consists of radius and ulna in the arm, tibia and fibula in the leg; the nodular pieces are respectively carpals and tarsals, and the series of jointed bones or cartilages, the five digits. From the lowest Amphibia upwards, the limbs, when present, are always constructed upon this type.

Nevertheless, the Amphibia still retain certain fish-like characters, which are lost in the groups above them. They all, at some period of life, breathe by means of gills, although all have, in the adult state, lungs in addition. Some forms, such as the Proteus and Menobranchus mentioned above, retain their gills throughout life and are hence called *Perennibranchiates;* others, such as Menopoma, Amphiuma, &c., lose them in adult life, and are called *Caducibranchiates*. These two last genera, however, still retain traces of gill-clefts, but in all the Amphibia with which we are acquainted in this country, the frog, toad, and newt, even the clefts disappear, and the perfect air-breathing character is assumed.

These animals, in the course of their development, go through a very singular series of metamorphoses, comparable to those by which a grub is converted into a butterfly. At this season of the year, every pond is almost certain to contain frog-spawn, masses of transparent albuminous matter, with numberless imbedded eggs, consisting of yolk, black on one side and white on the other. A few hours after these eggs are laid, the process of development begins by the formation of a shallow groove, which appears quickly on the black, more slowly on the white hemisphere, and is just such a groove as would be produced by drawing a blunt instrument along the equator of a soft globe. The egg is thus divided into two masses. A second form appears at right angles to the first, dividing the whole egg into four; others appear, in definite order, cutting it up into smaller and smaller masses, until the whole yolk becomes granular, or formed of microscopic *cells*. Two ridges then appear, on the surface of the egg, and, uniting in the middle line, inclose a cavity, the lining membrane of which is converted into the brain and spinal cord. The head gradually becomes differentiated, and the mouth appears on its under side; the tail grows out, and the little creature, getting too long for the egg, becomes coiled upon itself, and, before long, ruptures the egg-membrane, and makes its exit from its mass of jelly.

It is now, to all intents and purposes, a fish; it has no limbs, its mouth is provided with horny jaws, and it breathes by means of a pair of plumose gills. It further differs from the adult frog in being herbivorous, feeding on water plants, to which it attaches itself by means of two suckers near the mouth. The tadpole grows rapidly, and, before long, a fold of skin appears on each side, which gradually closes over the gills, leaving, however, for a considerable time, a small opening on the left side. In the meantime the limbs appear, and the lungs are developed, the tadpole breathing for a time both by lungs and gills; the latter eventually disappear, the tail shortens, the limbs lengthen, the horny jaws are replaced by teeth, and an insect-eating tail-less frog is formed, the adult air-breathing form having thus been attained by a wonderful series of changes, in which the fish, Lepidosiren, perennibranchiate, and triton, are all represented.

One would be inclined to infer from these metamorphoses, that, on tracing the Amphibia back in time, the story of their origin should be told, but, as a matter of fact, palæontological history tells a different story altogether. Abundant remains of frogs and toads are found in the Miocene deposits, some of which are of so fine a character that even the tadpoles are preserved; but these tertiary frogs and toads do not differ, in any important particulars, from those of the present day, and the same is true of the tritons and salamanders. Some of the latter attained a very great size, and one of them—a near ally of the great Japanese salamander of the present day—has had a very singular fate, having been described, about the middle of the last century, as a fossil man, by the German naturalist Scheuchzer, who named it "Homo diluvii testis," the man who saw the flood!

In the Wealden and Purbeck formations no Amphibia have as yet been discovered, but, from the Lower Lias to the Carboniferous they turn up again in remarkable numbers, and of great size, but differing from existing forms in some important peculiarities, and affording no help whatever to our inquiries as to the origin of the existing or of the tertiary frogs, toads, and salamanders. Under the throat, these gigantic Amphibia had a remarkable shield of three bony plates, as well as a series of plates along the belly. Their teeth were large and powerful, and presented an extremely complicated structure, whence the group has received its name of *Labyrinthodonta*.

Thus, in tracing back the existing Amphibia, we find a great break in the secondary period, and then come upon a distinct group, the Labyrinthodonta, from which the existing forms cannot possibly be deduced. These, again, have been traced no farther back than the carboniferous epoch.

(*To be continued.*)

PHYSICAL SCIENCE IN SCHOOLS

THE beginning of a discussion on any great subject elicits mainly differences of opinion; its end should be to establish agreement as to principles, and in great measure as to details. The first half of this dictum has been illustrated by the interesting letters in your columns on Physical Science in Schools; its entire confirmation as the correspondence proceeds will confer on education a benefit of the most timely kind.

The moment is a critical one for scientific teaching. Lord Salisbury's Bill will come to mean a revolution in the educational structure of the Universities; the Report of the Science Commission proposes to re-cast the teaching of the schools; public feeling, unexpressed as yet on other points, is distinct in wishing to see Science heartily recognised and systematically taught. If Science Teachers will agree as to what they want and press it vigorously, the game is in their hands.

I venture to lay down for consideration in NATURE certain propositions on this subject in the hope that they, or such others as may be preferred to them, may become the basis of the agreement we all desiderate:—

1. The business of a school is general education; the business of a University is special education.

2. The principal subjects taught at a school should be Literature, Mathematics, Science.

3. Each of these subjects should be studied in fixed relative proportions of time, from the very beginning of a school course until its close.

4. Scholarships offered for any one of these subjects to the exclusion of the others at the entrance on University life are mischievous in their effect on school teaching, and ought to change their character or be abolished.

5. Science should be taught to every boy in a school for at least six hours in the week; holding a fair place in Entrance Examinations, being encumbered with no pecuniary charges unimposed on other subjects, and having a value in school-marks proportional to the time spent upon it.

Of these five theses, the first three and the fifth are in exact harmony with the recommendations of the Science Commission; the fourth follows necessarily from the others, as stigmatising a system whose continuance makes general school teaching impossible, and whose significance gains point from the curious admission of one of your correspondents as to the intellectual cost of a Balliol Scholarship.

The feasibility of teaching science to the youngest schoolboys, assumed in what I have said, demands a word of comment. The evidence on this point scattered through the Report of the Commission, and partly summarised in Report VI., pp. 6—9, is, if not overwhelming, so strong as to outweigh many-fold anything that has yet been said against it. I desire to advance with humility, but with great earnestness, my own experience, extending over fourteen years, in support of the view there laid down; and Mr. West's admirable letter in NATURE, vol. xiii., p. 48, represents, as I well know, the conclusions of many successful teachers. If grammatical analysis and arithmetical numeration are taught every day to boys of nine years old, why not the elements of science? It were well surely to inquire what parts of this vast subject and what treatment of them have been found suitable to younger minds; for the statement on the part of any individual that science cannot be taught to little boys means nothing more than that he himself has failed to teach it.

My object in writing is a practical one. I have stated the principles which seem to me to underlie all school science teaching worthy of the name, and I invoke a judgment upon them, possibly a reversal of them, at the hands of experienced teachers. If it be true, as we were lately told, that the head-masters are awaiting instruction from the public, let us prepare the public to educate their illustrious pupils. At any rate, let scientific men be ready to answer the appeal which will be made to them when the Report of the Science Commission comes before the House of Commons, with such unanimity as only abundant and unprejudiced discussion can generate. To let slip this opportunity will be to find, I fear, with the Jew of Malta, that "Occasion 's bald behind."

W. TUCKWELL

I notice in your columns that a discussion has been conducted for some time past on that important subject, Physical Science in School Teaching. Permit me, as one possessing a deep practical interest in this matter, and also as a science teacher of some years' experience, to remark that in Scotland, generally, and in this great educational centre in particular, the chief obstacle which stands in the way of extended science teaching, is the simple apathy of educationalists to the claims of scientific instruction. It were well that, before disagreeing as to the exact mode of teaching, the claims of one science over another, and other points, science teachers should thoroughly agree as to the necessity for more openly enforcing their claims upon the notice of those who sit in high places in the world of educational management. I gladly welcomed an opportunity afforded me by the Edinburgh branch of the "Educational Institute of Scotland," in December last, to address the members of the Institute, consisting in the main of teachers of all subjects, on the "Place, Method, and Advantages of Biological Instruction in Ordinary Education." The substance of that address will shortly appear in *Fraser's Magazine*, and to that medium I would respectfully refer those of your readers who are interested in this question, for a *résumé* of a science teacher's work and method in the northern metropolis. I would fain hope that the arguments therein stated, as applying to the extension of my especial subject—Biology—may be found to suit the case and claims of science teaching at large. And it may not be inappropriate to conclude by re-echoing the remark with which I started, namely, that if we can succeed in creating a *demand* for science teaching, by showing the honest claims and true value of scientific instruction in an ordinary educational curriculum, we shall have paved the way for a harmonious and natural after-adjustment of such questions as have very ably been ventilated in NATURE during the past few weeks.

Edinburgh Medical School ANDREW WILSON

I have read with considerable interest what may be styled the evidence of your correspondents as to the state of scientific instruction in schools, and I think possibly if your space will permit me, that I shall be able to confirm some of the statements of previous writers. I have reason to believe that in some large schools where science is demanded as a branch of education it is practically suppressed, some of the clever lads are removed from the science classes in order to be "crammed" in classics, sometimes against their own desires, for the purpose, if possible, of making a show in school-lists as having obtained scholarships at Oxford. I am acquainted with facts which cannot be otherwise explained. Sometimes I have learned these from the boys themselves, sometimes from science-masters in different establishments. At one large school in connection with a College there are about 600 boys; formerly very nearly 100 attended chemistry lectures once a week, and about 25 attended the chemical laboratory of the College for $1\frac{1}{2}$ hour. The subject was a voluntary one, and the undoubted interest shown by the scholars was very striking; one could see that they were being taught to think, it was something so entirely different from their ordinary school work. For the last year or two the number of boys attending these science classes has been limited almost entirely to those who intend matriculating at the London University, those whose parents expressly wish their sons to receive such education, or others "the most stupid and ignorant," who are so unlikely to hold their own in any other competition that it is considered they may be better fit for distinction in science. I need hardly say that one fails to make anything of the latter class, although, on the other hand, I have seen such lads display unusual mechanical skill. The number of boys from the school now attending the laboratory is only eight, and those who hear lectures about thirty-six. In a school with unusual facilities for scientific instruction at a small cost, since the teachers, the laboratories, the lecture-rooms, and the very costly scientific apparatus, all belong to the College, there is this small result simply because the pupils are prohibited attending the lectures on science lest, as it is said, "*they should shirk their other work.*" This is certainly not equalising the various branches of human knowledge. In some schools the science masters are appointed not from among those who have made the teaching of science a study, but from that peculiar body who are willing to combine instruction in science (which includes, of course, Physics, Chemistry, Natural History, and Botany), with Mathematics, Classics, and Foreign Languages, and whose views as to the suitable remuneration for their services suggests a limited expenditure of thought, time, and money, on their own acquirements. From the present low estimation in which scientific knowledge is held, I should be exceedingly sorry to see the number of efficient science teachers increased. The capital expended on a classical education gives a far better, a more certain, and a quicker return than that invested in science. Hence the lamentations about the state of science in this country. Until the Head Masters and College dons have been so liberally educated as to understand that besides Classics and Mathematics there are other branches of knowledge which ennoble and enrich the understanding, and further, until a legal status has been secured for professional scientific men, such things must continue. W. N. HARTLEY

NOTES

THE John Hopkins University, some account of the organisation of which we recently published, was formally instituted at Baltimore, U.S., on February 22. Prof. Gilman in his address hinted that elementary instruction in all branches of science is not contemplated at the new University. There will be no stated curriculum of four years. Great freedom is to be allowed both to teachers and to scholars; the former must be "free and competent to make original researches in the library and the laboratory;" the latter will be encouraged to "make special attainments on the foundation of a broad and liberal culture," and to make them through a "combination of lectures, recitations, laboratory practice, field work, and private instruction." Pending the filling of the several professorial chairs, the trustees will ask the most eminent men, both in Europe and America, to come to Baltimore during a term of years, and reside there an appointed time, "and be accessible, *publice et privatim*, both in the lecture-room and in the study." One most important appointment has already been made, by which England will lose, for a time at least, one of her most distinguished mathematicians; Dr. J. S. Sylvester has been appointed to the Chair of Advanced Mathematics, at a handsome salary. Prof. Sylvester will probably enter upon his duties in October next.

THERE is great activity at present at South Kensington; the preparations for the opening of the Scientific Loan Exhibition are in a forward state. A large number of contributions have been already received from France, Germany, Belgium, Holland, and Italy.

CONTRARY to the assertion of a contemporary, who apparently desires to mislead, the men of science of this country are giving the greatest help in the organisation of the Conferences and Conversazioni in connection with the Loan Exhibition; these will be held between May 16 and 31.

H.M.S. *Challenger* arrived at Monte Video on Feb. 15, and was to sail on Feb. 23 for Ascension and St. Vincent. The ship is expected to arrive in England about the end of May.

A CAREFULLY prepared and well classified and indexed Catalogue of Maps, &c., of India, and other parts of Asia, has been prepared by the Geographical Department of the India Office, and published by order of H. M. Secretary of State for India in Council. The Catalogue is accompanied with an Index-Map showing the different sheets which are published or which are being prepared by the engraver for publication.

M. J. CAPELLO, director of the Observatory at Lisbon, has selected Lisbon, Campo-Maior, Angra in the Azores, and Funchal in Madeira, as the stations from which meteorological observations will be furnished for international objects. Their situation, and the fact of their observations being made four times daily, have determined the selection of these four stations. The hours are well suited for purposes of international meteorology.

THE Belgian Academy of Sciences offers prizes for papers on the following subjects, to be sent to the Secretary, M. J. Liagre, at the Museum, Brussels, before Aug. 1, 1877:—1. To give a *résumé* of works which have appeared on the theory of continued fractions, and to improve it in some important point. 2. To examine and discuss, on the basis of new experiments, the perturbing causes which bear on determination of the electro-motive force, and on the internal resistance of an element of the electric pile; to exhibit in numbers these two quantities for some of the principal piles. 3. New researches to establish the composition and mutual relations of albumenoid substances. 4. To establish, by direct observations and experiments, the functions of the various anatomical elements of Dicotyledinus stems, especially in relation to the circulation of nutritive substances and the use of the fibres of the liber. 5. Does the generative vesicle perform the same part in eggs which are developed without previous fecundation (by parthenogeneses) as in fecundated eggs? 6. Investigation of the cycle of evolution in a group of the class of Algæ.—The conditions usual in such competitions are laid down, and the prizes are gold medals varying in value from 600 to 1,000 francs.

THE *Athenæum* of Saturday last has a well-timed and justly severe note in connection with the filling up of two vacancies among the trustees of the British Museum. A writer in the *Times* has mentioned the names of Sir Henry Rawlinson and Mr. Layard as having claims for the vacant posts, and the *Athenæum* shows that only one trustee is appointed by the Crown, and that the two vacancies will be filled up by the Trustees themselves. "Let us hope," the *Athenæum* says, "that they may see fit to appoint the two scholars in question, or at least one of them. But if they are elected, they will succeed to a perfectly barren honour, unless they are subsequently placed on the Working Committees. It is notorious, that Dr. Hooker, who is a trustee, by virtue of his office as President of the Royal Society, has absolutely no voice in the disposal of the vast collections of natural history contained in the Museum; and that, although there is no naturalist among the trustees with the exception of Sir Philip Egerton. And it is doubtful whether such men as Mr. Layard and Sir Henry Rawlinson, whose sympathies are likely to be with progress and reform, with scholarship and education, will be quite in harmony with that system which has made the British Museum what it now is. They might not feel anxious to strengthen the hands of those officials who are said to have recently endeared themselves to the gentlemen and scholars beneath them by the issue of a slave circular (to use the name by which it is popularly known in the Reading-room), of which it is asserted that some member of the legislature will before long demand the publication."

WE are grateful to the *Daily News* for the advanced and decided views it always takes in matters affecting the interests of science; indeed its advocacy of the claims of science in the country is a distinctive feature of the paper. In an able article in Friday's issue the unsatisfactory condition of the British Museum is pointed out, and it is shown that until an entirely new system of management is instituted, no reform can be expected. "It would seem, indeed, as if the framer of the constitution of the British Museum had, with fiendish malignity, selected precisely those persons as trustees who could by no possibility find time to attend to their duties." It is shown that the recommendations of successive Royal Commissions have been ignored, and that no means have yet been taken to carry out improvements which would greatly increase the usefulness of the Museum. We hope that this article, in conjunction with the note in the *Athenæum* to which we have referred, will have some effect in stimulating the Government to carry out the recommendations of the Duke of Devonshire's Commission and take steps to render the Museum of greater service than it is to science and the country; and that even with its present drawbacks it does render great services must be admitted.

THE Royal Irish Academy has made the following grants out of the fund placed at its disposal by Parliament for advancing scientific research:—35*l.* to Rev. Eugene O'Meara for further Report as to the Distribution of Irish Diatomaceæ; 12*l.* to Prof. Leith Adams for a Report on Irish Pleistocene Mammals; 50*l.* to Rev. Prof. Haughton for a Report on the Tidal Constants of the Irish Coasts (towards the sum of 100*l.* required for the expenses to be incurred); 25*l.* to Dr. Studdert and Mr. Plunkett for a Report on the Nature of the Mineral Waters of Mallow; 20*l.* to Dr. Chichester Bell for Report on the Chemical Constitution of Pyrol; 40*l.* 12*s.* 8*d.* to Dr. Emerson Reynolds for Report on the Atomic Weight of Glucinum; and 10*l.* to Dr. E. P. Wright for Report on Chytridia Parasitic on Florideæ.

THE Royal Irish Academy, at its stated meeting held on the eve of St. Patrick's Day, elected the following honorary members:—In the department of Science: Carl W. Borchardt, Alphonse Decandolle and Ernst Haeckel. In the departments of Polite Literature and Antiquities: Thomas Carlyle, Margaret Stokes, William Stubbs, Eugène E. Viollet-le-duc, and Ernst Windisch.

M. EMILE DE GIRARDIN and others are trying to organise a Universal Exhibition in Paris for 1878.

THE electric lamp and gramme machine which have been used so successfully at the Northern Railway Station, Paris, have been sent *viâ* Marseilles to Malta, to be employed in the illuminations when the Prince of Wales stops there on his way home from India.

IN the title to Mr. Evans's recent address to the Geological Society, we inadvertently prefixed Royal to the designation of the Society; we regret that so important a society has not attained to this dignity.

THE Imperial Zoological-Botanical Society of Vienna, celebrates, on April 8, its sixtieth anniversary.

ON July 1 an Exhibition of Arts, Manufactures, Agriculture, &c., will be opened at Helsingfors, the capital of Finland.

PROBABLY not many of our readers are aware of the fact that Great Britain has recently become possessed of the island of Socotra, near the mouth of the Gulf of Aden. Mr. P. L. Sclater calls attention to the fact in Saturday's *Times*, in order to intimate that we are almost completely ignorant of its natural productions. We trust, with him, that the new British Governor and his assistants will not neglect to furnish us, before long, with some account of the natural denizens of this *terra incognita*.

FEARS are entertained that the extraordinary dryness which has recently prevailed in Algeria will lead to a famine. It is stated that no rain has fallen this summer during the usual wet season.

IT is said that a number of governments have given their approbation to the scheme initiated by Austria for sending to the Polar regions a number of vessels to explore scientifically the countries which have been discovered by the *Polaris* and *Tegethoff* expedition.

VISCOUNT CARDWELL is to ask the Government to-day in the House of Lords what course they intend to pursue with regard to Cambridge University. In answer to the Marquis of Lansdowne who, on Monday, among other things asked whether Science would be represented in the Oxford University Commission as well as rank, dignity, and learning, the Marquis of Salisbury stated he had no objection to name the Commissioners next Monday, and at the same time he would state the nature of the amendments to be proposed by the Government.

VAST masses of dense smoke were reported to be issuing from Mount Vesuvius on Sunday; flame was visible at night; the apparatus at the Observatory was in a state of disturbance, and an eruption seems probable before long.

DR. PETERMANN has sent us one of the best maps we have seen illustrating Cameron's route between Lake Tanganyika and the coast. The map, which is based on that of the Royal Geographical Society, is on a comparatively large scale, shows the routes of Cameron, Livingstone, Magyar, and the Pombeiros, Cameron's camping stations, all the rivers observed by Cameron, and is coloured to show the orographical features. It extends from 3° to 13° N. lat.

IN Monday's *Times* is a long letter from the Rev. S. Macfarlane, giving an account of an interesting trip in the missionary steamer *Ellangowan*, for 170 miles up the Fly River, New Guinea. The account seems to be essentially the same as that read at the last meeting of the Geographical Society. Signor D'Albertis was on board and obtained a considerable number of natural history specimens. Mr. Macfarlane sums up the results of the trip as follows:—"Several important ends have been gained by our visit to the Fly River. We have proved that there really is a navigable river there extending far into the interior of the country. We have opened up the way, which has hitherto been guarded with great determination by savages, and have taught them the danger of attacking European vessels. On our return we succeeded in establishing what appeared to be a genuine friendship between the natives and ourselves, exchanging presents. We have learnt something of the character of the interior; and, although we found it low and swampy up to the highest point we reached, we have at least proved that high land is not to be reached within at least two hundred miles by the course of the river, the first hundred being thickly populated by a mixed race—Papuan and Malayan—speaking different dialects, and at war with each other. They are an intelligent-looking, energetic people. We obtained a considerable number of specimens of natural history. We were disappointed at not reaching high land with populous and healthy villages suitable for stations."

THE death is announced of the widow of the late Hugh Miller at the age of sixty-four years. She took a chief part in editing her husband's works after his death, and gave much assistance to Mr. Peter Bayne in the preparation of the sturdy geologist's biography.

DR. PARKES, F.R.S., the distinguished professor of hygiene at the Army Medical Schools, died on the 15th inst.

THE Oxford Burdett-Coutts Scholarship has been awarded to Mr. A. H. S. Lucas, of Balliol College.

SEVERAL letters have appeared in the *Daily News* calling attention to the fact that on Sunday week red snow was observed to have fallen in several parts of the country—at Forest Hill and Streatham in the south of London, at Reading and at Thurston in Norfolk. This phenomenon was observed in ancient times, and is referred to by Pliny; in modern times it has been frequently observed in all parts of the world, and is familiar to Arctic explorers. The phenomenon is generally ascribed to the presence of an algæ, *Protococcus nivalis*.

WE have received from the U.S. Geological and Geographical Survey of the Territories one of these valuable publications, which it is grievous to think the caprice of a political party may soon bring to a stop. This is a preliminary map of South-west Colorado, and part of Utah, Arizona, and New Mexico, showing the location of ancient ruins. The map is on the scale of five miles to an inch, and shows not only the sites of the prehistoric ruins which abound in the region, but the courses of the principal rivers and of dry gulches, and by means of lettering the general character of the surface of the country.

Bulletin No. 1, vol. ii. of the Geological and Geographical Survey of the Territories, under the direction of Prof. Hayden, is one of unusual interest. It contains seven articles, with the following titles:—1. A notice of the ancient remains of South-western Colorado examined during the summer of 1875. 2. A notice of the ancient ruins in Arizona and Utah lying about the Rio San Juan. 3. The human remains found near the ancient ruins of South-western Colorado and New Mexico. 4. Ancient art in North-western Colorado. 5. Bead ornaments employed by the ancient tribes of Utah and Arizona. 6. Language and utensils of the Utes. 7. Fossil Coleoptera from the Rocky Mountain Tertiaries. The text is illustrated with twenty-nine octavo plates, embracing cliff and cave houses, arrow-heads, pottery, human skulls, &c. Mr. Scudder's article contains descriptions of thirty-one new species of fossil Coleoptera.

THE first section of the building for the American Museum of Natural History, in Central Park, New York, will be ready for occupation in the coming summer. Some time ago, our readers may remember, New York appropriated 700,000 dollars to commence this edifice, and it has also set aside for this section and its future extensions, 18¼ acres of land worth from 5,000,000 dollars to 8,000,000 dollars. The whole edifice when complete will be about eighteen times as large as that now nearly ready, and will cost about 15,000,000 dollars. The collection is at present in a wooden building, which is visited by an average of 13,600 people per week—2,000 more than the average weekly number of visitors to the entire collections in the British Museum.

THE additions to the Zoological Society's Gardens during the past week include two Suricates (*Suricata zenik*) from S. Africa, presented by Mr. G. Thorburn; a Knot (*Tringa canutus*), European, presented by Mr. C. Clifton; a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. Robert Law Ogilby; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. J. Shortland; a White-Cheeked Capuchin (*Cebus lunatus*) from Brazil, presented by Dr. Lynn; an Aztec Conure (*Conurus aztec*) from Mexico: two All Green Parrakeets (*Brotogerys tiriacula*) from S. America, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

REPORT OF THE CAMBRIDGE STUDIES' SYNDICATE

THE Syndicate appointed in May last year to consider the requirements of the University of Cambridge in different departments of study, have just issued their Report. This contains many features of interest. We reprint the answers of the Board of Natural Science Studies to the questions sent by the Syndicate. What the nature of these questions is may easily be gathered from the answers.

I.—A—(*a*). The Board is of opinion that lectures are required in the University on the following subjects:—1. Principles of chemistry and inorganic chemistry, organic chemistry, physical and thermal chemistry, &c., analysis, elementary qualitative, analysis, elementary quantitative, analysis (1) of minerals (metallurgy, &c.); (2) organic; (3) volumetric; (4) spectrum.

Catechetical lectures are also required, suited for students of different degrees of attainment. There should be also laboratory teaching in practical chemistry, including qualitative and quantitative analysis and instruction in chemical research. Probably one term would suffice for each course of lectures, except the general course on chemistry and perhaps the course on organic chemistry which might occupy two terms each. For the special courses on analysis one or two lectures a week or three lectures a week for part of a term would suffice.

2. An elementary course on physics, occupying two terms. Special courses:—(1) General physics, dynamics, &c. (1 term). (2) Heat and thermodynamics (2 terms). (3) Sound and Light (2 terms). (4) Electricity and Magnetism (3 terms). (5) Methods of observation, &c. (1 term). Higher courses (chiefly mathematical):—(1) Heat and thermodynamics (1 term). (2) Sound and light (1 term). (3) Electricity and magnetism (2 terms). There should be a course of practical laboratory instruction extending over three terms, and special laboratory teaching for advanced students.

3. A course on elementary crystallography, and one on mineralogy, together occupying about two terms.

4. General geology, physical geography, and geological physics. Stratigraphical geology. Petrology. Palæontology—general.

Special Palæontological lectures and demonstrations in connection with the lectures on stratigraphical geology.

5. *Elementary biology.

6. Systematic botany:—(1) *Elementary and (2) Advanced.

7. Vegetable morphology and physiology:—(1) *Elementary, and (2) Advanced.

8. Zoology:—General. Special, (1) Vertebrates. (2) Molluscs. (3) Insects. (4) other Invertebrates.

9. Comparative anatomy:—(1) Elementary and (2) Advanced. *Embryology. Osteology.

10. Physiology:—(1) Elementary and (2) Advanced. *Physiology of the senses. *Physiology of nutrition.

11. Human anatomy, including animal mechanics, &c.:—(1) Elementary and (2) Advanced. *Ethnology.

Each of the courses on the subjects numbered 5 to 11 would probably require two terms, except those marked *, each of which might be concluded in one term. In many of these subjects more or less catechetical teaching would be desirable.

With respect to the distribution of these courses among different teachers:—

1. The general superintendence of the chemical laboratory with the delivery of one course of lectures, usually those on general chemistry, would sufficiently occupy the time of the professor. Organic chemistry, including the superintendence of the practical work in this subject, would occupy the greater part of the time of a second professor. He might, however, in some cases also deliver one of the special courses. Some of the special departments of chemistry might perhaps be undertaken by demonstrators, but for the remainder, and for catechetical instruction with a proper division of classes, two additional teachers are at present needed who may very well be inter-collegiate lecturers.

2. The superintendence of the physical laboratory, with the teaching of such branches of mathematical physics as are not provided for by other professors under the jurisdiction of the Mathematical Board, would probably occupy all the time of the Professor of Experimental Physics. The special experimental courses might, if necessary, be given by demonstrators, but at least one regular teacher of experimental physics in addition to the professor would be desirable.

3. The mineralogical teaching at present required in the University might be given by the professor, the students being referred for the chemical part of the subject to one of the teachers of Chemistry.

4. Stratigraphical geology, petrology, and Palæontology would each require a separate teacher. Lectures on different portions of stratigraphical geology might be delivered in different years. Parts of the course on general geology (*e.g.* that on glacial phenomena, earth movements, &c.) might be given by the lecturer on stratigraphical geology. Some parts (*e.g.* that on volcanic phenomena) being undertaken by the petrologist. Special demonstrations on Palæontology in connection with the course on stratigraphical geology might be given by curators or demonstrators.

5. The course on elementary biology might be given by a demonstrator acting under a Professor of Physiology or of Comparative Anatomy.

6. The elementary and advanced courses on systematic botany might be given by one teacher.

7. The elementary and advanced courses on vegetable morphology and physiology might be given by one teacher. A third botanical teacher (for cryptogamic botany) will probably be required at a future time.

8. The general course of zoology requires one teacher. The teaching which is at present required in the special departments of zoology might be given by Curators of the Museum, who should also act as demonstrators; but special teachers of each of the four departments will be required eventually.

9. The elementary and advanced courses on comparative anatomy might be undertaken by one teacher. The courses on embryology and osteology might be given by demonstrators; but each subject is important enough to occupy the whole time of a teacher if a suitable one is available.

10. The elementary and advanced courses on physiology require one teacher. The remarks made on embryology and osteology apply also to the subjects of the physiology of the senses and the physiology of nutrition.

11. Elementary and advanced courses on human anatomy might be undertaken by one teacher. The subject of ethnology would be best undertaken by a separate teacher if circumstances should admit.

A (*b*). It is desirable that the University should have the opportunity of inviting men who have devoted themselves successfully to the prosecution of special departments of science to give lectures in the University; but the delivery of such lectures must depend rather upon the men being forthcoming than upon any *à priori* consideration of what subjects require elucidation.

B (*a*). Viewing this question with reference simply to the numbers of students, there appear to be no branches of natural science in which the classes which require to be put through exactly the same course in the same term are so large as to require division.

B (*b*). The approximate number of students in the University classes in most of the above great groups of subjects is from twenty to thirty; in the class of elementary biology the number is larger; in chemistry the number is nearly a hundred. The number may be expected to increase.

C. In most of the natural science subjects opportunities for individual personal intercourse between teachers and students occur in the course of laboratory and field work. Most of the professors encourage the students to ask questions after lecture, and some give short catechetical lectures before the ordinary lecture.

D. For the superintendence, under the professors, of the laboratory work, and for giving instruction in such of the special chemical subjects as may not be otherwise provided for, four demonstrators are required. If the number of students increases, more demonstrators will be required. In physics not less than three demonstrators will probably be required. Each of the professors or other principal teachers of chemistry and physics will require a lecture assistant, and boys to do general work in connection with the laboratories will be required in the proportion of about one to each demonstrator. In the geological Museum three curators or demonstrators will be required—one of these at a time would be occupied as a demonstrator in assisting the professor and the Palæontologist—the others would be engaged in the general work of the Museum. The petrologist would require a curator who should also act as demonstrator. The Professor of Geology also requires an assistant to prepare and keep in order diagrams, maps, models, &c. The teacher of systematic botany requires a demonstrator. The teachers of vegetable morphology, of comparative anatomy, and of physiology will each require demonstrators in the proportion of one to every ten or fifteen students. Assistance in the same proportion will be required for the class in elementary biology, but this may probably be provided from the staff of the teachers of comparative anatomy, physiology, and vegetable morphology. Four curators, who might also act as demonstrators, will be required for the special departments of zoology. One or two demonstrators in human anatomy will be required.

E. In addition to special libraries attached to the different departments, a general scientific library, easily accessible from the Museums is required. In *Chemistry*. A new and more spacious laboratory is urgently required. To this should be attached a museum of chemical preparations. In *Geology*. A new museum has long been an acknowledged want. In *Botany*. Workrooms are required in connection with the Herbarium; also a laboratory for vegetable morphology and physiology, including rooms for microscopical work, &c. In *Zoology*. Workrooms are required for the professor, superintendent of the museum, curators, and demonstrators. In *Comparative Anatomy*. A laboratory is required, including dissecting-rooms, rooms for microscopical work, &c. In *Physiology*. A laboratory is required, including chemical laboratories, rooms for microscopical work, &c. In *Human Anatomy*. Dissecting-rooms are required, and rooms for microscopical work. Each department will require rooms for research, microscopes and other apparatus, as well as diagrams.

Such are the requirements necessary to make instruction in natural science fairly complete. In the physical departments the wants of chemistry are the most urgent; teachers of palæontology and petrology are urgently required. In reference to more immediate wants of the biological departments, it may be stated that the present teaching staff consists of the Professors of Anatomy, Botany, and Zoology and Comparative Anatomy, each of whom, except the Professor of Botany, has a demonstrator.

The chief teaching of physiology is at present conducted by the Trinity Prælector in Physiology. The additions to the teaching staff most urgently required are (1) a professor or teacher of comparative anatomy; (2) a more definitely recognised teacher of vegetable morphology and physiology; (3) two curators in zoology (molluscs and insects), to act also as demonstrators; (4) two Demonstrators of Physiology; (5) an additional Demonstrator of Comparative Anatomy; (6) an Assistant-Curator of the Herbarium, to act also as Demonstrator of Systematic Botany; the Professor of Botany being *ex officio* Curator of the Herbarium. The appliances most urgently needed are laboratories for chemistry, comparative anatomy, physiology, and vegetable morphology, and workrooms for the zoological museums.

II. (*a*) It is desirable that all the teachers in each of the several departments should be grouped in one organisation.

(*b*) The Board considers that while there is room in the University both for professors and lecturers, appointed directly by the University, and for inter-collegiate lecturers, it is undesirable to have lecturers in natural sciences teaching members of their own colleges exclusively.

(*c*) It appears that physiology, comparative anatomy (as distinguished from zoology), and vegetable morphology and physiology (as distinguished from systematic botany), are so important and so distinct that they should be entrusted to independent professors, but till this can be done the subjects may be undertaken by other lecturers.

(*d*) It seems desirable that the selection of University professors should be entrusted to a body of about seven electors, of whom a majority should be residents in the University; that such electors should be appointed either for life, for a term of years, or by virtue of holding some official post, and that those who are not *ex-officio* electors should be nominated by the Board of Studies with which the professorship is connected, and be elected by the Senate. Further, that the selection of other teachers appointed by the University, but not directly subordinate to the professors, should be made by similar bodies of electors resident in the University, or by the several Boards of Studies, and that demonstrators should be appointed as at present.

(*e*) It seems desirable that in the case of the recognition of individual inter-collegiate lecturers by the University, the appointment of such lecturer should receive the confirmation of the several Boards of Studies.

III. (*a*) It seems highly desirable that the professorial and inter-collegiate lectures should be brought into closer relations with each other; and it seems probable that this may be effected, in part at least, by organising meetings of the professors and other teachers in each department, in order to arrange a plan of combined action in teaching, and to consider and determine a scheme of lectures, such scheme to be submitted to the Board, and, if approved by the Board, published at the beginning of the academical year by its authority.

Further, the Board thinks it desirable that the university should appoint, from time to time, on the recommendation of the Boards of Studies, lecturers on any subject or subjects which may not at the time be adequately represented by professors, inter-collegiate lecturers, or other teachers.

(*b*) The Board is not prepared to suggest any further provision for the organisation of the professorial lectures in its department.

With respect to inter-collegiate lectures, the control exercised by the Board over the authoritative publication of the scheme drawn up after consultation with the professors would, it is hoped, be sufficient for the effective organisation of the whole system.

(*c*) The power given to the Board of Studies of remitting for further consideration any scheme of professors' lectures which the Board disapproves, may be used to prevent any undue interference of one professor with the departments properly belonging to another.

With regard to competition in a wider sense, the Board does not see that any regulation of it is necessary or desirable.

Considering the importance in many cases of the lectures on natural sciences being delivered in a central building, and of the University collections being made as much use of as possible, it is desirable that power should be possessed by the Museums and Lecture-rooms Syndicate, or by some other University authority, to allow inter-collegiate or other lecturers, recognised by the University, to make use of University lecture-rooms, museums, &c., with the consent of the professors concerned, and under such conditions as may be found necessary to avoid interference with the work of the professors or risk of injury to the collections.

IV. There seem to be two ways in which the advancement of knowledge may be assisted by organisation. One is by giving mature students (in which light the Board must regard the professors and inter-collegiate lecturers) some amount of leisure for the prosecution of their studies, and some inducement to pursue them with energy, and to give the results of them to the world. The other is by giving opportunity to younger students, such as our younger graduates, who may show promise of capacity to do original work, and who are anxious to attempt it, the opportunity of making their first essays, under skilled guidance and under favourable conditions, in some place where their qualifications can be judged and their results appreciated.

A considerable part of the original work done by those engaged in the higher teaching at Cambridge must probably be always done during the vacations, but it must be always difficult for a professor, or other advanced teacher, to keep himself well acquainted with all that is being done in his department, to say nothing of advancing knowledge in it, unless the more engrossing kind of work is so distributed and arranged that each of the principal teachers should have one term in the year of, at any rate, comparative leisure. For any additional stimulus that may be necessary in order that such leisure may be employed for the benefit of science we must look to public opinion.

In order to encourage and facilitate the advancement of knowledge by the younger graduates, it seems desirable that most of the rather numerous demonstratorships which are required should be temporary appointments, and should be offered to such of the younger graduates and others as shall have shown a desire to attempt original work, and given promise of capacity for doing it. The work of the demonstrators, however, if it is properly done, takes up so much time and energy that but little original work can be expected from them, unless they too are allowed, at any rate, comparative freedom from work for one term in the year, during which they may be expected to assist the professors in their researches, or to carry on work of their own under the direction of the professors. They should not be allowed to take private pupils. In all branches of natural science it is desirable that the teaching should be continued throughout the terms and not be limited as at present to the middle two-thirds.

SCIENTIFIC SERIALS

American Journal of Science and Arts, February.—The first article is an obituary notice of Sir W. E. Logan, read before the Natural History Society of Montreal last October.—Mr. W. B. Taylor contributes a continuation of his history of recent researches in sound.—Mr. A. H. Rowland continues his studies on magnetic distribution, in which he critically examines M. Jamin's recent work.—On the rifts of ice in the rocks near the summit of Mount McClellan, Colorado, and on the different limits of vegetation on adjoining summits in the territory, by Edward L. Berthond. Mount McClellan is 13,430 feet high, and contains mines which are extensively worked. At a height of 13,100 feet, and about 30 feet from the entrance of the tunnel of one of the mines, were three or four veins of solid ice, parallel with the bedding of the rock, and filling all its inner side with cracks and fissures. In another tunnel 300 feet westward and about 100 feet from the entrance, veins of ice were also met with. It has been suggested that this ice has remained ever since the Glacial period. The mountain presents these two strange antagonistic phenomena in immediate proximity. On one side of the valley there is a mountain slope facing north-east, well grassed, totally devoid of shrubs and trees, where the rocky *débris* are underlain by a perpetual icy coat hundreds of feet in depth, supporting on its surface a growth of plants strictly Alpine and Arctic, and abounding with Ptarmigan, *Lagopus leucurus*, and the tail-less, earless marmot. A list of plants found bloom Oct. 2, 1875, is given. Less than half a mile distant on the opposite slope of the vale *Pinus aristata* of large size and a profuse growth of birches, willows, grasses, and arbutus abound.—On a new form of lantern galvanometer, by Francis E. Nipher, which possesses the advantages of being adaptable to any vertical lantern; the distance between the deflecting coils is readily varied and can be adjusted to currents of various intensity; the resistance of the galvanometer is quickly varied from one half to twice the resistance of the galvanometer coils.—On the occurrence of tartronic acid, with some remarks on the molecular structure of glyceric acid, by S. P. Sadtler. A comparison is made of two views taken of glyceric acid, and it is suggested that there are two isomeric acids, one of which is normal and the other an unsymmetrical acid.—On the "chloritic formation" on the western border of the New Haven region, by J. D. Dana.—A new Tertiary lake basin, by G. B. Grinnell and E. S. Dana. During recent explorations a new series of Tertiary deposits has been found at Camp Baker, Montana; they indicate the existence in this region of a Miocene lake basin, which was succeeded by another lake basin in Pliocene time.—The remaining papers are: The product of the action of potassium on ethyl succinate, by Ira Remsen.—The action of ozone on carbon monoxide, by the same.—The appendix contains an article on the Dinocerata, by O. C. Marsh, with five plates.

Journal de Physique, Dec. 1875.—We simply name the principal papers in this number, which are mostly of a mathematical nature:—Application of the laws of Coulomb to electrolytes, by M. G. Lippmann.—On the determination of condensing power, by M. Terquem.—On the magnetisation of steel by currents, and on the situation of the poles in long needles, by M. Bouty.—On an experiment relative to the transformation of forces (we refer to this more fully elsewhere).—Criticising a paper of Mr. Tomlinson's on the action of solids in liberating gas from solution, M. Gernez disputes that observer's result in the experiment in which a small metallic cage with very close meshes is introduced into seltzer water. M. Gernez says that, varying the experiment in many ways, he has always found that the gaseous mass imprisoned in the cage increases at expense of the dissolved gas. In a few minutes it increases sufficiently for bubbles to be formed in the larger meshes, and one may even determine beforehand the points where gaseous liberation will take place, by enlarging certain meshes with the point of a needle.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Feb. 17.—"On Experimental Contributions to the Theory of Electrolysis," by Alfred Tribe, Lecturer on Chemistry in Dulwich College. Communicated by J. H. Gladstone, Ph.D., Fullerian Professor of Chemistry in the Royal Institution.

Linnean Society, March 2.—Prof. G. J. Allman, president, in the chair.—Sir Victor A. Brooke, Bart., Mr. R. B. Croft, Dr. Ralph Gooding, Mr. F. J. Horniman, and Mr. W. Percy Sladen were elected Fellows of the Society.—Preceding the business routine, it was the painful duty of the President to announce the demise of John J. Bennett, F.R.S,, who formerly, and for twenty years most creditably acted as secretary to the Linnean Society. Among his scientific labours the "Plantæ Javanicæ" worked out a then imperfectly-trodden field; his colleague in the said volume being Robt. Brown, *facile princeps botanicorum*. Mr. Bennett afterwards, and for years, was chief of the botanical department of the British Museum, retiring to Sussex, where he died. As a man he worked well, wisely, and energetically, and his name will always be remembered among botanists and friends as ripe in science, humanity, and fulness of heart. Another Foreign Member who has lately died, M. Adolphe T. Brongniart was among the most distinguished botanists of our age and a Fellow of the Society for upwards of forty years. His fame will rest on his "Végétaux Fossiles," wherein he may be said to have laid the foundation of fossil botany. He, moreover, wrote a vast number of other original and independent memoirs, and still found time for years to conduct as editor the botanical section of the *Annales des Science*, enriching the same with his great erudition.—J. Gwyn Jeffreys, F.R.S., exhibited on behalf of Sir James Anderson, a fine and interesting specimen of the so-called felt or blanket sponge, *Askonema setubalense*, Kent. This was picked up Aug. 24, 1875, along with the telegraph cable from a depth of 550 fathoms off Cape Finisterre.—Mr. C. Stewart called attention to peculiarities of the large rossette spicules found in its fluffy structure.—A mould of the upper surface of the cranium of the fossil *Ornithocheirus* and various fragments of the skeleton were exhibited and commented on by Prof. Seeley; these illustrating points raised in a former paper of his "On the Organisation of the Ornithosauria."—A paper was read on a new genus of Turneraceæ from Rodriguez, by I. B. Balfour, F.L.S. The tree in question is known to the inhabitants under the name of *Bois Gaudine*, and grows on the hilly parts of the island. It possesses a fine-grained, light-coloured wood, which, however, is not much used. The tree itself is handsome though small, being very erect in habit; its terminal branches are clothed with a light-green foliage. This new genus *Mathurina*, has close relationship to *Erblichia*, but differs manifestly from *Turnera* and *Wormskioldia*, its circumscribed habitat, moreover, lending additional interest. Mr. J. G. Baker, of Kew, in addition, stated that the botanical results of this Rodriguez Transit of Venus Expedition, through Mr. Balfour's collecting, had yielded some 280 species of flowering plants and ferns. Of these 110 were common weeds and 170 species indigenous to the island. The botany of Rodriguez, with a total area of fifteen miles, has now been fully settled by Mr. Balfour's researches, and these go to sustain its flora as belonging to the temperate region, and not truly tropical in character.—A paper on pollen was communicated by M. P. Edgeworth, F.L.S. The pollen grains of some 400 species have been carefully examined and drawn to scale by the author, those of the main orders of plants receiving comparison. It results from his survey that some families appear to have the bodies in question of variable forms, while others are remarkably uniform in shape.—Notes on algæ found at Kerguelen Land (by the Rev. A. E. Eaton), by Prof. Dickie, F.L.S. In this paper three new species, *Sphacelaria corymbosa*, *Melobesia kerguelini*, and *Ptilota eatoni* are described. The total number of algæ recorded are 65; of these 16 belong to the Olive, 34 to the Red, and 15 to the Green series. While there are 9 peculiar to the island, 21, or about one-third, are also found on European shores.—A list of the Musci and Hepaticæ collected in Kerguelen Island (by the Rev. A. E. Eaton), by William Mitten, F.L.S., was taken as read. This contains reference to 38 mosses and 13 liverworts, of the former, *Bartramia eatoni*, of the latter, *Tylimanthus viridis* and *Balantiopsis incrassata*, are new to science.—W. Carruthers, F.R.S., in calling attention to the specimens on the table, gave a *résumé* of the recent researches of Prof. De Bary of Strasbourg, into the potato fungus. The Peronosporeæ De Bary separates into three genera. In *Cystopus* the conidiophores grow in large bunches, the conidia, or bud-cells, being developed in single rows in basipetal order. In *Peronospora*, from a tree-like mycelium, conidiophores arise singly or in small bunches at the end of the branches, and have no successors in the direct line. *Phytophthora* differs from the last in its multiple and successive conidia, which, when shed, leave swellings on the branches. The ripe conidia in all, when placed in water, produce zoospores, or nucleate moveable cells provided with cilia. These penetrate the plants, and, ceasing to move, develope threads, or mycelium. By another sexual method of propagation the oogonia, bladder-shaped female cells, after being fertilised by the small male cells, antheridia, produce from their protoplasm a thick-walled oospore. Mycelial threads sprout from this latter and the above process is repeated. A considerable period of inactivity may, however, precede the germination of the oospore, which in this case hybernates for the winter, whilst its host decays. The conidia, De Bary states, propagate and spread the fungus during the summer season only, but do not live through the winter. He has, moreover, found in decayed potato tubers bodies exactly corresponding to oospores. On experimenting with the oogonia of these and planting them in potatoes he obtained bodies which conducted themselves precisely like zoospores, and in most respects resembled those of *Pythium*. Other experiments with them, on the moistened legs of dead flies and bodies of mites, resulted in their complete phases of development, which was watched step by step, the zoospores producing a plentiful crop of mycelium, &c. As this new fungus in many ways differs from the *Phytophthora infestans*, he names it *Pythium vexans*, on account of his trouble therewith. He regards it as a true Saprolegniea. De Bary has likewise investigated the question of the perennial mycelium of *Phytophthora* occasionally discharging the function of hybernation where the oospores are not found in the district. He believes he has established by proofs that there are two methods whereby the conidia pass from the tuber to the foliage. The general opinions held in this country De Bary is at variance with. Mr. Worthington Smith replied at some length to Mr. Carruthers' epitome, and criticised De Bary's conclusions unsparingly. Dr. Masters supported Mr. Smith's views, as opposed to Prof. De Bary's interpretation of the subject at issue. Further discussion of this interesting topic was postponed till next meeting. A series of the said parasitic fungi prepared by De Bary were exhibited under the microscope to the Fellows present. His complete memoir hereafter is to appear in the Roy. Agric. Soc. Trans.

Chemical Society, March 16.—Prof. Abel, F.R.S., president, in the chair.—Before commencing the ordinary formal business of the Society, Dr. J. H. Gladstone rose and in a short speech proposed a vote of thanks to the president for the exceedingly enjoyable visit to the Royal Arsenal at Woolwich on the preceding Tuesday, and for his generous hospitality on that occasion. This was seconded by Dr. Gilbert and carried by acclamation. The following papers were then read:—On crystallosed glycerin, by Dr. P. F. van Hamel Ross; notes on the fatty acids and on a suggested application of photography, by Mr. W. H. Hatcher.—On stibine, by Mr. F. Jones.—On the use of platinum in the ultimate analysis of carbon compounds, by Mr. F. Kopfer;—and on the action of organic acids and their anhydrides on the natural alkaloids, Part v., by Mr. G. H. Beckett and Dr. C. N. A. Wright.

Royal Astronomical Society, March 10.—Mr. Huggins, president, in the chair.—Since the last meeting the Society has received a valuable present of rare books from the library of the late Mr. Sheepshanks. Lord Lindsay has also presented the Society with the sun-spot manuscripts and observations of the late Mr. Carrington, a very valuable series, which has been made use of in determining the present received values of the elements of the position of the sun's axis and the drifts of the solar photosphere.—A paper by Dr. Royston Piggott was read on a star-illuminated transit eye-piece. A sheet of glass, on which a thin film of silver is deposited, is placed in the focus of the eye-lens; transparent lines are drawn on the film, instead of wires, and as the star passes across the lines it is seen to flash out brightly. The film of silver is made sufficiently thin to permit of the star being seen when it is between the lines, but it appears that the lines themselves are only visible, except in the case of very large stars, when the star disc is in transit across a line. Capt. Abney read a paper on photographing the least-refracted end of the solar spectrum. He said that within the last two years many attempts had been made to photograph the ultra-red rays. Dr. Vogel, in 1874, and more recently Capt. Waterhouse, had made use of aniline dyes in the collodion. They stated that with a red dye the collodion was found to be most sensitive to the red end of the spectrum. He had repeated these experiments, and had obtained only partial success; he had, however, from considering the chemistry of the question rather than the physical explanation which had been given and which he believed to be a mistake, been led to try other experiments as to mixing gum resins with the collodion, and had obtained a compound which was very sensitive to the long wave-lengths, so that he had been able to obtain distinct traces of the spectrum beyond A. He hoped to continue his experiments and to give a fuller account of them to the Society at a later meeting.—Two papers were read on the proper motion of the star B. A. C. 793. It appeared from the remarks of the Astronomer Royal and Mr. Dunkin that there is no sufficient evidence to prove that its proper motion has changed during the present century.—Capt. Noble drew attention to a paper by M. Normand on the occultation of stars by the planets as a means of determining the solar parallax. He wished the owners of large telescopes to determine with what degree of accuracy they could observe the occultation of minute stars at the limb of Mars.

Entomological Society, March 1.—Prof. Westwood, president, in the chair.—Dr. G. Kraatz, President of the German Entomological Society, Berlin, and Mr. Clemens Müller, of Berlin, were elected Foreign Members; and Mr. O. E. Jansen was elected an Ordinary Member.—Mr. Jenner Weir exhibited two grasshoppers, in an undeveloped state, taken by himself in the Rhone valley, *in copulâ*—a peculiarity which had frequently been observed among the Hemiptera. He also exhibited a remarkable moth from Madagascar belonging to the *Uraniidæ*, bearing a very striking resemblance to a *Papilio*, except that it had the antennæ of a moth, and the hind wings were destitute of tails.—Mr. E. Y. Western exhibited Coleoptera taken chiefly in Switzerland.—Mr. W. Arnold Lewis exhibited a specimen of *Argynnis Dia* taken in England by Mr. Wallace A. Smith. Mr. Smith, who was present at the meeting, stated in answer to various inquiries by the President, that he had taken the specimen in 1872 in Worcester Park, and distinctly remembered the capture, as it was the first fritillary he had ever had in his possession, and also that it had never been out of his possession since.—Mr. Bates read a paper from Mr. Trovey Blackmore to Mr. McLachlan stating that he was much interested in observing a notice in the Proceedings of the Society respecting the habits of *Cychrus cylindricollis*, reported by M. Baudi to feed on snails. He had already called attention (in the *Entomologist's Monthly Magazine*, vol. xi. p. 214) to the fact that the *Carabus stenocephalus*, Fairm., fed on snails, which in Morocco were so very abundant as to form a marked feature in the landscape by covering the bushes so thickly as to resemble, at a distance, clusters of blossom. He had captured in all eighteen specimens of this rare *Carabus*, and of these fifteen were obtained either feeding on snails or climbing up bushes of *Retama*, which were covered with snails, especially with *Helix planata*. The *Carabus* having an unusually long head, and the prothorax being narrowed anteriorly enabled it to thrust its head and prothorax a considerable distance into the shell in search of its food. Mr. Blackmore referred to some other North African species of *Carabi*, which he thought might be found to have similar habits to those of *C. stenocephalus*.—The President read a paper entitled "A Dipterological Note from Pompeii," containing remarks on the habits of the genus *Bombylius*. The President also presented descriptions of some new species of *Tipulidæ* in the British Museum, accompanied by drawings, showing them to be furnished with hind legs of unusual length.—Mr. John Scott contributed a monograph of the British species belonging to the *Hemiptera-Homoptera* (family *Psyllidæ*), together with a description of a genus which might be expected to occur in Britain.

Physical Society, March 11.—The president, Prof. G. C. Foster, F.R.S., in the chair.—The following candidates were elected members of the society:—W. H. Coffin, T. D. Humpidge, and Rev. G. H. Hopkins.—Prof. W. G. Adams gave an account of some researches on which he has been engaged in connection with the influence of light and heat on the electric conductivity of selenium, and exhibited numerous experiments in illustration. The subject has also been studied by Lieut. Sale and Dr. W. Siemens of Berlin, and as a general result it is found that after it has been kept in the dark, the resistance of the metal is diminished by exposure to light. The effect, however, both of heat and light, is different in the several states through which the metal passes. Thus when a piece of amorphous selenium is gradually heated to about 100° C. kept at this temperature and slowly cooled, its resistance at first is so great that it cannot be measured by the ordinary arrangement, but as its temperature increases, the resistance diminishes and increases again more slowly when the metal is allowed to cool. The resistance of several pieces which at the higher temperature were from one to three megohms were found to be from 100 to 130 at the ordinary temperature. If this selenium be placed in a paraffin bath and heated, its resistance diminishes, and when the temperature is kept constant above 140° C. for some hours and the metal is then slowly cooled, it assumes a crystalline structure, and its resistance *diminishes* as it cools. The resistance of such selenium at ordinary temperatures *increases* with the temperature. The effect is more marked as the temperature of the paraffin bath is increased. In studying the effect of light, the metal which had been heated to 140° C. was exposed to a candle at distances of 1, $\frac{1}{2}$, and $\frac{1}{4}$ metre; the initial resistance being 115,500 ohms. The readings in these three cases were 112,000, 108,700, and 101,500. Deducting each from the initial number we have 3,500, 6,800, and 4,000 ohms as the changes of resistance due to exposure at these distances. Hence the effect of light varies inversely as the distance or, what amounts to the same thing, directly as the square root of the illuminating power. These considerations have led Prof. Adams to suggest the use of selenium for comparing the illuminating powers of different sources of light, and he exhibited the arrangement which he proposes to use for this purpose. The action of light of different degrees of refrangibility was then exhibited, by allowing the light from several parts of a spectrum of the electric lamp produced by a bisulphide of carbon prism to fall on the metal, the remainder being cut off by means of a screen, in which there was a narrow slit. The violet light gave a deflection of about two divisions on the screen, the greenish yellow four, the orange red five and a half, and the deep red nine divisions. The effects produced by the greenish yellow and the deep red are at times nearly equal. It may easily be shown by raising the temperature of the metal that the effect of light on its conductivity is essentially the same in kind at a low and moderately high temperature. The fact that light and not dark heat produces the observed effect has been shown by sending the beam through solutions of iodine in bisulphide of carbon. A very small effect on the metal was always observed, but this may be assumed to have been due to light, as in all cases it was possible to see the form of the carbon points through the solution. This fact may also be strikingly shown by exposing selenium through which a current is passing to the flame of a Bunsen burner, first, when in its ordinary condition, and afterwards with the air openings at the base closed. It was shown that, whereas in the first case the effect produced was equivalent to three divisions of the scale, in the latter case one-tenth of the current produced by the exposure deflects the needle to the end of the scale. Prof. Johnstone Stoney then explained the theory which he has suggested in explanation of the phenomena observed in the radiometers of Mr. Crookes, which has been published in the *Philosophical Magazine* for the current month. The theory rests on the supposition that there is an excessively small trace of residual gas in the sphere in which the moving discs are enclosed. When the apparatus is exposed to heat the blackened side of the disc is slightly warmed, and this warms a layer of air in contact with it. At the ordinary atmospheric pressure, Prof. Stoney assumes the layer so warmed to have the thickness of a sheet of paper, when the temperature of the disc is 20° C. above that of the surrounding air, and on such a supposition we may calculate it for any other pressure and temperature. If we diminish the pressure the thickness varies inversely as the pressure raised to the power $\frac{4}{3}$. Thus if the disc be raised $\frac{1}{10}$° C. above the surrounding air, and the exhaustion carried to the $\frac{1}{10000}$th of an atmosphere, the layer will have a thickness of more than a decimetre, and the effect of the air will then be peculiar. If the gas is of such a density that the glass envelope is beyond the range of this action, the gas beyond the limiting distance will be cold, but if the effect reach the glass, conduction will take place to it. There will then be a procession of warm molecules towards the glass, where they will be cooled down, and form a number of cold, slow-moving molecules, which will go back to the disc and beyond it. And these processions will be intermixed with molecules taking no part in the action. In consequence of this, very few members will travel far in their paths; a portion of the motion of each, however, will be carried forward in the right direction. So long as these processions go on, the slow-moving molecules which reach the front of the disc are thrown off more vigorously than from the back. Prof. Stoney considers the pressure thus produced to be that measured by Mr. Crookes. With a pressure of the gas of $\frac{1}{10000}$th of an atmosphere, an elevation of temperature of $\frac{1}{10}$° C. will produce the force actually observed, while if the exhaustion be carried to $\frac{1}{1000000}$th the elevation of temperature necessary will be $\frac{8}{10}$° C. Thus with the greater pressure a lower temperature will suffice, but other influences will then be brought into play tending in an opposite direction. It was pointed out that on this theory the action may be considered as closely resembling electricity, and Mr. Crookes has shown that the glass envelope is often itself slightly electrified.

Paris

Academy of Sciences, March 13.—Vice-Admiral Paris in the chair.—The following papers were read:—Observations of the moon made with meridian instruments of the Paris Observatory during 1875, by M. Leverrier.—Second note on the transformation of nautical astronomy, through the progress of chronometry, by M. Yvon Villarceau.—Observations of temperature at the Museum during 1875, with electric thermometers placed at depths of 1 to 36 metres in the ground; and *résumé* of ten years' observations, by MM. Becquerel. This *résumé* shows that the mean annual temperatures of the ten years increase regularly from 1 to 36 metres, at the rate of about one degree per 30 or 31 metres difference of level. An aquiferous sheet of 26 metres gave a slight excess of temperature. At 36 metres the temperature was constant and equal to 12°·42 (mean temperature at 1 metre = 11°·31).—On the siliciuration of platinum and of some other metals, by M. Boussingault.—On the flood of the Seine in February and March 1876, by M. Belgrand.—Observations on M. Resal's recent communication on steam-jacketing of engine cylinders, by M. Ledieu.—Note on water-pipes, by M. Boileau.—On the linear equations of the second order, of which the integrals are algebraic, by M. Jordan.—On the transit of Venus of Dec. 9, 1874, by M. André. The diameter of a star (of sufficient brightness) varies with the aperture of the instrument with which it is observed; the author verified this experimentally, and he draws some inferences relative to the transit observations.—On the eggs of Phylloxeras, by M. Lichtenstein.—On a process of direct application of sulphide of carbon in the treatment of phylloxerised vines, by M. Allies.—Treatment of phylloxerised vines with sulphide of carbon introduced and diffused in the soil by means of an aspirating apparatus, by MM. Crolas and Jobart. An iron tube, with terminal apertures, is inserted in the ground; air is drawn off through it by a pump, while sulphide of carbon is sprinkled over the surface; thus the vapour penetrates the soil. The cost is 320 francs per hectare.—On the employment of potash and of lime in treatment of the vine, by M. Demaille.—On the overthrow of the Grand-Sable at Salazie, by M. Vélain. The case was strictly analogous to that of landslips in Switzerland (not a volcanic phenomenon).—On a means of preservation against the accidents caused by fire-damp in mines, by M. Minary. The gas, being lighter than air, ascends, and M. Minary would make a series of vertical excavations in the roof to receive it, the apertures merely allowing the gas to enter and the air to escape. The collected gas could be drawn off to the surface by pipes. Should the gas in these reservoirs be largely mixed with air, he would place in them a system of porous tubes to separate it by endosmose, and these would be connected with the suction pipe.—Letter from M. Peters on the discovery of the planet (160) communicated by M. Le Verrier.—Observation of the planet (160) made with the garden equatorial, by MM. Henry.—Observations of same planet at the Observatory of Marseilles, by M. Borrelly.—On the approaching return to perihelion of the periodic comet of D'Arrest, by M. Leveau.—On polar auroras, by M. Planté. When the positive electrode of a strong secondary battery is brought towards the liquid surface of a vessel of salt water in which the negative electrode dips, you observe, according to its distance from the liquid, a corona of luminous particles round the electrode, or an arc bordered with a fringe of bright rays, or a sinuous line which rapidly bends to and fro on itself; the latter being especially similar to what one observes in auroras (like the undulation of drapery moved by the wind). Purple and violet tints appear as well as yellow. The liquid is greatly agitated, and steam rises more abundantly the further the electrode penetrates. Sound and magnetic perturbations are had, like those accompanying auroras. The negative electrode did not give the above phenomena, and auroras are probably due to a flow of positive electricity. Probably the imperfect vacuum in the upper regions plays the part corresponding to the negative electrode in the experiments, and the electricity comes from tropical regions.—Source of carbonic oxide, characteristics of formines, and of polyatomic alcohols, by M. Lorin.—On the canga of Brazil, and on the basin of fresh water at Fonseca, by M. Gorceix. Canga is a ferruginous conglomerate formed (according to the author) from *débris* of itabirites carried down by water, and cemented by ferruginous water.—On the causes which have brought about the retreat of glaciers in the Alps, by M. Gruner. From meteorological observations at St. Bernard, he finds that the period 1861-74, compared with the previous twenty years, shows an increase of mean temperature of 0°·92, a diminution of water of 0·204m., and, especially, a reduction of one-half in the falls of snow, 4·846m. instead of 10m. At Geneva, a similar change has been perceptible.—M. Cagnant called attention to a bed of kaolin at Saint Beaudelle, in the department of Mayenne. It would be well suited for manufacture of sulphate of alumina, which could be used for clarifying the Paris sewage water.

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