THURSDAY, NOVEMBER 28, 1878

RAMSAY'S MANUAL OF BRITISH GEOLOGY

The Physical Geology and Geography of Great Britain: A Manual of British Geology. By A. C. Ramsay, LL.D., F.R.S., &c., Director-General of the Geological Surveys of the United Kingdom. Fifth Edition. (London: Edward Stanford, 1878.)

THIS well-known work has now reached its fifth edition, and has undergone such changes that it may be almost regarded as a new book. Not only has the quantity of matter in it been almost doubled since the last edition, and its bulk and price augmented in the same proportion, but its plan has been very greatly modified, as is indeed indicated by the second title now prefixed to it.

The original work was justly deserving of the very great success which it achieved. It consisted of a corrected report of one of the well-known series of lectures to working-men delivered by the author in his capacity of Professor of Geology in the Royal School of Mines, at the Museum in Jermyn Street; and it was a model of clear exposition of a branch of science by one who was a master of his subject, and who at the same time had acquired great experience and skill in presenting it to popular audiences. Probably no better introduction to the principles of geology could possibly be recommended to the English reader than this little book of Prof. Ramsay's.

We must confess to feeling that this complete remodelling of the plan of a work that has already proved so successful, is a somewhat hazardous experiment. The original chapters of the book, which still retain the characteristics of popular lectures, do not always harmonise in style with the portions that were primarily intended for the pages of an encyclopædia. Indeed, as is admitted in the preface, the book now consists of two distinct works fused into one, and the reader is again and again reminded of the fact by somewhat awkward transitions and by abrupt changes in style and in the mode of treatment of the subject.

In almost every other respect we find the work to be worthy of the highest praise. The clearness and general accuracy of the information imparted by the book are as conspicuous in this as in the earlier editions, and Prof. Ramsay amply proves that he has not lost the most important gift which a teacher can possess, that of communicating his earnestness and enthusiasm to his readers. Many of the questions treated of at considerable length are of a somewhat controversial character, and the author has again and again to remark that he is teaching, not the universally accepted facts of the science, but the views which he himself has been led after long and careful study to adopt, and which he is sanguine enough to believe will be eventually accepted by all his brother geologists. Prof. Ramsay has certainly the merit of never being uncertain or hesitating in his convictions, and those who differ from, equally with those who coincide in opinion with him, will be glad to have the opportunity of reading his latest and most perfectly matured deliverances on questions in the discussions upon which he has long taken a very prominent part. We are bound to say that in respect to these matters he writes with the most perfect candour, and is ever ready to admit that there are subjects in which the timidity or caution of other geologists does not permit them to follow him in his bold generalisations.

The space at our disposal will not permit of our entering into detail on the numerous interesting questions suggested by a perusal of this book. The author's attempts to picture to the mind of his readers the ancient physical geography of our portion of the globe during successive geological periods may be cited as among the most graphic pieces of writing, and at the same time the most valuable portions of the work. Here Prof. Ramsay is evidently entirely in his element; he writes with an enthusiasm which is perfectly contagious, and his arguments, if not always sufficient to carry conviction, are at all times worthy of serious consideration.

We cannot resist quoting Prof. Ramsay's latest views on the important and much-vexed question of the classification of the Cambrian and Silurian rocks. On this subject he remarks:—

"If these strata were to be classified for the first time in England, with my present knowledge, I would divide them into three, as the most convenient method. The first series would include the purple and green grits and slates of the Longwynd and Wales, and range upwards as high as the top of the Tremadoc slates; the second would range from the base of the Arenig slates to the top of the Bala or Caradoc beds; and the third from the base of the Upper Llandovery beds to the top of the Ludlow rocks."

It is true that after this statement, which is in such perfect harmony with the results arrived at by palæontologists in Bohemia, Scandinavia, America, and our own country, Prof. Ramsay announces his intention of still adopting the nomenclature of Murchison and the Geological Survey, which he admits to be "old-fashioned;" but he states that his reason for doing so is simply that this plan will be the most convenient for those who wish to consult the geological maps and sections published by the Government. As the date fixed for the completion of the Government Survey is now passed, we may perhaps hope that the Director-General will be able to devote his attention to the much-needed reform of that old-fashioned classification and nomenclature. At all events, every geologist will be gratified by learning from so high an authority that any difference which may now exist concerning the classification of the older palæozoic rocks is mainly one as to the employment of certain terms, and that on the actual facts of the case something like substantial agreement has at last been arrived at.

On another question, that of the date of the earliest traces of human workmanship in this country, Prof. Ramsay's remarks are certainly not calculated to give quite so much satisfaction to his readers. He writes:—"The antiquity of man being thus clearly established, it becomes obvious that his advent into our area was either of pre-glacial or of inter-glacial date. I say inter-glacial, because Mr. Skertchly has lately discovered palæolithic flint implements in certain brick-earths. Similar, and I believe identical, brick-earths underlie the 'chalky boulder-clay' in the neighbourhood, the boulder-clay having been removed by denudation from that portion of the brick-earth in which the implements were found at Botany Bay, near Thetford, in Suffolk. The announcement at once provoked strenuous opposition, and therefore, on a tour of inspection of Mr. Skertchly's work with Mr. Bristow, we took care to examine into this point. The result was that I satisfied myself of the truth of Mr. Skertchly's observations that the implement bearing brick-earth in places underlies a boulder-clay, which, in his opinion, is not of the earliest date, in which case the men who made these tools must have been of inter glacial age."

The "strenuous opposition" to which Prof. Ramsay refers, was directed, it will be remembered, not against the possibility of human remains being found under glacial deposits, but against such a conclusion being accepted without the clearest and most irrefragable evidence being adduced in its support. And it must be borne in mind that a number of most competent observers have examined the sections in question, and have arrived at conclusions directly opposed to those announced by the officers of the Geological Survey. When, therefore, our author, still speaking of this question of the contemporaneity of man with the glacial epoch, goes on to exclaim: "Perhaps we cannot prove it, but there is nothing improbable in the hypothesis, and I am not the only one who believes it," we cannot help entertaining the feeling that this is hardly the spirit in which a scientific question should be treated, and that the method which he adopts is one scarcely calculated to carry conviction to the mind of any competent judge of the matter.

In laying down this book we cannot refrain from once more expressing our opinion that it is a work of the highest value, and one worthy to take a foremost place among popular manuals of science. The illustrations are excellent; the woodcuts, by Mr. Sharman—giving a very faithful representation of species which have been selected by Mr. Etheridge as characteristic of the several formations—are quite new, and some views of scenery have also been added to those contained in former editions of the book. The little geological map of Great Britain, which we are glad to see reproduced, is a marvel of clear and accurate printing in colours, and well sustains the reputation of the publishing firm which has produced it.

FLORAL DIAGRAMS

Blüthendiagramme. Construirt und erläutert von Dr. A. W. Eichler, Professor der Botanik an der Universität Kiel. (Leipzig: W. Engelmann. Theil i., 1876, Theil ii., 1878.)

THIS book supplies a want that every real student of systematic botany must have felt. The introductory chapters are devoted to an inquiry into the morphology of the flower and its parts, and the inflorescence; while the subsequent chapters are a full exposition under the head of each family and order of the floral type and its most important modifications. Preceding each order is a list of the most important works bearing on it, and every quotation is accompanied by a full reference. Hence the book is both a Thesaurus of the literature of its subject, and moreover a Prodromus of phanerogamic morphology. Despite the modest title, the vegetative arrangements are explained wherever they present interest, and the same ungrudging pains are often extended to fruit and seed. Unlike too many authors Prof. Eichler is utterly free from provincialism. He cites as freely and constantly foreign botanists as those who have used the German language. Unfortunately we are but poorly represented, for morphological research is all but unknown in England, and is untaught by both our swarms of botanical lecturers and the great institutions which are the outward and visible sign of what Government recognises as botany. The medical curriculum has overborne original teaching by the former, the herbarium has stunted all else in the latter. Hence few of our botanists are able, like an Eichler or a Baillon, to check observations on the adult flower, with its parts distorted by drying and soaking, by their own knowledge of the growth of the living plant. Even the greatest sagacity and experience must be at a loss sometimes from this weakness in the very foundations of their work. For this reason one regrets the more that Eichler makes not a single reference to the works of Griffith, perhaps the greatest botanical genius England ever possessed, who found out for himself the value of developmental research and worked out many a flower by its aid.

A word on the method of Eichler. The actual editor of the "Flora Braziliensis," he adds to his thorough knowledge of morphology proper a rare acquaintance with systematic botany. Hence he belongs to no school, though awake to the value of workers in more limited fields, in all of which he himself has done good service. A firm evolutionist, he accepts the testimony of systematist, anatomist, teratologist, organogenist, and histogenist, and believes that all of these can in turn shed light on doubtful points. Hence his opinion must be respectfully considered by those who differ from it, and it is worth while to note a few of his conclusions.

He regards the nature of the "calyx tube" as varying with the order; truly receptacular in Rosaceæ, for instance, it is, partly at least, appendicular in some cases. The petals of Primulaceæ are regarded as true petals, and not as appendages of the stamens, a view which our descendants will have forgotten or unearth with the lazy amusement with which we look on some of the naif theories of our ancestors. The nature of the placenta and ovule is a more difficult question, and our author, who, in the preliminary chapters of Part i., published in 1876, held it essentially variable, has been led chiefly by Celanowsky's arguments to regard it as in all cases an outgrowth from the carpellary leaves. Similarly, the ovule, regarded in the First Part as a bud, is now viewed as an emergence. Of course the last word is not yet said on these points, but it is worth noting that Warming also avows his final conversion by Celakowsky, in his brilliant paper on the ovule in the first volume of the *Annales des Sciences Naturelles* for 1877; and Eichler is at one with Warming in adopting Brown's view of the female flower of Gymnosperms. It is much to be regretted that this point was not really discussed at the late congress in Paris, or that its principal advocates do not answer the latest arguments in its favour. But the question cannot at all be regarded as settled.

The cup of *Euphorbia* is regarded as an inflorescence; but though the *pros* and *cons* are fairly stated, no new light is shed on the matter.

Enough has been said to show the extreme value of the book to the scientific botanist. May its teachings quicken sound study in England. MARCUS M. HARTOG

OUR BOOK SHELF

Manuel du Voyageur. Par D. Kaltbrunner, Membre de la Société de Géographie de Genève. (Zurich, J. Wurster und Cie, Editeurs. Paris, C. Rheinwald und Cie, 1879.)

A GREAT difficulty of writing a treatise for the use of travellers, on "What to Observe," lies in the impossibility of presenting to the imagination an ideal average traveller to address. If the great mass of intending travellers had much the same amount of scientific knowledge and were well grounded in the elements of science generally, a very useful and compact work might, no doubt, be composed. But as a matter of fact such persons are usually very ignorant, or variously ignorant, and a book fitted to instruct the whole of them must omit none of the more elementary considerations, and therefore would assume the shape of a collection of encyclopædic treatises. It is hard to define the level of previous knowledge to which "Kaltbrunner's Manuel du Voyageur" is best adapted. Every reader is sure to think it too diffuse for his own wants in some parts, neither deep nor full enough in a great many, and probably beyond his depth in others; but take it all in all, it is perhaps better adapted for persons of moderate culture than any similar book that could be named. It is beautifully got up, with abundant illustrations, and to say the least, would be often useful for reference and as a reminder. The range of its topics is wide enough to touch the interests of everybody, and it would be a capital present to give to a friend bound for foreign parts. Considerable space is allotted to subjects connected with social life and other anthropological questions.

There seems to be some irony in the fact that when the world is so nearly explored, manuals for the use of travellers should begin to appear. They were greatly needed many years ago, when the Admiralty Manual had the field nearly all to itself, but now that the need is less, these works are at last composed in abundance. The present one, however, is by no means intended to supply the wants of those travellers only who are exploring unknown countries, much of it being applicable even to home districts. It is less solid and more comprehensive than the recent German publication, "Anleitung, &c.," by Neumayer.

Pleasant Ways in Science. By R. A. Proctor. (London: Chatto and Windus, 1879.)

OF this book, which has been sent me for review, I can truly say that it is an excellent specimen of what has been well called (I forget by whom) *Paper Science*. A very few quotations will amply justify this verdict.

At pp. 8, 152, I find "heat" several times standing for "temperature." But the author (in these columns, vol. xvi. p. 227) insisted that

"What *mathematicians call* the *moving force* exerted by the earth on the moon is eighty-one times greater than the corresponding force exerted by the moon on the earth."

To put "heat" for "temperature" is after all not very strange for one who puts "moving force" for "accelerating force."

In the account given of the experiments of Andrews and Tait on ozone, the action of "iodine" is given as that of "mercury": and the now-received idea of the nature of ozone—though *twice* mentioned in the paper referred to—is described as a "beautiful" and "ingeniously conceived" hypothesis suggested after the publication of the paper (pp. 351-2).

The following passage, which refers to friends of my own, I quote without comment:—

". . . . no one, I think, would believe so ill of his fellow-men as to suppose for one moment that *advantage could be taken of the sympathies which have been aroused by the Indian famine*, or which may from time to time be excited by the record of great disasters by sea and land, *to advocate bottomless schemes merely for purposes of personal advancement.* We must now, *perforce*, believe that those who advocate the erection of new observatories and laboratories for studying the physics of the sun have the most thorough faith in the scheme which they proffer . . . ." (p. 51).

From p. 194 I gather that I know nothing about the motion of waves, and p. 240 proves me equally ignorant of voltaic electricity. I cannot read any more.

P. G. T.

LETTERS TO THE EDITOR

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

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

Receiving Telephones

I HAVE roughly tried two experiments which seemed likely to supply new forms of receiving telephones, and have had such partial success as seemed satisfactory in preliminary trials. As I have not time to continue the experiments I request the insertion of this note in the pages of NATURE, in the hope that some one else will follow the matter up.

In one experiment a spiral wire (I used German silver, but it may be of any material) was wound closely so that the spires were in contact, or nearly so. One end of the spiral was fixed and the other end attached by a thread to the middle of a small parchment drum-head, such as is sold by the toy-makers for thread telephones. A slight tension was put on the thread to draw the spires of wire slightly asunder. The spiral wire was then made part of a circuit, including one or two cells of Grove's battery and a line wire going to another room. By this apparatus such sounds as the scraping on a file were satisfactorily heard, although the spiral was only one coil of about an inch long. It will be observed that in this arrangement there are no magnets; the whole effect is produced by the varying induction of the current upon itself. The apparatus could obviously be rendered more efficient by using a longer spiral, or a coil consisting of a number of concentric spirals not quite in contact, so as to allow small motions to exist. The induction might be still farther increased by using a spiral of two wires, so that a powerful local current might be kept up in the alternate spires, while the varying line-current is passing through the intermediate ones. Another improvement would consist in using iron wire wound in a sufficiently loose coil. The self-magnetisation of this coil would co-operate with the electric induction to heighten the effect.

In the other arrangement an iron or steel spiral (in my experiment it was an ordinary steel spiral spring, of which the spires lay close) was placed inside a coil of copper wire in circuit with a battery and the line. The spiral, as before, was fixed at one end, and kept slightly stretched by a string connecting its other end to a drum-head. In this arrangement no current passes through the spiral, but it is the core of an electro-magnet, and becomes magnetised in a degree which changes with the alterations in the intensity of the line-current. This causes the spires to attract one another with varying intensity, and the tremulous motion so produced is propagated by the string to the parchment. By this arrangement singing, whistling, &c., were heard when a Reiss transmitter was used. Probably a soft iron coil would have been better than the steel spring I used, and the apparatus is susceptible of other obvious improvements which would add to its sensitiveness.

Before concluding permit me to thank Prof. Barrett for allowing me to make the experiments in his laboratory.

Dublin, November 25 G. JOHNSTONE STONEY

The Microphone for Military and Tonometric Purposes

My attention has just been called to a paper on the microphone, by Prof. W. F. Barrett, in NATURE (vol. xix. p. 12), in which it is asked whether the latter "has ever been tried by military men to detect the mining operations of an enemy?" Will you allow me to state that this application of the microphone suggested itself to me many months ago, and that I have begun to make experiments both in this direction and also with a view to ascertain to what extent sounds can be transmitted to a microphone immersed in water. Unfortunately the pressure of other matters has hindered me from completing the work, which, however, I hope shortly to be able to do.

May I take this opportunity of saying that I have been endeavouring with some success to apply the principle of the microphone to the counting of the beats of two slightly dissonant tuning-forks. In one experiment the two forks were inverted and screwed through a board above which the ends of their stems protruded. A thin piece of carbon was laid over these ends and the arrangement was placed in circuit with a Bell telephone. The beats were loudly heard and continued audible long after their direct sound had ceased. A reflecting galvanometer being placed in the circuit the beats were shown by deflections of the light spot, but irregularities in the current made it difficult to count them satisfactorily. The forks were then screwed horizontally into a vertical board and a screw was inserted about 1″ from the stem of each and on the same horizontal level. A small piece of carbon was laid over each stem and its adjacent screw. This plan gave even better results, and admits of the forks being any reasonable distance apart. The experiments were tried with two forks whose vibration numbers were about 60, and also with a pair of octave forks with vibration numbers of about 256 and 512. A small piece of copper wire was then attached to each of the two large forks, and mercury cups were so placed that the points of the wires were just not touching the mercury surface when the forks were at rest. Both mercury cups were connected to one pole of the battery, and the current was arranged to branch through the forks uniting at the telephone. The beats were very loud. This plan, however, involves difficulties on account of the delicacy of adjustment required for the mercury surfaces and also the amalgamation of the copper-points. Several other experiments have been tried, but the method first described seems worth a trial by those interested in tonometry. The counting of beats, which is not an easy matter for aged or unaccustomed ears, may thus be immensely facilitated, while the period of the forks under observation is absolutely unaffected. The carbon used was that employed for the electric light, and it is probable that more carefully prepared and homogeneous material would have given better results in a galvanometer experiment. GEORGE S. CLARKE

Cooper's Hill, November 19

The Microphone as a Receiver

On the 3rd of June last, in a paper read before the Royal Society of Edinburgh, I described an experiment which showed that the microphone could be used, not only as a transmitter, but also as a receiver of articulate sounds. An abstract of the paper appeared shortly after in NATURE, and since then I have had communications from several experimenters, stating that they had failed to repeat the experiment, and asking for some details regarding it. I trust, therefore, that you will kindly give me space for a short explanation.

In performing the experiment the transmitting and receiving instruments which I used were precisely identical. Each was merely an ordinary white porcelain jam-pot, $3\frac{1}{2}$ inches in diameter and 4 inches deep, half filled with gas-coke, broken into coarse fragments and provided with electrodes whereby a current of electricity could be sent through the pieces of coke. Cinders from ordinary coal, if well burned, would, of course, do equally well. The elecırodes were two strips of tin about two inches wide slipped down, opposite to each other, between the cinders and the sides of the jam-pot and fastened by being bent over the edges and bound round the outside with a cord. When these jam-pots were put in circuit like a pair of ordinary telephones, and a battery of two strong Grove's cells, or four ordinary Bunsen's, included in the circuit the arrangement was complete.

In this way I have had no difficulty in making myself and others clearly hear the transmission both of singing and speaking, although, as I stated in my paper, the articulation is not so distinct as I have no doubt it will be when proper forms both of transmitter and receiver are adopted.

I may mention that since then I have found the result to be greatly improved by including a stronger battery in the circuit.

Edinburgh, November 18 JAMES BLYTH

Wind-Pressure

I BECAME acquainted, some years since, with the singularly great wind-pressures registered at the Liverpool Observatory, and I should be rather disposed to attribute them to the exceptional position of the wind-gauge than to think (as the writer of an article in NATURE, vol. xix. p. 25, appears to do) that the gauge is erroneous. I do not remember to have seen it noticed, in the recent discussions on the Cleopatra's Needle, that there is probably a rapid increase of wind-pressure from the ground-surface upwards. In any river the velocity is least at the bottom, and near the bottom the change is rapid. Similarly, in the great current formed by the wind, I imagine there is a much less velocity near the ground than at some distance above it, and less on a plain than above a hill standing out of the plain. Now I believe the Bidstone Observatory is on a hill, with the great plain formed by the Atlantic in front of it. It is, therefore, in a position in which it receives an exceptionally heavy wind-pressure. The pressure on the wind-gauge is probably much greater than on the windows of the observatory, and that, again, is probably greater than the pressure on buildings more inland, where the current near the ground has been more interfered with by obstructions. On the other hand, Cleopatra's Needle is in a very protected position, where I should be much surprised to find that the wind-pressure ever reached even 40 lbs. per square foot.

As Mr. Dixon has referred to the case of a window to disprove the possibility of a pressure of 80 lbs. per square foot, it may be well to see whether it is really conclusive. I have not at hand any formula for the resistance of a simply-supported square plate, but it will not be very different from that of a circular plate. Now, let p = pressure per square inch on surface of plate, t its thickness, r its radius. Then the greatest stress in the plate is by Grashof's formula, $f = \frac{5}{6} \cdot \frac{r^2}{t^2} p$. Taking a plate of glass 2 feet diameter, $\frac{1}{8}$ inch thick, and loaded with 80 lbs. per square foot, we get $f = 4{,}270$ lbs. per square inch. In some experiments which I made under Sir W. Fairbairn's direction, the tenacity of glass was found to be from 4,200 to 6,000 lbs. per square in. Hence, surprising as it may seem, it is probable that a pane of glass 2 feet diameter would sustain a load of 80 lbs. per square foot, uniformly distributed, without breaking, or a load equivalent to that of a dense crowd of people. I don't, of course, think that a window would be safe if subjected to such a pressure, but it is always desirable to subject general statements of this kind to exact calculation; and I think we may at least infer that well-constructed glass windows would sustain a considerable wind-pressure without necessarily giving way. W. C. UNWIN

Cooper's Hill, November 17

Was Homer Colour-blind?

I CRAVE some little space for a few remarks with regard to the recently much vexed question as to the traditional blindness of Homer.

It seems to have been overlooked that, apart from the statement made by Herodotus[1] (in his life of Homer), that in

[1] Homer, according to Herodotus, was born about 167 years after the Trojan war and, when still a child, adopted by his stepfather, to whom he succeeded in the management of a school. At an early age, however, it would seem, he set out for distant voyages and, at length, after having spent some time on visiting Tyrrhenia and Iberia, when about 32 or 34 years of age, lost his sight from what appears to have been some chronic disease of the eyes. Previously, when at Ithaca, he is said already to have had a narrow escape from that calamity. The text of this important narrative runs thus:—

. . . . οἱ μὲν Ἰθακήσιοι λέγουσι, τότε μὲν παρ' ἑαυτοῖς τυφλωθῆναι, ὡς δὲ ἐγώ φημι τότε μὲν ὑγιῆ γενέσθαι, ὕστερον δὲ ἐν Κολοφῶνι τυφλωθῆναι; συνομολογοῦσι δὲ μοι καὶ Κολοφώνιοι τούτοις . . . . . . Ἀπικομένῳ δὲ ἐς Κολοφῶνα συνέβη, πάλιν νοσήσαντα τοὺς ὀφθαλμοὺς μὴ δύνασθαι διαφυγεῖν τὴν νόσον, ἀλλὰ τυφλωθῆναι ἐνταῦθα. Ἐκ δὲ τῆς Κολοφῶνος τυφλὸς ἐὼν ἀπικνέεται εἰς τὴν Σμύρναν . . . .

From Colophon he sailed to Smyrna, where, for his sustenance, he began and, afterwards, continued, during his long wanderings, and for a good many years, the recital of his verses.

consequence of what appears to have been a chronic disease of the eyes, the poet lost his sight at the early age of about 32 or 34 years, and that he, once at least, styles himself a downright blind man, in his Hymn to Delian Apollo, ver. 169—73, which derives no mean authenticity from being so pointedly quoted by Thucydides, III., 104, and which runs thus :—

> . . . . ὁππότε κέν τις ἐπιχθονίων ἀνθρώπων
> ἐνθάδ' ἀνείρηται ξεῖνιος ταλαπείριος ἐλθών·
> ὦ κοῦραι, τίς δ' ὔμμιν ἀνὴρ ἥδιστος ἀοιδῶν
> ἐνθ 'δε πωλεῖται, καὶ τέῳ τέρπεσθε μάλιστα ;
> ὑμεῖς δ' εὖ μάλα πᾶσαι ὑποκρίνασθ' εὐφήμως·
> τυφλὸς ἀνὴρ, οἰκεῖ δὲ Χίῳ ἔνι παιπαλοέσσῃ,
> τοῦ πᾶσαι μετόπισθεν ἀριστεύουσιν ἀοιδαί.

> If some day an earthborn man, a wayfaring stranger,
> Asks you the name of whom best you like of all the minstrels
> you know,
> Whose songs are, oh lasses, the most delightful to you,
> Oh, then, unanimously, surely, you answer :
> It is the blind man who dwells in the rocky island of Chios,
> His songs are to us by far the sweetest of all.

I need not add, as a further argument, that Homer frequently was alluded to as the blind and humpbacked man, ὁ κυφὸς καὶ τυφλὸς ἀνήρ,[1] and it seems to me trifling to qualify, or mitigate, the racy juxtaposition of the two epithets.

To what extent colour hallucinations, so frequent in connection with certain forms of blindness, may possibly have impaired the poet's imaginative faculties with regard to the varying hues and shades of colour, it would be for the present, from want, for obvious reasons, of similar observations, difficult to settle. However, I cannot but think that what by some so recently has been called Homer's colour-blindness may be the natural consequence, on the one hand, of the increasing dimness of his recollections as well as owing to these optical hallucinations, and finally, to the defective chromatic terminology of his time. The following are some of the Greek and Latin authors who, together with Herodotus, aver and enlarge upon the blindness of Homer :— Plutarch, Vita Hom. 12 ; Thucyd., III. 104 ; Pausan., II. 33, 3 ; III. 4, 33 ; Lycophron, Cassandra, 422 ; Aristot., Orat., L. p. 703 ; Cicero, Tuscul, V. 39.

I refrain from discussing the question whether, from a physiological point of view, such a profound functional perturbation as is involved in the term of colour-blindness, viz., deficiency in the perception of any plurality of colours in the spectrum, would not seem to be symptomatical of most momentous organic disturbances in the nervous apparatus of the eye, generally conducive to the most hopeless forms of blindness.

Scientific Club J. HERSCHEL

IN reading Mr. Pole's article on Homer's sensations of colour, there is one point which seemed to me to call for explanation. Mr. Pole says that in the solar spectrum he sees only two colours, blue and yellow, and that the red space appears to him yellow. From this one would naturally infer that the whole of the spectrum visible to ordinary persons is visible to him also, but that it presents only these two colours, which graduate into one another without any break, and that the green space appears as yellow. And with a colour-blind person who has allowed me to test his capabilities, I found this actually to be the case. But later on Mr. Pole says that pure red and pure green appear to him not yellow but grey. I would wish, then, to ask Mr. Pole whether the spectrum presents to his vision, in place of the green, a neutral space or an interval of darkness? In other words, have the rays of that particular refrangibility no action at all upon his retina, or is it that they have no action peculiar to themselves, but simply produce the general effect of light? In either case the phenomenon seems more anomalous than if he saw all colours as colours, though he could only class them under two heads. To take a familiar analogy, it is as if a man should be perfectly able to distinguish the pitch of notes at either end of the scale, but the notes between should either not affect the auditory nerve at all, or should affect it simply as noise.

Pembroke College, Oxford FRANK PODMORE

[1] The very word of "Ομηρος signified "blind" in the vernacular idiom of Κύμη, or Cumæ, one of the Æolian colonies in Asia Minor, where he lived for some time, and, as will be shown anon, accidentally came by the name of Homer, his original name being Melesigenes, from his happening to be born on the banks of the small river Meles, which flows by Smyrna and runs into the Smyrnian sinus.

One day, pointing out how much of the poet's glory was certain to redound to their own city's glory, if the poet could be induced to settle among them, it was proposed to the people of Cumæ to provide during his lifetime for his wants, at the public expense, when somebody explained that such a resolution would be tantamount to inviting all sorts of blind, "Ομηροι, and useless, people to their city, whereupon the proposal dropped. But it seems that, henceforth, the poet went by the name of Homer:—

"Ομηρος ἐπεκράτησε τῷ Μελησιγενεῖ ἀπὸ τῆς συμφορῆς ; οἱ γὰρ Κυμαῖοι τοὺς τυφλοὺς "Ομηρους λέγουσιν. "Ωστε πρότερον ὀνομαζομένου αὐτοῦ Μελησιγενέος, τοῦτο γενέσθαι τοὔνομα "Ομηρος.

Herodot. Halic., vita Hom., 2, 13.

Anthropometry

As I have stated in the preface that my object in publishing my "Manual of Anthropometry" is to invite criticism with a view to perfecting the anthropometrical chart which it contains, and which forms its chief feature, I may be excused for referring to the notice of the work which appears in NATURE, vol. xix. p. 29. The reviewer objects to the large number of measurements given in the chart, but he has overlooked my statement that many of them are of a secondary character, and that I leave the student liberty to select the measurements which best suit his purpose, requiring only of him that they shall be made and recorded in a uniform manner, and thus become the common property of statisticians. Anthropometry can make no progress as a science, so long as observers are at liberty to make the same nominal measurement of the body in four or five different ways, as is the case, for instance, with chest-girths.

I may add that my manual was not written for the three or four individuals in this country who have mastered the "theory of human proportions" as a mathematical curiosity, but for army surgeons, busy medical men, schoolmasters, and others who are much more concerned with actual facts than theories of probabilities. CHARLES ROBERTS

Bolton Row, W.

Divisibility of Electric Light

IN all communications on this subject in NATURE and elsewhere, the division of light is considered only with reference to parallel circuits, and this naturally causes great loss of light by the law that heating is proportional to the square of the current. But in electric circuits their resistance has always to be considered ; and if two lamps are taken parallel, only half the resistance of the one lamp is obtained, and such resistance can be obtained by taking two parallel circuits of two lamps in series in each ; the light obtained then is one quarter in each lamp, as half the current is flowing through each circuit, and as four quarters make a whole, no loss of light is caused by division in such a method of one current to any number of lamps. There are certainly practical difficulties in the way of burning lamps in series, though these are greatly diminished if incandescent wire is used as the light-emitting source. However, there is no inherent reason why the electric light should be wasteful in division, as is described by Mr. Trant. F. JACOB

Verification of Pervouchine's Statements regarding the Divisibility of Certain Numbers

THE statements of Pervouchine, reported in some recent numbers of NATURE, are equivalent to the following :—That the 2^{10} power of 16 is less by 1 than some multiple of $7 \times 2^{14} + 1$; and the 2^{21} power of 16 is less by 1 than some multiple of $5 \times 2^{25} + 1$.

Let r_n be the remainder after dividing the 2^n power of 16 by one of the above divisors. Then since the 2^{n+1} power of 16 is the square of the 2^n power, r_{n+1} differs from the square of r_n by a multiple of the divisor ; or r_{n+1} is the remainder arising from the division of the square of r_n.

Use for the work the scale whose radix is 16. In this scale the above divisors are

1 12 0 0 1 and 10 0 0 0 0 0 1.

In the first case, calculating on the plan indicated, we find the remainders,

$r_3 = -$		5	2	4	9
$r_4 = -$	1	11	6	4	13
$r_5 = -$		5	9	10	6
$r_6 = -$		15	10	4	13
$r_7 = -$		1	0	10	15
$r_8 = -$	1	10	8	15	15
$r_9 = -$		14	5	2	11
$r_{10} = -$					1

Consequently the 2^{10} power of 16, or the 2^{12} power of 2, increased by 1, is divisible by $7 \times 2^{14} + 1$

In the second case, we find the remainders

$r_3 = -$	4	0	0	0	0	1	10
$r_4 = -$	7	9	9	9	7	0	11
$r_5 = -$	9	8	2	10	9	9	4
$r_6 = -$	4	6	6	11	8	8	11
$r_7 = -$	2	2	3	12	10	8	5
$r_8 = -$	9	14	1	0	14	6	10
$r_9 = -$	6	9	14	11	8	11	0
$r_{10} = -$	3	14	4	6	15	1	3
$r_{11} = -$	7	7	10	5	12	10	4
$r_{12} = -$	7	12	1	4	5	1	4
$r_{13} = -$	7	3	7	12	8	1	2
$r_{14} = -$	5	1	13	9	4	6	4
$r_{15} = -$	3	15	2	2	4	13	3
$r_{16} = -$	1	5	6	9	1	2	6
$r_{17} = -$	2	5	9	12	5	9	3
$r_{18} = -$	7	13	11	14	2	8	5
$r_{19} = -$	8	3	0	0	6	15	7
$r_{20} = -$	3	14	3	10	2	11	0
$r_{21} = -$							1

Consequently, the 2^{21} power of 16, or the 2^{23} power of 2, increased by 1, is divisible by $5 \times 2^{25} + 1$.

The work involved in the first verification can be done by a good calculator in less than half-an-hour; the second is, I think, not more than thrice as long, for the divisions are more easily performed.

Here is one of the eighteen stages of the work of the second verification, namely, the getting of r_6 from r_5.

```
r5 = 9 8 2 10 9 9 4
     ---------------
     9                     5 1
   1 2 8                       9 4 0
   1 3 0 2                       2 6 0 4
   1 3 0 4 10                      11 14 2 14 4
   1 3 0 5 4 9                        10 11 2 15 9 1
   1 3 0 5 5 2 9                         10 11 2 15 14 7 1
   1 3 0 5 5 3 2 4                           4 12 1 5 4 12 9 0
                           ------------------------------------------
                           5 10 7 2 9 13 1 2
                           5 0 7 4 3 1 7, 4 10 4 11 13 0 0 +
                                          9 0 11 7 6 1 11 -
                                          ------------------
                                 r6 = - 4 6 6 11 8 8 11
```

The last four lines of the work are made up thus:—In adding the parts of the square depress the last six places to line 2, leaving the rest in line 1; then proceeding to the extreme left, carry the tens figure, in this case 0, six places to the right, for subtraction into line 3, and depress the units figure (5) into line 2. Multiply the just depressed figure (5) by 16, and add to it what is found (10) in the place to the right of it in line 1 (giving 90); again carry the tens figure (9) for subtraction into line 3, and depress the units figure into line 2; repeat the process, moving to the right, until line 1 is exhausted; then the difference between line 3 and the last seven places of line 2 gives line 4, the result required.

For the sake of safety, before proceeding to calculate r_7, calculate r_6 again from the complement of r_6 with reference to the divisor, in this case from + 7 13 5 6 6 13. If the same result is again obtained, you may go on confidently.

Hampstead JOHN BRIDGE

Vulcan and Bode's Law

IN the year 1778—just a hundred years ago—the astronomer Bode published an approximation to a law respecting the planetary distances. He took the numbers

0, 3, 6, 12, 24, 48, 96, 192, 384,

each after the second being double the preceding; to these he added 4, giving

4, 7, 10, 16, 28, 52, 100, 196, 388,

numbers which, with the exception of the last, agree very well with the distances of the planets from the sun:—

3·8, 7·2, 10, 15·2, (27), 52, 95·3, 191·8, 300·3.

The publication of this law, at a time when the asteroids between Mars and Jupiter were as yet undiscovered, drew attention to Kepler's speculation that a planet was wanting between Mars and Jupiter. Twenty-one years after Ceres, the first of the asteroids, was discovered, and then others, until now there are nearly 200, the average distance of the whole being 27, and agreeing very well with Bode's number 28. All this is doubtless known to the majority of your readers.

In calling attention to the law, while not wishing to attach too much importance to it, I would point out one or two suggestions which present themselves. If we place 3 before the 0 in the first row of figures the line becomes

− 3, 0, 3, 6, 12, &c.

If 4 be now added the numbers are

1, 4, 7, 10, 16, &c.

The number 4 in this line represents the relative distance of Mercury from the sun; may not the number 1 represent the distance of Vulcan, or more probably the mean distance of a ring of asteroids, of which Vulcan is the brightest?

Referring now to the modified law, represented by the numbers

1, 4, 7, 10, 16, 28, 52, 100, 196, 388,

if 1 represents the mean distance of the Vulcan-asteroids, and 28 that of the Ceres-asteroids, it is a fact that after the first ring come four planets, Mercury, Venus, Earth, Mars, and after the second ring four planets, Jupiter, Saturn, Uranus, Neptune, the two sets of planets having marked differences as regards axial rotation and density.

What, then, is beyond Neptune? The law seems to say, a ring of asteroids at an average distance of 772. The motion of Neptune does not lead astronomers to suspect a planet beyond. Perhaps the optical instruments of the future may help to answer this question, Is there a ring of asteroids beyond Neptune? B. G. JENKINS

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Irish Bog Oak

CAN you or any correspondent kindly give me the scientific name of the Irish "bog-oak" (fossil)? It should be either *Quercus pedunculata* or *Q. sessiliflora*, the existing species, but though I have seen many specimens, I never got hold of one which would enable me to determine the species, and, for aught I know, there may be some of both. W. F. SINCLAIR

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OUR ASTRONOMICAL COLUMN

THE TOTAL SOLAR ECLIPSE OF JANUARY 11, 1880.—The central line in this eclipse ends soon after reaching the coast of California, where it is possible totality may be witnessed close upon sunset. Tracing the previous path of the shadow through its long course across the Pacific with the aid of the Admiralty chart, it will be found that the only islands included within it are the Coquille, Bonham, and Elizabeth Islands, lying near together, between 169° and 170° E. longitude, and belonging to the Marshall Islands group. The eclipse passes centrally over the largest of the Coquilles, as laid down in the Admiralty chart of this group, according to a calculation in which the moon's place has been made to accord very nearly with Hansen corrected to Newcomb, which gives the following track:—

Long. E.	Lat. N. limit.	Lat. Cent. line.	Lat. S. limit.
°	° ′	° ′	° ′
168 ...	+ 6 44·6 ...	+ 6 28·0 ...	+ 6 11·6
170 ...	6 20·3 ...	6 3·8 ...	5 47·3
172 ...	5 57·8 ...	5 41·4 ...	5 24·8

So that the breadth of the shadow in the direction of the meridian does not exceed 33′. Reading off from the chart, it will be found that the centre of the largest of the Coquille Islands is in about 169° 35′·5 E. and 6° 8′·5 N., and, calculating directly for this point, it appears that the total eclipse will commence at 8h. 41m. 25s. A.M. on January 12, local mean time, and continue 1m. 16s., and this represents the most favourable condition under which the eclipse can be observed on land. For any other point within the shadow in this vicinity the duration of totality may be determined by the following formulæ, where L is the east longitude from Greenwich, l the geocentric latitude, and t the Greenwich mean time of beginning or ending, according as the upper or lower sign is employed :—

$$\cos. w = +109{\cdot}0051 - [2{\cdot}34285] \sin. l + [1{\cdot}98006] \cos. l \cos. (L - 15^\circ\ 15'{\cdot}9).$$
$$t = 11^h.\ 10^m.\ 48{\cdot}9^s. \mp [1{\cdot}58154] \sin. w + [3{\cdot}16228] \sin. l.$$
$$- [3{\cdot}95668] \cos. l. \cos. (L - 126^\circ\ 35'{\cdot}7).$$

TRANSITS OF MERCURY.—Prof. Holden has published an "Index-Catalogue of Books and Memoirs on the Transits of Mercury," which he had prepared to aid him in a search for records of the physical phenomena which have been observed at such transits. The list is not quite a complete one, the publications of observatories not being included, but there is little inconvenience in the omission, as such observations and memoirs can be found by reference to the volumes for transit years, and Prof. Holden gives a list of the dates of all the transits of Mercury so far observed. Catalogues of this description must prove most serviceable to the student and to every one who has occasion to consult the general literature of an astronomical subject, and we hope the American astronomer may find leisure to continue them. Reference has already been made in this column to his very valuable "Index-Catalogue to the Literature of Nebulæ and Clusters," &c., forming No. 311 of the "Smithsonian Miscellaneous Collections." The publication above mentioned forms No. 1 of "Biographical Contributions," edited by Justin Winsor, Librarian of Harvard University. The copy before us is republished from the *Bulletin* of the library for October, 1878.

BIELA'S COMET AND JUPITER IN 1794.—It will be remembered by those who may have interested themselves in cometary astronomy, that between the first appearance of Biela's comet in 1772, and the next return at which it was observed, in the latter part of 1805, the elements had undergone alterations of a magnitude that occasioned doubts as to the identity of the comets, notwithstanding the general similarity of orbits, Bessel pronouncing against it, while Gauss pointed out that more than one revolution must have been accomplished in the interval, so as to admit of the comet having approached one of the larger planets and thereby experienced perturbation to account for the differences in several of the elements. The disturbing body is now known to have been the planet Jupiter, and there has been no difficulty in fixing the epoch when the comet's motion was most deflected, but we do not recollect to have seen the particulars of the near approach of the two bodies stated in any astronomical work. Starting from the final elements for perihelion passage in 1806, determined in the masterly investigation of the late Prof. Hubbard of Washington, it appears that neglecting planetary perturbation in the interval, the comet would have made its nearest approach to the planet at the beginning of June, 1794, when their distance was less than 0·47 of the mean distance of the earth from the sun. The following distances have been similarly obtained :—

1794	Distance from Jupiter.	1794	Distance from Jupiter.
March 2	0·654	May 31	0·469
April 1	0·562	June 15	0·473
May 1	0·496	„ 30	0·488
„ 16	0·477		

At the time of closest approximation, the heliocentric longitude of the comet was about 269° 40′, and the latitude + 4° 25′.

BIOLOGICAL NOTES

GALL-MAKING INSECTS.—At the St. Louis meeting of the American Association Prof. C. V. Riley read a paper on the gall-making *Pemphiginæ*. He said that the life-history and agamic multiplication of the plant-lice (*Aphididæ*) have always excited the interest of entomologists as well as of anatomists and embryologists. The life-history, however, of the gall-making species belonging to the *Pemphiginæ* has baffled the skill of observers more than that of any other group. Mr. Riley is about to publish some new biological discoveries relating to this family of insects, in connection with a descriptive and monographic paper by Mr. J. Monell, of the St. Louis Botanic Gardens. The paper laid before the Association simply records some of the yet unpublished facts discovered. All of the older writers, in treating of the different gall-producing *Pemphiginæ* of Europe, have invariably failed to trace the life-history of the different species after the winged females leave the galls, and, with few exceptions, have erroneously inferred that the direct issue from the winged females hibernates somewhere. The most recent production on the subject is a paper published in the present year in Cassel, by Dr. H. F. Kessler, which is entitled the "Life-History of the Gall-Making Plant-Lice, affecting *Ulmus campestris*." The author, by a series of ingenious experiments, rightly came to the conclusion that the insects hibernate on the trunk, but he failed to discover in what condition they so hibernate. Led by his previous investigations into the habits of the grape Phylloxera, Mr. Riley discovered, in 1872, that some of our elm-feeding species of *Pemphiginæ* produce wingless and mouthless males and females, and that the female lays but one solitary impregnated egg. Continuing his observations, especially during the present summer, he has been able to trace the life-history of those species producing galls on our own elms, and to show that they all agree in this respect, and that the impregnated egg produced by the female is consigned to the sheltered portions of the trunk of the tree and there hibernates—the issue therefrom being the stem-mother which founds the gall-inhabiting colony the ensuing spring. Thus the analogy in the life-history of the *Pemphiginæ* and the *Phylloxerinæ* is established, and the question as to what becomes of the winged insects after they leave the galls is no longer an open one. They instinctively seek the bark of the tree and there give birth to the sexual individuals, either directly or (in one species) through intervening generations.

LEAF ABSORPTION IN PLANTS.—The earlier experimenters on this subject, M. Perault, to wit, and Hales (1731), were persuaded that leaves absorbed dew and rain. For over a century the investigations of others supported this view, until M. Duchartre, in 1857, from his experiments, advanced a contrary opinion—that now held by most vegetable physiologists, and commonly taught in our schools. But, strange to say, gardeners, in their every-day operations, adopt a different notion from that prevailing in science. The subject has recently received the attention of the Rev. G. Henslow, who, in a paper read before the Linnean Society (November 7), shows that, while it may be true that, as Duchartre has said, dew is not absorbed by saturated tissues at night; yet, on the contrary, his (Henslow's) experiments go to prove that absorption *does take place* at and after sunrise, when transpiration recommences, and an indraught is caused by the moisture, wherever lingering on the leaves. He further corroborates M. Boussingault's late assertion, that, when leaves are purposely or naturally killed by excessive drought, they then do absorb water, as proved by the balance, or otherwise.

BRITISH NEWTS.—From an article by M. Ferrand Lataste in the last volume of the *Journal* of the Société Zoologique de France, it appears that the supposed fourth species of British newt—Gray's banded newt (*Ommatotriton vittatus*) of Mr. Cooke's "Our Reptiles"—may be altogether removed from the British catalogue. It was first introduced into the British list by Jenyns, in 1835, on the faith of some specimens found in a bottle in the

British Museum by the late Dr. Gray, which, being associated with some British newts, were supposed to have been obtained in the neighbourhood of London. Through a somewhat similar error, some specimens in the collection of the Jardin des Plantes at Paris were believed by Valenciennes to have been obtained in France, near Toul, and other examples were supposed to have been found living at Antwerp. It has thus come to pass that naturalists, copying one from another, have assigned "England, France, and Belgium" as the locality of this newt. It now turns out, from M. Lataste's researches, that all these localities are erroneous, and that the so-called *Triton vittatus* is no other than the *Triton ophryticus* of Berthold, an Eastern species of newt which is found in Syria and Asia Minor. The British newts are now, therefore, reduced to three in number—the crested newt (*Triton cristatus*) and the smooth newt (*Triton tæniatus*), both of ordinary occurrence, and the rarer palmated newt (*T. palmatus*).

SPERM WHALES ON EUROPEAN COASTS.—Prof. Turner, of Edinburgh, has been collecting and investigating a number of rare prints of sperm whales stranded on European coasts at the end of the sixteenth and beginning of the seventeenth centuries. One of these illustrates a whale caught in the port of Ancona in 1601, 56 feet long, 33 feet in girth; the scene is an active and lively one, representing a landscape, fishing-boats, men engaged in cutting up the whale, spectators, &c. The Netherlands seem to have had numerous specimens stranded. These, like those occasionally visiting the Scottish coast, are all males, which, when fully grown, appear to go singly in search of food. Other whales, as cachalots, visit the south in larger numbers. Over thirty cachalots, mostly females, were stranded in 1784 in the Bay of Audierne, department of Finisterre; and a school visited Citta Nuova, in the Adriatic, in 1853.

AMERICAN JURASSIC DINOSAURS.—Prof. O. C. Marsh publishes in the current number (November) of the *American Journal of Science and Arts* the principal characters of some new species of dinosaurs. On the flanks of the Rocky Mountains a narrow belt can be traced for several hundred miles, which is always marked by the bones of gigantic dinosaurs. The strata consist mainly of estuary deposits of shale and sandstone, and the horizon is clearly upper Jurassic; the dinosaurian remains in this series of strata are mostly of enormous size, and indicate the largest land animals hitherto known. One new species (*Atlantosaurus immanis*) must have been at least eighty feet in length and several others nearly equalled it in bulk. With these monsters occur the most diminutive dinosaurs yet found, one (Nanosaurus) not being larger than a cat. Some of these new forms differ so widely from typical dinosauria that Prof. Marsh has established a new sub-order to receive them, called Sauropida, from the general character of the feet. They are the least specialised forms of the order, and in some of their characters show such an approach to the mesozoic crocodiles as to suggest a common ancestry at no very remote period. In them the front and hind limbs are nearly equal in size; the feet are plantigrade with five toes on each foot. The carpal and tarsal bones are distinct; the precaudal vertebræ contain large, apparently pneumatic cavities; the sacral vertebræ do not exceed four, and each supports its own transverse process. The pubic bones unite in front by a ventral symphisis; the limb bones are solid. One of the species described and partly figured in Prof. Marsh's paper is called *Morosaurus grandis*; when alive it was about forty feet in length; it walked on all four legs, was probably very sluggish in its movements, and had a brain proportionately smaller than any known vertebrate.

ZOOLOGICAL STATION AT TRIESTE.—It may not be generally known that the University of Vienna in addition to having a zoological establishment in Vienna, has also founded a zoological station on the borders of the Adriatic Sea at Trieste. The general director of both is Prof. Dr. Claus. The assistant at Vienna is Dr. C. Grobben, and the inspector at Trieste is Dr. Ed. Graeffe. As a first fruits of these two excellent establishments Prof. C. Claus has published Part 1 of a handsome 8vo volume entitled "Work Done at the Zoological Institute of the Vienna University and at the Zoological Station in Trieste." The work done consists of 1. A very exhaustible memoir, by Dr. Claus, on a new species of Halistemma (*H. tergestinum*), with remarks on the minute structure of the Physophoridæ. This memoir is illustrated by five folding plates. 2. Contributions to our knowledge of the male reproductive organs in the Decapod Crustacea, with remarks on their comparative anatomy as compared with the same organs in the rest of the Thoracostraca, by Dr. C. Grobben, with six folding plates. 3. On the origin of the nervous vagus in the Selachians, with special regard to the electrical lobes in Torpedo; this is illustrated with woodcuts and one plate. The University of Vienna and Prof. Claus are indeed to be heartily congratulated at these first results from their new institution.

GEOGRAPHICAL NOTES

AT the meeting of the Royal Geographical Society on Monday last, a paper on "Usambara, East Africa, and the Adjoining Country," was read by the Rev. J. P. Farler, who has spent the last three years there in connection with the Universities' Mission. Usambara is described as the Switzerland of Africa, and forms a link in the great East Coast range, which extends from Abyssinia to Natal; roughly speaking, it lies between S. lat. 4° 20′ and 5° 25′, and E. long. 38° 20′ and 39° 10′. The mountains form four detached lines running due north and south, and rising in the higher peaks to about 6,000 feet above the sea-level. The range was evidently thrown up by volcanic action, and consists of granite mixed with spar, with sandstone in the lower spurs containing plumbago. Mr. Farler describes the scenery as varied and beautiful, now soft valleys and hill-sides with hanging woods, now again wild ravines with precipitous cliffs of bare granite. Usambara is drained by four rivers: the Zigi, with its affluent, the Kihuwi, the Mkulumuzi, the Ukumbini, and the Luari, the two first-named emptying into Tanga Bay; none of the four, however, are navigable. Trees are found in the region in great variety, but mostly of stunted growth; euphorbias, fan-palms, and mimosa thorns are seen everywhere, and occasionally baobabs, tamarind-trees, and clusters of the Borassus palm; there is also a kind of wild palm-tree. Various animals are found in the Mjika, or wilderness—antelopes varying from the size of a cow to that of a small goat, gazelles, lions, leopards, hyænas, and large apes. Mr. Farler mentions a noteworthy peculiarity in regard to the River Mkulumuzi, which in the rainy season becomes a torrent: "The stream has cut a deep bed for itself in the granite sides of the mountain, and exploring this bed in the dry season, I have found perfectly round, well-like basins in the rock, varying from a foot in diameter and depth to 10 feet in diameter, and from 8 to 12 feet in depth. There is always a stone at the bottom of these basins, and they must have been formed by the torrent giving, during the rainy season, a rotary motion to the stone." The soil throughout Usambara is a red disintegrated clay upon a granite and sandstone foundation, and covered with a rich vegetable loam; the bottoms of the valleys contain beds of alluvial clay. Probably no more fertile soil could be found in the world, and it is capable of producing every tropical plant. The flora of the region is extensive; in the forests are found ebony, copal, teak, acacia, the india-rubber tree, the orchella weed, the betel-pepper climber, prickly smilax, with several varieties of the strychnos tree, and many other trees producing valuable wood. The inhabitants are many of them rather Semitic than Negro in their type, having high foreheads, while the prognathous jaw and spur heel are both wanting. They average 5 feet 7 inches in height, are strong, though not robust, and in form and figure resemble bronze statues. After describing the curious marriage customs of these people Mr. Farler concluded with some interesting remarks on the Masai country, which, sooner or later, must be thoroughly explored, so as to obtain a short route from the coast to the Victoria Nyanza.

At the same meeting Sir Fowell Buxton, at the special request of Sir Henry Rawlinson, gave an account of the progress of the road-making experiment from Dar-es-Salaam to the north end of Lake Nyassa. The work does not appear to proceed very rapidly, for but forty miles of road have been made in over twelve months, but it is satisfactory to learn that the natives give no trouble and willingly take to the good road provided for them; as, however, they still persist in their old habit of walking in Indian file, their traffic does not do much towards keeping down the rapidly growing vegetation.

IT is now definitely settled that the Earl of Dufferin will preside at the meeting of the Geographical Society on Monday, December 9, and as an appropriate compliment to his lordship's early experiences as a traveller, the evening will be devoted to Arctic matters. We understand that the papers to be read will include an account of the Swedish Arctic Expedition now being so successfully carried out by Prof. Nordenskjöld, a review of the work done by the recent Dutch Arctic Expedition, suggestions as to the best route for future exploration, &c.

FROM a letter of Prof. Nordenskjöld's, published by Mr. Oscar Dickson, the liberal patron of the North-East Passage Expedition, we learn that during the short stay of the *Vega* at Vaigatz Island the scientific staff did some good work on the fauna of the sea and the flora of the land. A large collection of fishes was made, and special attention was given to Arctic phanerogamous plants. Nordenskjöld himself made some important purchases of "idols" from the Christianised Samoeides, who, notwithstanding their baptism, worship and sacrifice to their old divinities.

WE have been favoured by a correspondent with the following extracts from a letter lately received from Mr. Carl Boch, who is exploring and collecting in Sumatra:—"I have been collecting for a month in the highlands of Mount Sago, and, considering the very bad weather, have been successful. My hut is on the south-eastern slope of the mountain, at an elevation of about 4,000 feet above the level of the sea. The mountain is about 8,000 feet high, and covered to the top with virgin forest. In about a week I purpose going on to Siedjoendjoeng, a place noted for its tigers, tapirs, and elephants, and said to be in every respect the best district for a naturalist. At Ayer Muntjer I met the celebrated Italian traveller, Signor Beccari, and stayed with him three days."

THE Emperor of Austria has conferred the Order of the Iron Crown upon Drs. Gerhard Rohlfs and Georg Schweinfurth, the celebrated African travellers, and upon Drs. Alfred Brehm and Eugen von Homeyr, the well-known ornithologists.

THE well-known African traveller, Dr. Nachtigal, has been elected president of the Berlin Geographical Society.

THE *Russische Revue*, as referred to in Behm's monthly summary, contains some further details of Mushketow's recent exploration of the Pamir Mountains. He ascertained that the Pamir consists mainly of granite, metamorphic clay, and mica slate, covered with beds of triassic formation; at least in the northern part or Pamir Chorgosh. The direction of all the granite outcrops is that of the general direction of the Thian Shan, viz., east-north-east, or nearly so. North of the Pamir the granite soon ceases, and in the Trans-Alai Mountains diorite predominates, which takes the eastward direction of the main axis of elevation of the Trans-Alai Mountains, and forms the highest summits, which, as in Kaufmann Peak, reach a height of 25,000 feet. Further north, secondary formations prevail, with great diluvial accumulations. In the region explored by him M. Musketow could recognise no meridional elevation such as could favour the hypothesis of a meridional mountain-system, as was assumed by Humboldt.

IN an article on foreign trade with Western China, contained in a recent issue of the *China Overland Trade Report*, we find some interesting notes on the intention of the Russians to push their trade southwards from the Siberian frontier. For this purpose a great commercial station is to be founded in the south-east of the province of Semipalatinsk—probably at the town of the same name, which is well situated for such a purpose, and is even now one of the chief commercial centres of Siberia. It occupies a good site on the east bank of the Irtisch, one of the most important rivers of Siberia, and has a population of several thousands. There are also many Tartar merchants in the place engaged in trade with the Chinese frontier towns in the north, Bokhara, Tashkend, &c. The Semipalatinsk caravans carry southwards printed Russian goods, copper, iron, and hardware, and return with tea, silk, dried fruits, &c. The warehouses of Semipalatinsk also contain carpets from Persia and Bokhara, costly silks and shawls embroidered with gold, ornaments and porcelain from China, diamonds, rubies, and emeralds, together with curiosities and jewellery of various kinds. There is likewise a large trade in cattle, herds of 4,000 or 5,000 being driven into the town by Kirghiz at one time; more than two million sheep are also sold there every year, most of them being forwarded on to Ekaterineburg, where they are killed and the fat used in the great candle-works of the town. It is thought possible that the Russians may intend to hold at Semipalatinsk the great *Yermak* or fair, which now takes place at Irbit, on the frontier, and to induce Chinese and Thibetan traders to go there.

AN excellent little book has just been published by Hartleben, of Vienna. Its title is "Malta; Geschichte und Gegenwart, by Herr A. Winterberg. The work consists of three principal divisions. The first gives an exhaustive and well-written account of the topography, climate, position, and political division of the Maltese Islands, besides describing the agriculture, industry, commerce, and institutions of the little country. It closes with an interesting chapter on the physical and moral condition of the inhabitants. The second division treats of the islands from a military point of view, and contains minute descriptions of the fortifications, the various towns and villages, the harbours, bays, sources, and grottoes of the island. The final division, by far the most elaborate, is an ably-written summary of the history of Malta, which in its closing chapters has the additional interest of "showing us ourselves as others see us." The little book contains eighteen illustrations and two neatly-finished maps.

THE first article in the November number of Petermann's *Mittheilungen* (it still retains the name) is on the use of elephants in African exploration, by the late editor, and was found on Petermann's table on the evening of his death. The number contains besides a short account by Dr. Miklucho Maclay of his visit to some of the Pacific Islands and New Guinea, and a paper by the same on Volcanic Phenomena on the north-east coast of New Guinea; an account of Bernoulli and Cario's travels in Guatemala and South Mexico in 1877; the conclusion of Dr. C. E. Jung's Contributions to the Geography of Victoria; an important paper, with map, on the Chinese province of Kwang-tung and its people, by Herr J. Nacken; another on D'Albertis' New Guinea Exploration, with map of the Fly River; with papers on the Exploration of the Ogowé, Nordenskjöld's Voyage in the *Vega*, and Dr. Behm's monthly summary. Thus it seems that Dr. Behm, the new editor, is likely to maintain the reputation and value of this, the most important geographical organ.

THE October *Bolletina* of the Italian Geographical Society contains a short account of the Progress of the Italian African Expedition, and letters from Lieut. Bove who accompanies Prof. Nordenskjöld in his North-East Passage Expedition. In the *Bulletin* of the Paris Society is a translation of the Grand Duke Nicholas's paper on the Shortest Route for a Railway to Central Asia; a paper by M. L. Simonin on the Indians of the United States, with a map showing the Indian reservations; the continuation of Dr. Decugis' Account of his Journey in Morocco; a long article by the Abbé Ménager on Guinea, besides shorter papers on a Uniprojectional Atlas, and the Rio Casca of Peru.

THE Portuguese African expedition, under Serpa Pinto, which left Benguela a year ago, reached Bihé in March last, and was to enter the unknown interior in two divisions. The Lisbon Geographical Society are moving Government for a scientific expedition into Portuguese Senegambia.

ON SOME IMPROVED METHODS OF PRODUCING AND REGULATING THE ELECTRIC LIGHT[1]

AMONG the manifold functions which the elementary substance carbon performs in organic nature, not the least important is that by which it becomes the great source of artificial illumination, whether derived from oils, coal gas, or from coke rendered incandescent by the action of powerful electric currents. Since the time when Davy first produced the voltaic arc, between two points of wood charcoal, through which was transmitted the current from the great battery of 2,000 plates belonging to the Royal Institution, many experiments have been made to determine the best kinds of carbon for developing the electric light. The carbon which, until recently, was most commonly employed for this purpose, is obtained from the sides of gas retorts, where it accumulates in the form of coke during the destructive distillation of coal. The shells of coke from the retort are sawn up into pencils from one quarter to half an inch square, and from six to nine inches in length. Although very good results are obtained from carbon of this kind, it is a difficult material to work on account of its hardness, and it sometimes contains impurities which interfere with its conductivity. It is also liable to fracture when suddenly heated by the transmission of powerful electric currents. These defects have led to the introduction in electric lighting of artificial carbon, composed of powdered coke and lampblack, formed into a paste with molasses and gum. This material is pressed into cylindrical forms, and subjected for a given time to a high temperature in a special furnace. The manufacture of these carbon pencils has attained great perfection in the hands of Carré, of Paris, and they can be made into perfectly straight and cylindrical forms of from two to sixteen millimetres in diameter, and half a metre in length.

When the electric light is to be used for illumination, it is necessary that it should be as continuous as other modes of lighting. For this purpose not only should the current be regular in its action, but the distance between the carbon points must not alter, which necessitates the use of some arrangement for bringing them nearer together in proportion as they are consumed. Much ingenuity has been displayed by electricians in solving this problem, and the automatic contrivances invented by Staite, Duboscq, Foucault, Serrin, and others, leave little to be desired in regard to the steadiness of the light, when the regulators are in good order, and in the hands of intelligent operators. All automatic instruments, however, from the delicacy of their mechanism, are liable to derangement, and their action is not easily understood by persons not having a special knowledge of their construction. To obviate the objection to the use of such instruments by unskilled attendants, I devised, a few years since, a regulator for use on H.M.'s ships of war, to be actuated by hand. In this arrangement the carbons are made to approach and separate from each other by means of a right and left-handed screw connected with the carbon holders. Each of the screws, with its carbon holder, can be actuated independently of the other, for the purpose of adjusting the points of the carbons to the proper focus of the optical apparatus used in connection with it. The regulator, with its carbon points, is placed in the focus of a dioptric lens, which parallelises the divergent rays of light into a single beam of great intensity. The lens with the regulator is pivoted horizontally and vertically on the top of a short iron column, fixed on a raised platform above the deck, and the beam of light may be projected upon any distant object within its range. This special application of the electric light, however, as will be seen, requires the frequent adjustment of the carbons by the operator, but as he is always required to be in attendance to manipulate the projector, no inconvenience is experienced through the absence of the automatic arrangement. This method of regulating the electric light has now been in use in the Royal Navy for more than three years, and has proved very satisfactory.

Simultaneously with the progress of improvements in the mechanism for regulating the electric light, experiments have been made with the object of dispensing with the regulator altogether. The most recent, as well as the most successful, of these attempts has been made by M. Jablochkoff, a Russian inventor. In the specification of his letters patent of 1877 he proposes to place the carbons side by side (as had been previously proposed by Werdermann in 1874), and to separate them by an insulating substance to be consumed along with the carbon. The inventor states that the insulating substance for separating the carbons may be kaolin, glass of various kinds, alkaline earths, and silicates, which he prefers to apply in the form of powder rammed into an asbestos cartridge-case containing the carbons. A powder which the inventor found serviceable consists of one part lime, four parts sand, and two parts talc. These materials are rammed into the cartridge-case surrounding and separating two parallel sticks of carbon placed in the case, at a little distance apart. One of the carbons is made thicker than the other to allow for its more rapid waste. The lower ends of the carbons are inserted into pieces of copper tube or other good conductor, separated from one another by asbestos, and the ends of the tubes are pinched between two limbs of a screw vice, connected respectively to the conducting wires. This combination of carbons and insulating materials the inventor terms an electric candle, which, when mounted on a stand or candle-stick, has the appearance of the Roman candle of pyrotechnists. The inventor further states that the heat produced by the electricity fuses the material between the carbons and dissipates it; and the freedom of the passage afforded by the fused material to the electric current permits the subdivision of the light by placing several lamps in the course of one electric circuit. It is also stated that the construction of the candle may be varied; and, among the forms described, is one in which the carbons, instead of being contained in a cartridge case,

[1] Paper read by Mr. Henry Wilde at the Manchester Literary and Philosophical Society, October 29.

are separated by a partition of kaolin or other similar insulating material.

I have thought it well to describe, as nearly as possible in the words of the inventor, the electric candle, which is now the subject of so much attention in its application to electric lighting; so that its relation to what follows may be more clearly perceived. A remarkable peculiarity of the direct current in electric lighting is that of its consuming the positive carbon at twice the rate of the negative one, and while the negative carbon is a pointed cone, like that of a pencil, the positive pole takes the form of a hollow cavity or crater.

M. Jablochkoff's early experiments seem to have been made with the direct current, and hence his carbons are described as being of unequal thickness, in order that the positive and negative carbons of the candle might be evenly consumed. When the alternating current is used for producing electric light both carbons are of the same thickness, and are consumed at an equal rate, and both points terminate in regular cones. This property of the alternating current, besides other advantages, always maintains the luminous point in the focus of any optical apparatus used in connection with it, that is, when the carbons are placed end to end, as I had occasion to point out in a former paper read before the Society in 1873, on an electro-magnetic induction machine for producing alternating currents.

M. Jablochkoff, in the course of his experiments, would appear to have met with some difficulties in adapting the direct or continuous current to a system of lighting with his electric candles, and now uses the alternating current for this purpose. The candle has also been simplified by substituting a slip of plaster of Paris for the cartridge and partition of kaolin formerly employed.

To produce the alternating currents, however, to supply a number of lights, it was found necessary to employ powerful electro-magnetic induction machines, excited by the currents from other smaller machines, according to the principles laid down in my paper read before the Royal Society, and published in the *Philosophical Transactions* of 1867. From sixteen to twenty lights are produced from one of these electro-magnetic machines, each light absorbing about one-horse power.

The system of electric lighting above described would now seem to be definitely established in some places as a substitute for gas, and visitors to the French capital during the present summer will have been struck with the fine effects produced in the avenues and squares where the light is displayed.

My connection with the history of this system of lighting placed me in a position to make some experiments with the Jablochkoff candle, and led to the discovery of the following facts. One of the conditions necessary for producing a constant light from the candle, in its most recent form, was that the quantity and intensity of the alternating current should be such that the carbons consume at a rate of from four to five inches per hour. If the electric current were too powerful, the carbons became unduly heated, and presented additional resistance to the passage of the current; the points at the same time lost their regular conical form. If, on the other hand, the current were too weak, the electric arc played about the points of the carbons in an irregular manner, and the light was easily extinguished by currents of air.

In the course of these experiments I was struck with the apparently insignificant part which the insulating material played in the maintenance of the light between the carbon points; and it occurred to me to try the effect of covering each of the carbons with a thin coating of hydrate of lime, and mounting them parallel to each other in separate holders, and without any insulating material between them. The use of the lime covering was intended to prevent the light from travelling down the contiguous sides of the carbons. On completing the electric circuit the light was maintained between the two points, and the carbons were consumed in the same regular manner as when the insulating material had been placed between them.

Two plain cylindrical rods of carbon three-sixteenths of an inch in diameter and eight inches long, were now fixed in the holders parallel to each other, and one-eighth of an inch apart. The strength of the alternating current was such that it would fuse an iron wire 0·025 of an inch in diameter and eight feet in length. On establishing the electric current through the points of the carbons by means of a conducting paste composed of carbon and gum, the light was produced, and the carbons burnt steadily downwards as before.

Four pairs of naked carbons mounted in this manner were next placed in series in the circuit of a four-light machine, and the light was produced from these carbons simultaneously, as when the insulating material was used between them. The light from the naked carbons was also more regular than that from the insulated ones, as the plaster of Paris insulation did not always consume at the same rate as the carbons, and thereby obstructed the passage of the current. This was evident from the rosy tinge of the light produced by the volatilisation of the calcium simultaneously with the diminution of the brilliancy of the light from the carbons.

The only function, therefore, which the insulating material performs in the electric candle, as shown by these experiments, is that it conceals the singular and beautiful property of the alternating current to which I have directed attention.

As I have already said, the strength of the alternating current must bear a proper proportion to the diameter of the carbons used, and when a number of such lights are required to be produced in the same circuit, the quantity and property of the current will remain constant, while the tension will require to be increased with the number of lights.

This simple method of burning the carbons will, I believe, greatly further the development of the electric light, as the carbons can be used of much smaller diameter than has hitherto been possible. They may also be of any desired length, for as they are consumed they may be pushed up through the holders without interrupting the light. One of these developments will be a better method of lighting coal and other mines. In this application the alternating currents or waves from a powerful electro-magnetic induction machine may be used for generating, simultaneously, alternating secondary currents or waves in a number of small induction coils, placed in various parts of the mine. The light may be produced in the secondary circuits from pairs of small carbons inclosed in a glass vessel having a small aperture to permit the expansion of the heated air within. Diaphragms of wire gauze may be placed over the aperture to prevent the access of explosive gas. By generating secondary currents or waves without interrupting the continuity of the primary circuit, the contact-breaker is dispensed with, and the subdivision of the light may be carried to a very great extent.

A STUDY IN MAGNETISM

THE name of Faraday will go down to posterity foremost amongst the names of the scientific men of this century, for the simple comprehensiveness and original beauty of his researches in electricity and magnetism; chiefly, perhaps, for his discovery of magneto-electricity—the kind of electricity that can be induced in conductors which are caused to pass near magnets. Those who have carefully read Faraday's works know how he was led to this discovery by the conception he had formed of magnetic force. Until his time magnetic attractions and repulsions had been explained as a kind of action-at-a-distance. Faraday explained them as the results of the action of the medium filling the intervening space; and he gave several indisputable proofs that the space surrounding a magnet was thrown into a peculiar condition by the presence of the magnetism. Two centuries previously another Englishman, as uniquely

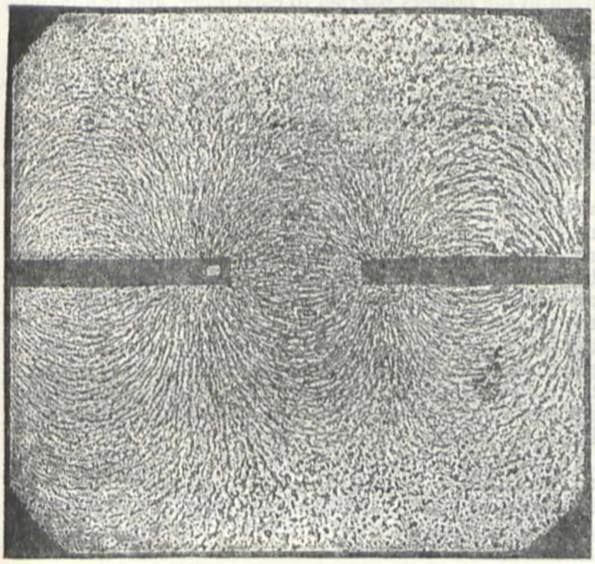

FIG. 1.

great if not greater, Dr. Gilbert, had in his famous treatise "De Magnete," told how iron filings sprinkled on a piece of card beneath which a magnet lay, assumed certain mysterious lines. To these lines Faraday gave the name of *lines of force*, and showed that they represented, wherever they went, the direction and strength of

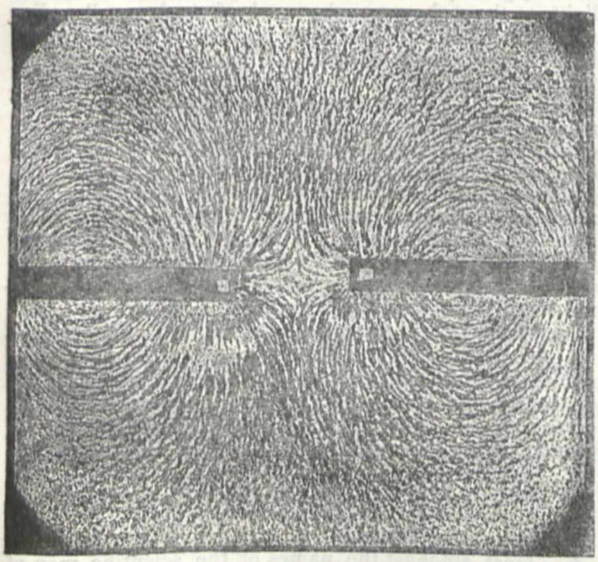

FIG. 2.

the magnetic force. His imagination seized upon these mysterious lines, and he saw all space, wherever a magnet had influence, traversed by them. He perceived that they were in some way bound up with that which was mysterious and unexplained in this seeing action-at-a-distance. He found them to react on one another, and to follow certain definite laws ascertainable by experiment. In the volumes of his researches he filled several entire plates with drawings of the figures assumed by the lines under various combinations. They had taught him to anticipate magneto-electricity and electro-magnetic rotation. He had diligently followed them up from the hint afforded by Dr. Gilbert's experiment with the iron filings. He had begun to apply the method to

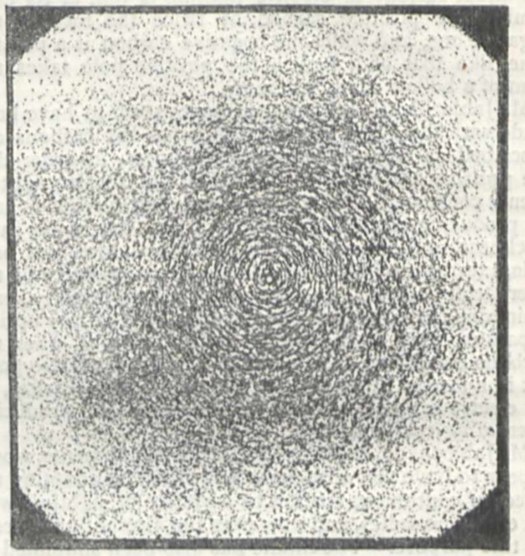

FIG. 3.

the investigation of the interaction of electric currents, when the decay of age overtook him, and the research dropped from his grasp. Had he lived the study which the writer of the present article is about to narrate would have been completed long ago.

The experiment of laying a card or a sheet of paper

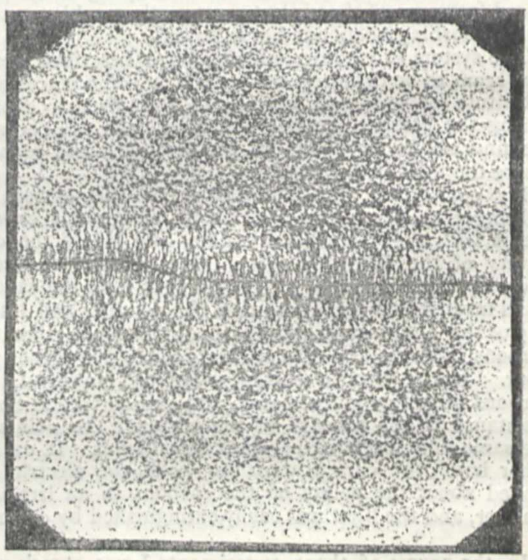

FIG. 4.

upon a magnet, sprinkling over it fine iron filings, and then tapping the card gently so as to allow the filings to take up their places in the "curving lines of force," is one which always possesses a peculiar interest and fascination for youthful electricians. Two other experiments, due originally to Musschenbroek, are not quite so familiar, though they are as simple; and since they have a special bearing on that which follows, we will mention them in detail.

Let two bar-magnets of steel be placed on the table with the north-seeking pole of one towards the south-seeking pole of the other, but not touching. Over these lay a sheet of stiff writing-paper, or card, or a sheet of window-glass. Fill a pepper-box with fine iron-filings,

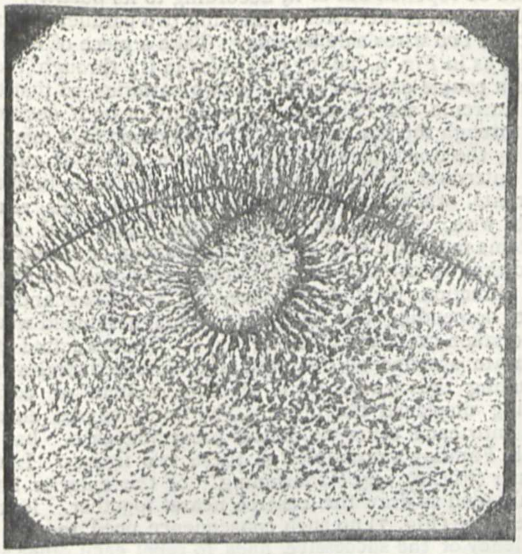

Fig. 5.

and sprinkle them evenly over the sheet; then tap the sheet gently, until the filings have arranged themselves. Observe (Fig. 1) that the lines of force run across from pole to pole. A line of force represents the direction in which the forces act. Suppose that the pole on the right is the north-seeking pole, and that on the left a south-seeking pole. The forces act across the space between them in

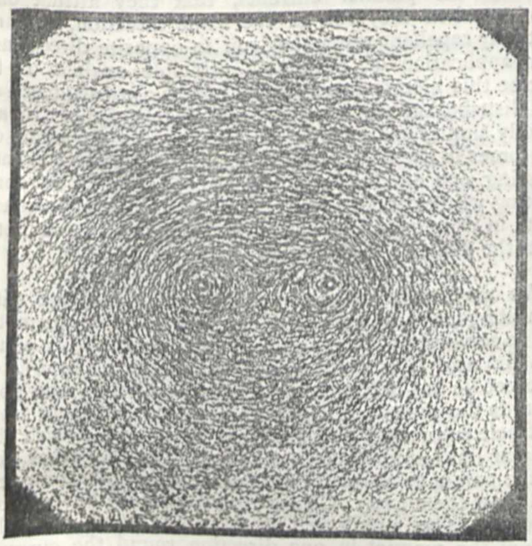

Fig. 6.

the continuous curves from pole to pole. Suppose you could obtain a piece of steel imbued with magnetism of one kind of polarity only—a magnetic "particle," in fact, of the same kind of magnetism as the north-seeking pole. If you were to put that magnetic particle down on one of these lines near the north-seeking pole on the right, it would, as we know, be repelled away, since similar poles repel one another. And it would move away along the line of force (for that line of force represents the direction in which the force acts), and would pass right over and be attracted to the south-seeking pole on the left. Similarly a magnetic particle of south-seeking polarity, if we could get one and place it down on a line of force, would be driven along the line in the opposite direction.

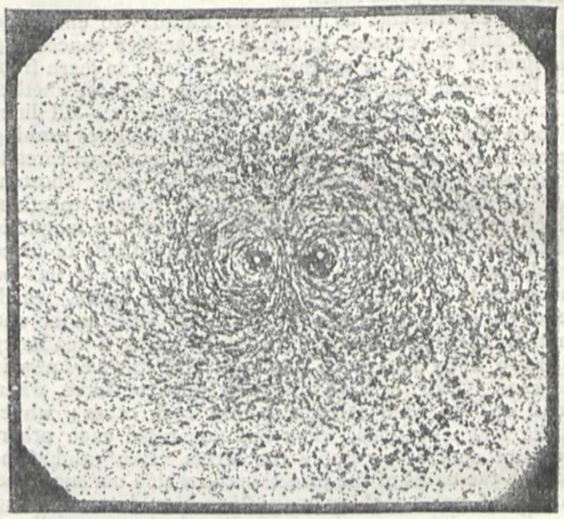

Fig. 7.

Notice, too, that a great many of the lines of force that run out of one pole run into the attracting pole opposite. This you will find always to be the case when two poles attract: their lines of force run into one another.

As a second experiment lay down the two magnets, but put their north-seeking poles towards one another, and then lay on them a sheet of card or glass, and sprinkle

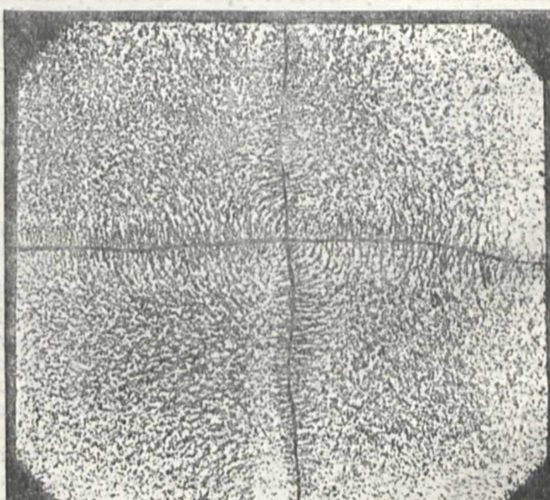

Fig. 8.

filings over, as before. The curves you obtain, which are like those of Fig. 2, are quite different from those obtained before. This time the lines do not run across from pole to pole. They start out, but instead of uniting and blending together, and bending over to run into one another, they turn away sharply where they encounter one another, and, without ever joining, swerve aside in almost parallel paths. If our supposed particle of north-seeking magnetism were placed on a line near one pole it would not pass over from pole to pole, but would follow the line where it swerves away to the side. We know (by experiment) that two north-seeking poles repel one another, and we see here that the lines of force of two such poles never run into one another, but turn aside mutually repellant. You will find that this is always the case when two poles repel.

Such experiments as these led Faraday to enunciate several simple yet most important principles concerning the lines of force, by means of which we can learn from the lines what kind of action they will produce, whether attraction, or repulsion, or rotation. *Firstly.*—All lines of force tend to shorten themselves. If the lines running across in our first figure were replaced by actual threads of stretched elastic material, we see that any "shortening" of them would bring the poles nearer together, which, indeed, is precisely the tendency of the magnetic attraction between the poles. *Secondly.*—Lines of force repel each other when placed side by side. If this be the case then the lines in our second figure, which bend outwards, and run off side by side, repel one another, the two poles must be experiencing a tendency to move away from one another; and this we know is the case. *Thirdly*, Like magnetic lines of force, when "end on" to each other, run into each other; while, unlike magnetic lines, when end on, repel each other. Here, of course, we apply the terms "like" and "unlike" to the cases of the directions in which our supposed particle of north-seeking magnetism would move along the lines. These notions of Faraday's are full of meaning, and it is not many years since Prof. Clerk Maxwell showed how well they agreed with the most perfect mathematical expression of the forces that operate in the medium filling the surrounding space.

Keeping these simple principles in mind, let us apply them to some further cases of magnetic action, and see if they are equally applicable. We know that the wires carrying electric currents possess certain magnetic properties, and will deflect magnetic needles; that two electric currents may attract or repel each other; and that current may make a magnet pole rotate round it. Can we explain such electrodynamic actions also by applying the principles of Faraday to the magnetic lines of force existing in these various cases?

In the first place, what are the lines of force belonging to a wire through which an electric current is passing? To ascertain this we will bore a hole through a card or a piece of glass, and pass a wire up through the hole. Then, joining the ends of the wire to the poles of a powerful battery, we will, while the current is passing, sprinkle on iron filings, and, tapping lightly, will permit them to assume their places in the lines of force. Fig. 3 was thus obtained. It shows us a series of concentric circles. If a supposed north-seeking magnetic particle were put down on one of these circles it would move round and round in one direction; supposing the current to come up through the hole, this direction would be opposite to that of the hands of a watch. If the current went down through the hole, the movement would be the other way round. But we may examine the current in another way. Lay the conducting-wire down flat, and place over it the card or piece of glass. The forms assumed by the iron filings are in this case (Fig. 4) straight lines across the wire—are edge-views, so to speak, of the systems of circles we just now obtained.

These two figures were discovered by Faraday, and are given in his researches. They are also given by Dr. F. Guthrie in his book on "Magnetism and Electricity."

If we wind up our conducting-wire into a simple knot or loop, carefully preventing the overlapping parts from touching, the figure obtained with the iron filings is like that of Fig. 5. It is interesting to observe how in the middle of the loop there are no lines, only dots. The lines of force run through the loop, perpendicularly to its plane, and we only see them end-ways as points. It is clear that a magnetic particle such as we have imagined would be either attracted into the middle of the loop, or would be repelled out of it, according to its polarity.

Now what is the effect of carrying two parallel currents through two wires side by side? Take a piece of card or glass, as in Fig. 6, having two holes in it; through these pass a couple of wires joined to two batteries, so that the two currents are either both ascending or both descending through the flat surface. The magnetic field mapped out by the iron filings will then show a series of curves, the outermost of which are rough ovals inclosing both the currents, whilst the innermost are small ovals round each wire. The lines between the inner and outer systems present a sort of hour-glass shape or *lemniscate.* Had the two parallel currents, however, passed in opposite directions through the plate, one ascending and the other descending, the filings in the magnetic field would have taken the form given in Fig. 7. Here we find two separate systems of distorted and flattened circles surrounding the wires, each separate system of circles having displaced the other. The outer curves do not run into each other as in the preceding case. Let us apply Faraday's principles to these two figures. In the former (Fig. 6) any "shortening" of the exterior lines would tend to draw the centres nearer together. In the latter case (Fig. 7) no such consequence need result. A tendency of the successive lines to repel each other and to maintain equal distances from each other, would in the former case tend to reduce the entire figure to a system of concentric circles, which could not be accomplished unless the two centres approached each other and coalesced. In the latter case, since the systems of lines round the two centres never join across, this tendency would have the result of driving the two centres far apart to allow of the lines becoming perfect sets of circles. Now we know from Ampère's classical researches on parallel currents, that they attract one another when they run in the same direction, but are mutually repellant when they run in opposite directions. Our application of Faraday's principle enables us to foresee this electro-dynamical action as a consequence of the distribution of magnetic force in the field. In an exactly similar manner we may reason out the action of the forces in the field which is produced by two currents crossing one another at a right-angle (Fig. 8), the conducting wires attracting one another across those quadrants in which the currents flow both towards or both from the point of intersection.

We may apply our study further and investigate, with iron-filings, the action which currents exert on magnets. Let us conduct a current vertically through a hole in a plate, and fix near it a small magnetic needle, as in Fig. 9. The needle has been placed so as to point with one pole towards the current. The lines of force radiating from that pole run round and coalesce on one side with the circular lines of force of the current. On the other side of the pole they absolutely refuse to unite with the circles, and repel them away. Clearly, the "tendency to shorten," which Faraday predicated of the lines, would drag the pole of the magnet in one direction round the current. Looking at the other pole of the magnet we see that the tendency acts in the opposite direction, so that the total result would be a tendency to turn round the magnet about its middle point, and set it at right angles to its present position. This consequence, too, is, as we know from Oersted's famous experiments, the fact.

If, instead of laying the needle down flat, we had reared it up on end, as in our Fig. 10, where a square black spot marks the place of the pole, we should perceive that the systems of circles round the current and of rays round the pole mutually disturbed each other, and that the figure was consequently unsymmetrical. Round one half of the figure the lines coalesce; round the other they repel each other, and stream away. Applying the notions we have already obtained, we see that the result will be a

FIG. 9.

force tending to make the pole and the current rotate round each other. This, we know, was shown by Faraday himself to be the case, for when one was fixed and the other free to move, the one rotated round the other. Carry on the idea one stage further, and make the current run up through the plate at the precise point where the pole

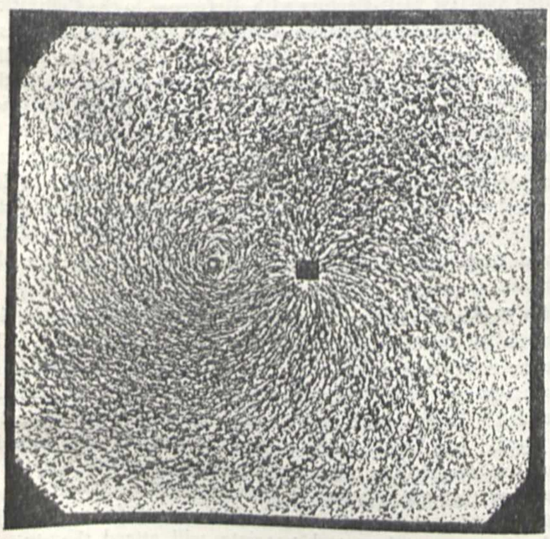

FIG. 10.

of the magnet is. Let it run up through the magnet. The "field" we obtain (Fig. 11) shows us neither the rays of the magnet nor the circles of the current, but a set of beautiful spirals unwinding from a common centre. What kind of motion can we deduce from this remarkable figure? If the branches of the spiral could shorten themselves they would certainly rotate the central region round on itself. The corresponding fact exists in another of Faraday's discoveries: that a magnet can be made to rotate round its own axis, under the influence of a current running up it through one of its poles.

One experiment more will close for the present our

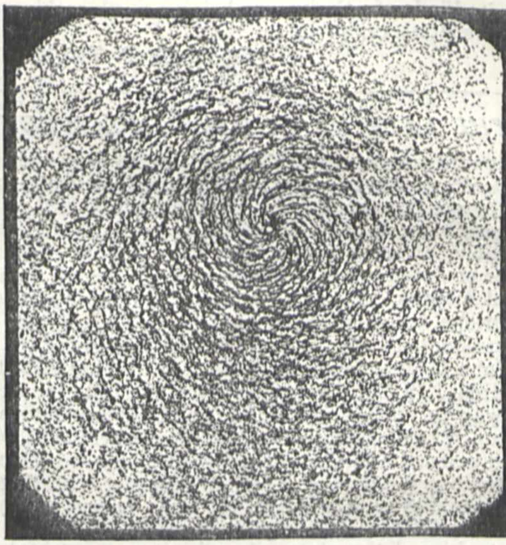

FIG. 11.

study in magnetism. We know that a rod of iron becomes a magnet when we wind a spiral of wire round it and send a current through the wire. There must be some relation between the iron bar and the coils of wire: what is it? Let us investigate this also by looking at the distribution of the lines of force within the coil.

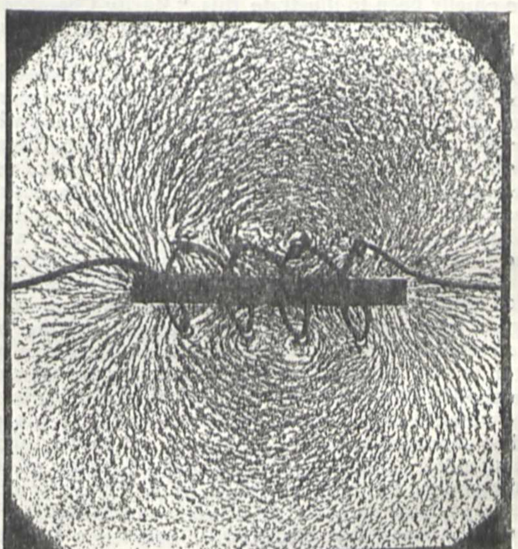

FIG. 12.

Take a plate of glass or a piece of card and bore eight holes through it, as in Fig. 12, and wind a corkscrew of wire in and out; then lay a little bit of thin, soft iron down the middle. We see by the lines of force, when the current is passed, that the iron becomes a strong magnet, but that the wires at the same time are magnetic also. We shall discover also that the magnetism of the little iron bar is not distributed exactly in the same way as if it had been a permanent steel magnet, for the lines of force follow curves that fill surrounding space slightly differently. Still, on the whole, we should argue that the iron core possessed magnetic poles where the force was greatest, and that the two poles were of opposite kinds of polarity, one being a north-seeking, the other a south-seeking, pole.

SILVANUS P. THOMPSON

THE LATE MR. G. DAWSON ROWLEY

IT is with sincere regret that we have to announce the death, on the 21st inst., at his house in Brighton, of Mr. George Dawson Rowley, the projector of, and principal contributor to, the *Ornithological Miscellany*, which he published at his own very considerable cost, and author of several papers on ornithological and archæological subjects. Educated at Eton and Trinity College, Cambridge, where he graduated B.A. in 1846, he was the companion, both at school and at the University, of the late John Wolley, whose early passion for natural history he shared. In Mr. Rowley, however, the taste for a time gave way to antiquarian studies, and did not return, at any rate very strongly, until some years afterwards, when he had married and was settled at Brighton, where, notwithstanding the *dictum* of Mr. Ruskin that "no English gentleman has ever thought of birds except as flying targets or flavorous dishes," he became, so far as the opportunities of the place allowed, a very watchful observer of all that was passing in the feathered world, while in the spring he yearly repaired to his father's estate at St. Neot's in Huntingdonshire, the better to study the habits of birds in the breeding-season. He also began to form a collection of ornithological specimens of singular value, sparing no cost or trouble in the acquisition of objects of rarity or peculiar interest, and the treasures thus amassed finally became very numerous. The design of his *Ornithological Miscellany* seems to have chiefly been to illustrate this "Rarity Chamber"—for so, after the example set by old Rumphius, it might well be called—a considerable number if not most of the specimens therein figured or described being his own possessions. Yet he willingly accorded room in its pages to worthy contributors, among whom may be mentioned Mr. Dresser, Dr. Finsch, Messrs. Salvin, Sclater, Seebohm and Sharpe, and Lord Tweeddale, and his printing a translation of Prjevalsky's important work on the birds of Turkestan, published in Russian, with copies of the plates, was a real boon to those ignorant of that language. Besides this he often wandered into the by-ways of ornithology, which frequently possess a curious kind of interest, and he gave views of many places remarkable for the birds which frequent them. Never did the contents of a work better justify its title, for anything more miscellaneous than they are cannot well be imagined. Failing health, as he himself only a few months ago stated in his concluding remarks, brought it to an end far sooner than he had intended. Setting aside the scientific value of some of the papers, the beautiful plates by which nearly all are illustrated make its cessation a loss to ornithologists; and those who knew that Mr. Rowley had for a long time been gathering information bearing on the history of the extinct Gare-fowl (*Alca impennis*) had hoped that some result of his labours in this respect would one day make its appearance. But this was not to be. More than a year ago a violent hæmorrhage of the lungs gave warning of serious danger, and the attack was only too quickly followed by others of a like nature, under which he sank, in his fifty-seventh year, dying, by a singular coincidence, on the very same day as his father, who had long been an invalid.

NOTES

WE notice with regret the death, at the age of sixty-eight, of Mr. James M'Nab, the well-known curator of the Edinburgh Royal Botanic Garden. Mr. M'Nab's father was also curator of the Edinburgh Botanic Garden, where the son was trained. In 1834 Mr. M'Nab paid a visit to the United States and Canada, the fruits of which appeared in a variety of contributions, descriptive of the more interesting plants found during the journey, in the *Edinburgh Philosophical Journal* for 1835, and in the *Transactions* of that period of the Edinburgh Botanical Society. On the death of his father, in December, 1848, after thirty-eight years' superintendence of the Botanic Garden, Mr. M'Nab was promoted by the Regius Professor (Dr. Balfour) to the responsible post thus vacated. The extent of the Garden at that time was not more than fourteen imperial acres. Ten years later, however, two acres were added on the west side, which were laid out and planted by Mr. M'Nab, under the superintendence of Prof. Balfour. After the lapse of five more years the Experimental Garden, extending to ten acres, was thrown into the Botanic Garden, and planted with conifers and other kinds of evergreens. On a portion of the ground so acquired a Rock Garden was, on the suggestion of Mr. M'Nab, begun towards the end of 1860. The Rockery has now upwards of 5,442 "compartments" for the cultivation of Alpine and dwarf herbaceous plants, and is yearly being added to; while of late years portions of the southern slopes have been set apart for the rearing of bulbous and other plants, whose roots require to be well ripened before flowering. Mr. M'Nab was a frequent contributor to horticultural and other magazines, his writings including papers, not only on botanical subjects, but on vegetable climatology, landscape gardening, and arboriculture. One of the original members of the Edinburgh Botanical Society, founded in 1836, he was a voluminous writer in its *Transactions*; and in 1872 he was elected to the presidency of the society—a position rarely held by a practical gardener. In November of the following year Mr. M'Nab delivered his presidential address on "The Effects of Climate during the last Half-Century with Reference to the Cultivation of Plants in the Royal Botanic Garden of Edinburgh and elsewhere in Scotland," a paper which excited a good deal of discussion at the time, the writer having adduced facts with the view of showing that a change in our climate had taken place during the period in question. Mr. M'Nab also contributed to the Society a monthly report on thermometrical readings and progress of open-air vegetation in the Botanic Garden, which was highly valued, alike by horticulturists and meteorologists, for the practical information it conveyed. Prof. M'Nab, of the Royal College of Science, Dublin, is a son of the late Mr. M'Nab.

ON Friday a meeting of the local executive of the British Association was held at Sheffield to appoint committees to make the necessary preparations for the visit which commences on August 20 next year. The Master Cutler (Mr. W. H. Brittain) presided. It was stated that the guarantee fund now amounted to 3,338*l.*, and would eventually reach 5,000*l.* The Association, however, do not wish the expenses to exceed 1,500*l.*, or they fear that the expense of entertaining the Association will deter other towns from sending invitations. It is expected that at least 1,500 members and associates will attend the sittings. The necessary committees were appointed, and Mr. J. E. H. Gordon, who was present representing the Association, thanked the people of Sheffield for the splendid preparations they were making for the reception of the Association and for the hospitality which was already offered.

M. BARDOUX has appointed a great commission for the reorganisation of the Museum of Natural History of Paris. This famous institution is almost entirely deserted by students. The report describes all the transformations the Jardin des Plantes has undergone since it was taken out of the hands of the king's physician and entrusted to the care of a special director.

ALTHOUGH we are aware that the columns of NATURE are studied by a considerable number of readers in Australia, New Zealand, and Japan, it is with some pleasure that we find an extract, however incorrect, from one of our articles ("On Cleopatra's Needle and the Wind Pressure"), inserted in the *Bolton Evening News.* Before "A Constant Reader" (we presume of the *Evening News*) took the trouble to multiply out the supposed 80 lbs. to the *square inch*, obtaining the somewhat alarming result of 11,520 lbs. to the square foot for a wind pressure, it might have allayed his fears concerning his own *integrity* and that of the Manchester houses, if he had consulted the original article.

THE Dundee Naturalists' Society have just obtained possession of a very fine specimen of *Pterygotus anglicus*, which was found at Carmyllie Quarries some months ago, and has now been presented to the Society by Messrs. Duncan, Falconer, and Co., the lessees of the quarries. Only fragments of this animal have hitherto been found, and its general appearance has been shown by what are known as restorations; but the correctness of these has been doubted by many palæontologists. This specimen, which is on a slab of the well-known Carmyllie pavement, has from head to tail the segmental plates all intact, with the exception of about an inch of the telson, which is wanting. The length of the fossil is 4 feet 2 inches, and its widest segment 15 inches. The carapace or head plate measures 10 inches by 8, and the telson or terminal plate 8 inches by 7. The abdominal aspect is presented, and the curious arrow-shaped plate, "epistoma," is distinctly shown attached to the middle of the second abdominal segment. In many attempted restorations this plate is figured on the under side of the anterior portion of the carapace.

THE rich collection of insects of Dr. Moritz Isenschmied is bequeathed to the Natural History Museum of Bern, together with a sum of 3,200*l.* for the entomological part of the museum.

A SCIENTIFIC society has been formed at Berlin under the title "Freie Akademie, wissenschaftlicher Centralverein," with the object of propagating scientific knowledge in wider circles by means of lectures. The new society will begin its work in January, 1879. Herr Eberty, the syndic of Berlin, and Dr. Max Hirsch are its directors, and the number of members is rapidly increasing.

AT the instigation of the "Society for the History of the Lake of Constance and its Surroundings," the King of Würtemberg has requested the Statistical and Topographical Office of Stuttgart to undertake a complete investigation of the lake in question. It appears that the various depths of the different parts of the lake have not been measured since 1826. The new investigation will doubtless yield a number of highly interesting data.

AN excellent geological map of Germany has just been published by the Photolithographic Institute of F. Graaz at Leipzig. It is drawn by Prof. Hirschwald, of Berlin, after the relief of C. Raoz, and is specially intended for use at geological lectures.

THE *Times* of yesterday contains an account of Dr. Schliemann's further excavations on the site of Troy, the account being evidently condensed from several letters of the enthusiastic explorer. All Dr. Schliemann's previous conclusions seem to be confirmed, and his already large collections have been greatly added to. Fortunately for his sceptical critics, some of his discoveries have been made in the presence of several British naval officers stationed at Besika Bay. Among other things he has found a steel dagger, the first iron object found on the site, but perhaps the most curious find are "the billions" of shells of cockles and mussels "found in all the strata of the prehistoric *débris*," and said to be no longer found on the shores of the Hellespont and Ægean.

AT some excavations recently made at Heidelberg a Roman well and several milestones were discovered, the inscriptions upon the latter giving interesting details regarding the old Roman colony on the banks of the Neckar.

MR. A. R. WALLACE has reprinted from the *Fortnightly Review* his valuable paper "On Epping Forest and how best to deal with it." It proves how well qualified Mr. Wallace is to have the care of what remains of the once extensive forest.

MR. DE WALL, the *Polytechnic Review* states, has observed that when two electric sparks are simultaneously produced at the extremities of a short tube smoked inside, the two discharges give figures in the form of a black ring at the middle of the tube. When the sparks are not quite simultaneous, the ring is slightly displaced. It is suggested by the author that this observation may afford a method of determining the velocity of sound, and of the speed of propagation of electricity in a conductor.

PROF. PERSIFOR FRAZER reports, we learn from the *Polytechnic Review*, the interesting observation that early in last June he tried a telephone with a diaphragm mounted so as to vibrate freely except in the circular line, where it was bound fast. With several other telephones in circuit, but muffled so that they could not take up the direct vibrations of the voice, he found that the over-tones produced in the diaphragm of one telephone, by a musical note sung into the mouth-piece, were reproduced in the others. This shows the extreme minuteness of the motion necessary to produce sound by fluctuations in the transmitting power of the line wire.

WE are glad to se that the *Princetown Review*, hitherto known as a high-class theological journal, is enlarging its programme so as to include subjects of scientific interest. In the November number, for example, we have excellent papers on "The Rights and Duties of Science," by Principal Dawson; "Man's Place in Nature," by Prof. Le Conte; "Eclipses of the Sun," by Prof. Simon Newcomb; "The Recent Solar Eclipse," by Prof. Young; and "Physiological Metaphysics," by President Ponter. Besides these there are other good papers on a variety of non-theological subjects.

L'Electricité of November 20 contains a first paper by Count du Moncel, on Lacour's Phonic Wheel, and several important papers on Electric Lighting.

THE *Lancet* announces the publication, next week, of a special article, from the pen of Dr. Richardson, on the remains of Harvey. The author has recently visited the church at Hempstead, in Essex, where Harvey lies, and has had photographed all the important historical mementoes, copies of some of which will be reproduced in the *Lancet.* The publication is intended as a further contribution to the literature of the tercentenary year of the birth of the greatest and most original of English anatomists.

AT 6 o'clock on the evening of October 2 a severe earthquake was experienced in the village of Jucuapa and neighbouring towns, in the department of Usulutan, in the southern portion of the Republic of Salvador. Nearly all the houses in Jucuapa were destroyed and many families buried in the ruins, particularly in the outskirts of the town, where the means of escape were confined to narrow streets, and where the houses were not so solidly constructed as in the centre. The towns included in the disaster are Guadalupe, Nueva Guadalupe, Chinameca, Usulutan, the Caserio del Arenal, Santiago de Maria, which is entirely ruined and some lives lost, a condition in which are also found Tecapa, Triunfo, and San Buenaventura. The shock which produced the greatest damage was at first a kind of oscillatory movement which lasted over forty seconds, and terminated in what felt like a general upheaval of the earth, and was so violent that solid walls and arches and strongly braced roofs were broken and severed like pipe-stems. The movement proceeded from the south-west to the north-east. It was supposed to proceed from the volcano of Tecapa, which is reported as being in conflagration. The district which has been devastated is one of the most thickly settled portions of the country. The *Idea* of Santa Ana reports that apprehensions exist in the public mind that the volcano of Santa Ana is about to be in eruption, from the effects of which serious consequences are feared. The *Panama Star and Herald* is the authority for these statements.

A CORRESPONDENT of the *Pioneer*, writing from Mirzapore, calls attention to a phenomenon which he considers worth recording. Early one morning large quantities of fish of every description were seen coming to the surface along both banks of the river gasping and dying; all the crabs came out and hung in clusters to the clay, or lurked in the grass above the water level, and large eels, leaving the water, lay like snakes along the edge. The next day great numbers of fish, some of enormous size, floated past, and endeavours were made to induce the natives to bring them on shore for manure, but as their fathers had never employed fish for such a purpose, they declined to make such an innovation. The river was high, but not in full flood, and the water, probably on account of the long drought, was intensely and abnormally turbid. The death of the fish is attributed to this peculiarity, for the particles of earth held in suspense appear to have impregnated the gills and stopped breathing; it had not, however, been ascertained which of the affluents of the Ganges or Jumna had caused the mischief.

THE following method of measuring approximately the velocity of sound, devised by M. Bichat (*Journal de Physique*) is said to form a suitable lecture experiment. A white-iron tube, about 10 m. long is bent back on itself, so that the ends A and B are near each other. A is closed with a caoutchouc membrane; B has a stopper with glass tube which communicates, through a caoutchouc tube of a certain length, with one of M. Marey's manometric capsules. Near the end A is an aperture which, by means of another caoutchouc tube the same length as the former, communicates with another of Marey's capsules. These capsules are arranged before a blackened cylinder, the ends of their levers applied to it one over the other. A tuning-fork, giving 100 vibrations per second, inscribes these also in the same vertical line on the cylinder. All being ready a slight blow is given, with the hand or otherwise, to the membrane A, while an assistant turns the cylinder. The capsules register the point of departure and that of arrival, while the tuning-fork gives the time. Thus it is found that, between those two points, there are, *e.g.*, three vibrations of the tuning-fork, *i.e.*, about $\frac{3}{100}$ of a second have elapsed. The velocity of sound is inferred to be 333·3 m. per second. By means of two iron tubes placed one above the other the difference of the velocities of sound in air and hydrogen may be demonstrated, even though it may be difficult to keep the one tube filled with pure hydrogen.

AN historico-ethnographical exhibition has been opened at Winterthur (Switzerland), and the visitors are agreeably surprised by the large number and great variety of objects exhibited as well as by their artistic arrangement.

JAPANESE farmers appear to be determined not to be left behind by their fellow-countrymen in matters of progress, for we hear that in some parts they are growing wheat from foreign seed. On this subject a Nagasaki paper says:—"We have seen a magnificent specimen of wheat grown in Japan from American seed, than which nothing better could be desired, the flour produced from it being fully equal to any we have seen from America. Such a result speaks well for the prospects of Japan becoming, with proper cultivation, a profitable wheat-producing country."

A GERMAN engineer residing at Smyrna, Herr Karl Humann, who some time ago had undertaken some successful excavations at Berghama at his own expense (the ancient Pergamum in Asia Minor), has recently been commissioned by the German Government to continue these excavations, and has succeeded in bringing to light some highly interesting objects of art. The Porte has permitted the continuation of the excavations under the condition that only half the objects found shall become German property, while the other half will be retained at Constantinople.

IN the *Annual Report* of the Royal Botanic Garden, Calcutta, for the year 1877-78, Dr. King, the superintendent, draws attention to the want of proper accommodation for the herbarium, which now consists of ninety-three cabinets of dried plants, forming, as we are told, "the only large herbarium in India, containing authentic specimens from almost every Indian botanist from Heyne to Kurz, including excellent sets of Wallich's, and Hooker and Thomson's plants." Dr. King reports that of the seedlings of the Para rubber plant (*Hevea brasiliensis*) received at the beginning of last year, some were retained at Calcutta, while the others were sent to the Cinchona plantation in Sikkim. Several of the plants have died during the year, but those remaining at Calcutta are healthy, and have grown fairly well. Of the Ceara rubber plant (*Manihot glaziovi*), many of them were found to be dead on arrival; those that survived were divided between Calcutta and the Cinchona plantation, one of the plants is said to be ten feet high, and the others vary in height from two to five feet, but they all appear weak and lanky, as if the climate were too damp for them. Regarding the cultivation of vanilla in India, especially in the climate of Calcutta, Dr. King's experience confirms his first impression that "it is not worth while to go to any further expense in attempting to make a plantation of it, to be conducted on commercial principles." It is satisfactory to learn that ipecacuanha has been propagated largely; like vanilla, Dr. King is of opinion that it can never be grown successfully as a crop in any part of Bengal. The utilisation of new vegetable substances for paper-making, especially baobab bark and bamboo shoots, are fully considered by Dr. King, who expresses an opinion with regard to the former that, if the plant is "to be grown to a profit, it would be hardly feasible to give it cultivation, however rough, after the first year." Considering also the comparatively slow growth of the baobab, Dr. King says he is driven to the conclusion that it is not likely to afford in India a sufficiently cheap paper-fibre. He points out that a plant yielding an annual crop is much more likely to fulfil the financial conditions of success than any perennial like the baobab, which yields a crop only after many years. Regarding the use of the young shoots of bamboo for paper stock, which have been very favourably reported on by Mr. Routledge, Dr. King does not look upon it in any hopeful light. Of the so-called "Rain Tree," which has already been noticed in our columns, and referred to *Pithecolobium saman*, a number of good trees are growing in the Botanic Garden, Calcutta. One set consists of five trees, about eleven years old, and the other of eighty-four trees, planted in an avenue about four years ago. The tree is a very fast grower, and is said to be perfectly at home in the soil and climate of Lower Bengal. From its umbrageous habit and wide-spreading branches it is extremely valuable as a shade tree. The wood is soft and of little value except as firewood, and the pod is sweet, like that of the carob (*Ceratonia siliqua*), and may probably prove valuable as a food for cattle, for which purpose, indeed, these pods are used in the West Indies. For this reason, and not for that of gathering and dispersing moisture (for which the tree became momentarily celebrated), it is probable the tree may be generally planted.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. Theodore Beck; a Black-crested Cardinal (*Gubernatrix cristatella*), two Red-crested Cardinals (*Paroaria cucullata*) from South America, purchased; a Macaque Monkey (*Macacus cynomolgus*) from India, deposited; a Baker's Antelope (*Hippotragus bakeri*) from Nubia, received in exchange.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE proposals of the Cambridge Mathematical Studies Syndicate for completing the new scheme for the mathematical tripos have been carried. The following summary of the whole scheme of the mathematical tripos which will come into operation in the year 1882 is given in the *Times*. It will consist of three parts, the examination for each part occupying three days. The subjects of the first part are to be confined to the more elementary parts of pure mathematics and natural philosophy, the subjects to be treated without the use of the differential calculus and the methods of analytical geometry. The examination in Part II. will only be open to those who have passed Part I. so as to deserve mathematical honours, and the subjects are algebra, trigonometry, plane and spherical, theory of equations, the easier parts of analytical geometry, plane and solid, including curvature of curves and surfaces, differential and integral calculus, easier parts of differential equations, statics, including elementary propositions on attractions and potentials; hydrostatics, dynamics of a particle, easier parts of rigid dynamics, easier parts of optics and spherical astronomy. Those who pass this second part will be arranged as wranglers, senior optimes, and junior optimes in order of merit. Both the examinations in Parts I. and II. will take place in June. The examination in Part III. will be held in January, and be open only to those who are classed as wranglers. It will last three days. On the tenth day after the end of the examination in Part III. the moderators and examiners, taking into account the examination in that part only, shall publish in three divisions, each division arranged alphabetically, those examined and approved. The moderators and examiners may place in the first division any candidate who has shown eminent proficiency in any one group of the subjects in Schedule III.

THE *University College of Wales Magazine*, the first number of which lies before us, is a neat little publication of fifty-two pages, doing credit to the Oswestry press from which it issues, as well as to the enterprise of the Aberystwith Institution, and the ability of its members. We do not suppose its promoters expect a large general circulation, though there is no reason why the magazine might not be so conducted as to meet with considerable favour in the principality. Curiously enough, the first paper after the introduction is on Persian literature, while one on Welsh literature occupies the sixth place. There is a paper on Cambria at Paris, showing what a good appearance she made at the recent exhibition; a Welsh story, an Oxford letter, college news, &c. We wish the magazine success; and it might do good service by devoting itself to research in various directions in regard to Wales. We should like to see the science professors in this college fill up some of its pages.

THE First Annual Report of the Dulwich College Science Society is, on the whole, satisfactory; the appended lists, forming the bulk of the volume, show that the Society has several diligent collectors, and we hope it will continue to do genuine work and nourish in the scho l a lasting love of real science.

PROF. H. G. SEELEY completed on Friday at the College for Men and Women, 29, Queen Square, Bloomsbury, a course of six lectures on some of the principal forms of extinct animals which resemble reptiles and birds, and have no representatives now living. The subjects have been as follows:—Lecture I.—On the Geological Distribution of Fossil Reptiles and Birds; and concerning points in which Extinct Reptiles differ from those which now inhabit the Earth. Lecture II.—The Ichthyosaurians and Animals of the Open Ocean. Lecture III.—The Plesiosaurians and Animals of the Sea Shore. Lecture IV.—The Dinosaurians and Allied Types of Land Animals. Lecture V.—The Ornithosaurians and other Flying Types of Life. Lecture VI.—The Classification of Reptiles and Allied Fossil Animals, as illustrating some Aspects of the Doctrine of Evolution.

PROF. WURTZ was charged some time since by the French Minister of Public Instruction, to make an inquiry into the organisation of the laboratories and practical instruction given in the several universities of Germany and Austro-Hungary. Prof. Wurtz accordingly made several journeys to the great seats of learning in these two countries, and the *Journal Officiel* of last Saturday publishes at full length his report. Prof. Wurtz insists strongly on the danger of creating large establishments, where students are taught something of everything, and on the necessity of creating special foci for every large section of experimental science. He shows the advantage of special institutes, and insists upon the organisation of chemical, physical, physiological, anatomical, and pathological institutions such as flourish on the other side of the Rhine, and may be established in Alsace-Lorraine. He ends his report by describing the Munich Hygienic Institute.

THE French budget of Public Instruction has been voted *au pas acceleré*. The resolutions proposed by the Commission were voted without any material alterations. The estimates reach about 2,000,000*l*.

The University of Bern celebrated, on November 15, the forty-fourth anniversary of its foundation. It numbers among its students, about twenty ladies, mostly Russians, who study medicine.

ACCORDING to a new law, all children who finish their education in any school of the Canton of Bern are submitted to an examination. This year 4,610 boys and 4,446 girls were examined (total population of the Canton 537,000), and the results proved unsatisfactory. The Canton continues to occupy the eighteenth and twenty-first places in the Cantons of the Swiss confederation.

A WEALTHY Serbian, Ilija Milosavljewitch Kolaraz, who died a month ago at the ripe age of eighty-two, has left the sum of 100,000 ducats for educational purposes, 10,000 ducats for the publishing of valuable works in the Serbian language, and 60,000 ducats for the foundation of a Serbian university at Belgrade, which is to be known as Kolaraz' University.

SCIENTIFIC SERIALS

Journal of Anatomy and Physiology, July, 1878.—Dr. Ogston, of Aberdeen, gives an account of the growth and maintenance of the articular ends of adult bones. He believes that the articular cartilage produces the osseous tissue beneath it, forms the epiphyses, supplies their waste, and maintains them in their proper size and bulk during adult life.—Prof. Cleland describes the brain in cyclopians or one-eyed monsters, including specimens of human kind, dogs, lambs, and pigs. He finds that there is no trace of a retina in the cyclopian eyeball, and that moreover there is an arrest of the development of the first cerebral vesicle.—Dr. Creighton gives an exhaustive account of the formation of the placenta in the guinea-pig, and refers very prominently to its early development in connection with the structure of the ovaries and supra-renal bodies.—Prof. Turner contributes notes on the fœtal membranes of the reindeer, and on the oviducts of the Greenland shark.—Mr. David Newman's paper on the functions of the kidney gives an account of the physical influences which promote secretion, so far as can be demonstrated by experiments with animal membranes and the kidneys of animals recently killed.—Dr. Dodds' historical and critical analysis of our knowledge upon the localisation of the functions of the brain deals with the anatomy of the brain in this number.

October.—Dr. Cunningham, of Edinburgh, gives his deductions on the intrinsic muscles of the mammalian foot, derived from a large number of dissections; and further describes the muscles of the foot of cuscus and thylacine.—Prof. Miall and Mr. Greenwood conclude their valuable memoir on the anatomy of the Indian elephant, dealing with the alimentary canal and its appendages, and the other abdominal and thoracic viscera. —Dr. Creighton publishes his observations on the supra-renal bodies based on microscopical investigations of these organs when adult and during development, and shows how they present many features of analogy to the ovaries.—Prof. Humphry gives his reasons for dissent from Dr. Ogston's views on the important share taken by articular cartilage in the growth of bone, as expressed in the July number of the *Journal*.—Prof. Turner describes the placentation of the hog-deer (*Cervus porcinus*).—Dr. Urban Pritchard supplements his previous accounts of the development of the organ of Corti in the internal ear.—Dr. T. B. Henderson, of Glasgow, describes the physiological effects of the inhalation of phosphuretted hydrogen.

Journal de Physique, October.—In this number Prof. Dufet studies the variation of the indices of refraction in mixtures of isomorphous salts, arriving at the experimental law that the differences between the indices of a mixture of two such salts and those of the component salts are in inverse ratio of the numbers of equivalents of the two salts forming the mixture; in other terms the curve which has for ordinates the indices and for abscissæ the equivalents, is a straight line. This law is regarded as a consequence of Gladstone's, on the constancy of specific *refractive energy* in mixtures.—M. Terquem describes an improved way of realising Plateau's liquid laminar systems, giving larger systems with less liquid. Instead of using pieces all rigid, he uses a combination of rigid pieces with flexible threads (silk), *e.g.*, two horizontal rods joined together at the ends with such threads or two rings joined with threads. Many instructive effects are thus had. The liquid used is a solution of soap and sugar, prepared in a special way.—M. Bouty contributes a mathematical paper on the number of elements necessary for determining the exterior effect of an optical system, and M. Bichat gives a new method of measuring the velocity of sound.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 21.—"On Repulsion resulting from Radiation." Part VI., by William Crookes, F.R.S., V.P.C.S.

In this part, with which the research closes, the author first examines the action of thin mica screens fixed on the fly of an ordinary radiometer, in modifying the movements. It is found that when a disk of thin clear mica is attached 1 millim. in front of the blacked side of the vanes of an ordinary radiometer, the fly moves negatively, the black side approaching instead of retreating from the light. When a thin mica disk is fixed on each side of the vanes of a radiometer, the result is an almost total loss of sensitiveness.

In order to examine the action of screens still further an instrument is described having the screens movable, and working on a pivot independent of the one carrying the fly, so that the screens can move freely and come close either to the black or to the white surfaces of the disks. By gentle tapping the screens can be brought within 2 millims. of the black surfaces. A candle is now brought near, shaded so that the light has to pass through one of the clear disks and fall on the black surface. The black side immediately retreats, the clear disk remaining stationary for a moment, and then approaching the light. If the candle is allowed to shine on the plain side of the black disk, no immediate movement takes place. Very soon, however, both disks move in the same direction away from the candle, the speed of the clear disk gradually increasing over that of the blacked disk.

Instead of allowing the clear screens to freely move on a pivot, an instrument was made in which the screens could be fixed beforehand in any desired position in respect to the blacked disk. It was then found that with the screens close to the blacked sides of the vanes the fly rotates very slowly in the negative direction, stopping altogether when the candle is moved five or six inches off. With the screens 1 millim. from the black surface the direction is negative, and the speed at its maximum. When the screens and disks are 7 millims. apart a position of neutrality is attained, no movement taking place. When the distance is further increased, positive rotation commences, which gets stronger as the screens approach the bright sides of the disks, where the positive rotation is at its maximum. The author adduces reasons for considering that the negative rotations here observed are caused by the warming up of the black surface by radiation falling direct on it, through the clear mica screen, and the deflection backwards of the lines of molecular pressure thereby generated.

The action of these radiometers being complicated, owing to the surfaces of the vanes being different in absorptive power, another instrument was made in which the vanes were of polished aluminium, perfectly flat and symmetrical with the bulb. The screens were of clear mica movable in respect to the vanes, and at right angles to their surface. When exposed to the light of a candle it was found that with the screens brought up close to the disks, the rotation was as if the unscreened side were repelled; at an intermediate position there was neutrality. Explanations are given of these movements, but without the illustrative cuts they would be unintelligible.

Experiments on radiometers having movable screens interposed between the vanes and the bulb are next given, and these are followed by a long series of experiments on the influence of movable screens on radiometers with cup-shaped metallic vanes, the screens being varied in shape and position in respect to the plane of rotation, as well as in respect to the distance from the vanes.

A similar series is given with metallic cylinders as vanes, and from the behaviour of the latter kind of radiometer an explanation is given of the various movements previously obtained. It is found that when the screen touches the convex surface of the vanes the rotation under the influence of light is always positive. It commences at a low exhaustion, increases in speed till the rarefaction is so high that an ordinary radiometer would begin to lose sensitiveness, and afterwards remains at about the same speed up to the highest rarefaction yet obtained. At any rarefaction after 87 M (millionths of an atmosphere) there is a neutral position for the screen. When it is on the concave side of this neutral position the direction of rotation is positive, and when on the convex side of the neutral position it is negative; the speed of rotation is greater as the vanes are further removed from this neutral position on either side. The position of this neutral point varies with the degree of exhaustion; thus at 12 M the screens must be 3 millims. from the convex side; at ·18 M they must be 13 millims. from the convex side. The higher the exhaustion the greater the distance which must separate the convex side of the hemi-cylinders and the screens.

The author gives explanations of these phenomena based on the following already ascertained facts:—When thin aluminium vanes are exposed to light the metal rises in temperature and becomes equally warm throughout, and a layer of molecular pressure is generated on its surface. The thickness of this layer of pressure, or the length of the lines of force of repulsion varies with the degree of exhaustion, being longer as the exhaustion increases. The lines of force appear to radiate from the metal in a direction normal to its surface. The force of repulsion is also greater the closer the repelled body is to the generating or driving surface, and the force diminishes rapidly as the distance increases, according to a law which does not appear to be that of "inverse squares." Diagrams are given illustrating the author's explanation based on the above data.

An apparatus is next described not differing in principle from the last, but having, in addition to the aluminium hemi-cylinder and movable mica screen, a small rotating fly made of clear mica, mounted in such a way that it could be fixed by means of an exterior magnet in any desired position inside the bulb. The screen was also capable of adjustment by means of another magnet; the aluminium hemi-cylinder in this apparatus being fixed immovably. The adjustible indicator being very small in diameter in comparison to the other parts of the apparatus, and, being easily placed in any part of the bulb, was expected to afford information as to the intensity and direction of the lines of pressure when a candle was brought near the bulb. Experiments have been tried, *a*, with the screen in different positions in respect to the hemi-cylinder; *b*, with the indicator in different parts of the bulb; *c*, with the candle at different distances from the hemi-cylinder on one side or the other; *d*, with the degree of exhaustion varying between wide limits. It would be impossible to give an intelligible abstract of the results obtained with this apparatus without numerous diagrams It may, however, be briefly stated that they entirely corroborate the theories formed from a study of the behaviour of the instruments previously described.

The next part of the paper treats of the action of heat employed inside the radiometer. In a previous paper the author showed that phenomena feeble and contradictory when caused by radiation external to the bulb, became vigorous and uniform when the radiation was applied internally by the agency of an electrically-heated wire. It was hoped that some of the more obscure phenomena shown by the deep cups with movable screens in front (referred to above) might be intensified if set in action by a hot wire. Several inds of apparatus and experiments with them are described, but the results are too complicated to be given in abstract. One experiment proves that the direction of pressure is not wholly normal to the surface on which it is generated, but that some of it is tangential.

The author then describes the turbine radiometer, early specimens of which were exhibited before the Royal Society on April 5, 1876. In the ordinary form of radiometer the number of disks constituting the fly is limited to six or eight, a greater number causing interference one with the other and obstruction of the incident light. In the turbine form of fly there is no such difficulty, the number of vanes may be considerably increased without overcrowding, and with corresponding advantage. In the earlier turbine radiometers the flies were made of mica blacked on both sides, and inclined at an angle like the sails of a windmill, instead of being in a vertical plane. This form of instrument is not sensitive to horizontal radiation, but moves readily in one or other direction to a candle held above or below. A vertical light falling on the fly gives the strongest action, but rotation takes place, whatever be the incident angle, provided the light is caught by one surface more than by the other. Ether dropped on the top of the bulb to chill it causes rapid negative rotation. If the turbine radiometer is floated in a vessel of ice-cold water, and the upper portion exposed to the air of a warm room, it rotates rapidly in the positive direction, acting as a heat engine, and continuing so to act until the rotating fly has equalised the temperature of the upper and lower portions of the bulb. By reversing the circle of operations—by floating the turbine radiometer in hot water and cooling the upper portion of the bulb—the fly instantly rotates in the negative direction.

After describing experiments in which the same fly was made to rotate first in a large bulb and then in a small one at the same degree of exhaustion, the author proceeds to discuss the influence exerted by the inner side of the glass case of the radiometer as a reacting surface. A flat metal band was put equatorially inside a radiometer, and lamp-blacked, so that the molecular pressure generated under the influence of light should react between the fly and the black band, instead of between the fly and the glass side of the bulb. It was found that the maximum speed with the band present was 40 revolutions a minute, against 8¼ revolutions when the band was absent.

The rotation of the case of a radiometer, the fly being held immovable by magnetism, is next described. A preliminary note on this subject having already appeared in the *Proceedings*,[1] it need not be again described in detail. Many different forms of instrument for effecting this rotation are described, and their mode of action explained.

The reacting inner surface of the envelope being thus proved to be essential to the rotation of the fly, other instruments were made in which this necessary reaction is obtained in a more direct manner. In one, the radiometer is furnished with a fly carrying four flat aluminium vanes, polished on both sides. Three vertical partitions of thin clear mica are fixed in the bulb, with their planes not passing through the axis of rotation, but inclined to it, thus throwing the obliquity off the fly on to the case, and giving three fixed planes for the reaction to take place against. Candles arranged symmetrically round the bulb make the fly rotate rapidly against the edges of the inclined planes. Breathing gently on the bulb gives negative rotation. A hot glass shade inverted over the instrument causes strong negative rotation, changing to positive on cooling. When the fly is furnished with clear mica or with silver flake mica vanes, the same results are obtained as when aluminium vanes are employed. The principal action is produced by dark heat warming the bulb, screens, and vanes.

The *otheoscope* is the next subject treated on in the paper. This has already been given in abstract,[2] and need not be again referred to. Many different varieties of otheoscope are figured and described.

It was suggested by Prof. Stokes that a disk might be made to revolve on its axis, and the author describes an instrument in which this suggestion is carried out. The disk is horizontal, mounted like the fly of a radiometer, and for lightness' sake is of mica, blacked above. Fixed to the bulb above the disk are four flat pieces of clear mica; each extends from the side of the bulb to near the centre, and ends below in a straight horizontal edge, leaving just space enough for the disk to revolve without risk of scraping. The edge is in a radial direction, and the plane of the plates is inclined about 45° to the horizon in the same direction for them all. Exposed to the light of a candle the rotation is against the edge. By slightly modifying this form the instrument becomes much more sensitive.

Whilst experimenting with the otheoscope it was found that, for a given exhaustion, the nearer the reacting surfaces were together the greater was the speed obtained. In the *Proceedings* of the Royal Society for November, 1876,[1] the author described an apparatus by which he was able to measure the thickness of the layer of molecular pressure generated when radiation impinged on a blackened surface inclosed in an atmosphere the rarefaction of which could be varied at will.

It was found that in this apparatus repulsion could be obtained at ordinary atmospheric pressures. Observations are given at normal pressure and at various degrees of rarefaction, with the driving and moving surfaces separated 1, 2, 3, 4, 6, 8, and 12 millims.; and diagrams of the resulting curves are shown when the atmospheric tension and the force of repulsion are used as abscissæ and ordinates. The tables and curves show that the law of increase of the force with the diminution of the distance between the disks does not remain uniform at all rarefactions. At the lowest exhaustions the mean path of the molecules of the attenuated gas is less than 1 millim., as rendered evident by the force of repulsion diminishing rapidly as the distance increases. At exhaustions higher than 9 millims. this condition alters, and as the gauge approaches barometric height the molecular pressure tends to become uniform through considerable distances, the mean path of the molecules now being comparable with the greatest distance separating the surfaces between which they act.

A similar apparatus to the one in which the last experiments were tried was used to measure the action at pressures at and approaching atmospheric. At pressures between atmospheric and 210 millims. the first action is very faint repulsion, immediately followed by strong attraction. The attraction then begins to decline, until, at 15 millims. pressure, it disappears. At the same time the repulsion, which begins to be apparent at 250 millims., increases as the attraction diminishes. The author considers that the attraction is the result of air-currents, caused by the permanent heating of the surface in front of the movable disk.

The paper concludes with experiments undertaken to measure the amount of repulsion, using a horizontal torsion balance,[2] on the principle of Ritchie's, in which the force of repulsion is balanced by the torsion of a fine glass fibre. The *pan* of the balance is a clear mica disk, and a similar disk is fastened to the tube in which the beam oscillates. This fixed disk is lamp-blacked on the upper side, and beneath is a spiral of platinum wire, connected with terminals sealed through the side of the tube. When the spiral is ignited by a constant electric current the blacked mica disk fixed above it becomes heated, and the molecular pressure thereby generated between it and the mica pan causes the latter to rise. The glass thread attached to the beam is thus twisted, and by means of a graduated circle the number of degrees through which the thread has to be turned in order to bring the beam back to equilibrium is noted. This gives a measurement of the pressure exerted, in torsional degrees, and these are converted into grains by ascertaining how many torsional degrees correspond to a known weight. A ray of light reflected from a mirror in the centre of the beam is used as an index, being brought back to zero at each experiment. The author gives in a table, and also shows in the form of a curve, the results obtained with this apparatus, giving the force of molecular pressure in grains weight at exhaustions varying between 2,237 and 0·7 millionths of an atmosphere.

Mathematical Society, November 14.—Lord Rayleigh, F.R.S., in the chair.—The Treasurer's and Secretaries' reports having been read and adopted, Prof. W. G. Adams, F.R.S., consented to act as auditor.—The scrutators declared the following gentlemen elected as the Council for the ensuing session, viz., Mr. C. W. Merrifield, F.R.S., President; Prof. Cayley,

[1] *Proc.* Roy. Soc., No. 168, March 30, 1876.
[2] *Proc.* Roy. Soc., No. 180, April 26, 1877.

[1] *Proc.* Roy. Soc., No. 175, vol. xxv. p. 310.
[2] For a description of this form of torsion balance, see the author's paper, *Phil. Trans.*, 1876, vol. clxvi. pt. 2, p. 371.

F.R.S., and Lord Rayleigh, F.R.S., Vice-Presidents; Mr. S. Roberts, F.R.S., Treasurer; Messrs. M. Jenkins and R. Tucker, Hon. Secretaries. Other Members: Mr. J. W. L. Glaisher, F.R.S., Mr. H. Hart, Dr. Henrici, F.R.S., Dr. Hirst, F.R.S., Dr. Hopkinson, F.R.S., Mr. A. B. Kempe, Dr. Spottiswoode, F.R.S., Prof. H. J. S. Smith, F.R.S., Mr. H. M. Taylor, and Mr. J. J. Walker.—Mr. Merrifield having taken the chair, Mr. J. D. H. Dickson was elected a Member, and Prof. W. S. Jevons, F.R.S., was proposed for election. The Rev. A. Freeman and Prof. Reinold were admitted into the Society.—The Chairman read a letter from Mr. Warren de la Rue, F.R.S., respecting a memorial to M. Leverrier.—The following communications were made to the Society:—On the instability of jets, by Lord Rayleigh.—On self-strained frames of six joints, by Prof. Crofton, F.R.S. (read by Mr. Hart).—On equivalent statements, iii., by Mr. H. McColl (abstract, read by Mr. Tucker).—The last paper contained a solution of a test problem to show the power of the author's method of elimination; then, an explanation, with illustrations and applications, of another allied method, called the "method of unit and zero substitution;" thirdly, a brief indication of the way in which this algebra of logic may render important service to scientific men in investigating the causes of natural phenomena; and lastly, a brief criticism of Prof. Jevons's method of solving logical problems.

Linnean Society, November 21.—Dr. Gwyn Jeffreys, F.R.S., vice-president, in the chair.—Dr. W. P. Kesteven exhibited, and a short note was read on some specimens of the so-called *Tête anglais* (*Melocactus communis*) from Vieuxfort, St. Lucia. There also was exhibited roots, tendrils, and tubers in different stages of *Vitis gongylodes* and *V. cuspidata*, illustrating the paper immediately thereafter read, viz.: On branch tubers and tendrils of *Vitis gongylodes*, by Mr. R. Irwin Lynch. Subterraneous tubers are by no means rare among plants, *e.g.*, the potato, but in contrast those of *V. gongylodes* present on the stem are aerial, at a height, and on dropping to the ground strike root. Cylindrical, of considerable size, and tenacious of life, they doubtless are a safeguard in propagation of the plant under circumstances prejudicial to the seed. The tendril possesses terminal adhesive disks, and these are formed without the stimulus of contact with any substance, therefore opposed to certain other climbers mentioned by Mr. Chas. Darwin. The aerial roots are of great length, eleven feet and more, they spring from each node, and are of a rich crimson colour in summer, so that they are attractive objects as seen in the Victoria House at Kew.—Report on the Mollusca of the *Challenger* expedition, by the Rev. R. Boog Watson. After introductory remarks, the author describes three genera of the Solenoconchia. Of these *Dentalium* has eighteen species, eleven being new. *Siphodentalium* has seven species, all new to science. Of *Cadulus* two only are already known, nine species and one variety being now recorded for the first time. In all, thirty-six species and four varieties, whereof twenty species were hitherto unknown. Some are of high interest, inasmuch as being remnants of genera now living which have existed since the cretaceous epoch.—The Secretary read the abstract of a paper by Mr. John Miers, on the Symplocaceæ. The author gives credit to Mr. Bentham for the earliest accurate knowledge of the group. The authors of the "Genera Plantarum" recently adopted the example of Prof. A. De Candolle, who regarded the Symplocaceæ as a mere tribe of the Styraceæ. This appears objectionable to Mr. Miers, who, with historical remarks, &c., gives grounds for his adverse opinion. Then follows a synopsis of, to him, eleven recognisable genera, with diagnoses of same, and lists of 125 species.—On the Algæ of Lake Nyassa, by Prof. Dickie, a brief communication, wherein he mentions being indebted to Dr. Laws, of the Livingstonia mission, for the collection. All the genera of the Algæ are known European forms, while the Diatomaceæ, with few exceptions, are likewise widely-diffused species, the only peculiar form being *Epithemia clavata*.—Messrs. Thos. Davidson, F.R.S., and Fred. Jas. Faraday, were elected Fellows of the Society.

Chemical Society, November 21.—R. Warington in the chair.—The following papers were read:—A chemical study of vegetable albinism, by Prof. Church. The author has made numerous analyses of white and green leaves of the same age from the same plant, in order to discover whether any difference in their composition could be detected. The leaves were gathered from the maple, the holly, the ivy, and three exotic plants. White leaves contain more water than corresponding green leaves, whilst the ash of white leaves contains more potash and phosphoric acid, but less lime, especially less oxalate and carbonate of calcium. Nearly sixty per cent. of nitrogen in the white leaves is non-albumenoid, while the green leaves contain thirty per cent. of nitrogen in that state. The author has also analysed a vegetable parasite, the dodder, and its host, the red clover; he finds that the white leaves resemble in composition the parasite, while the host represents the green leaves. The white leaf is therefore, in a sense, a parasite on the green leaf, and owes its existence to its connection with the normal portion of the plant.—Relation between the melting-points of the elements and their coefficients of expansion, by Dr. Carnelly. The author finds that, of thirty-one elements, twenty-six show that the coefficient of expansion increases as the melting-point diminishes; the five exceptions are arsenic, antimony, bismuth, tellurium, and tin.—A preliminary notice on a hydride of boron, by F. Jones. The author succeeded in preparing a grey friable mass of magnesium boride by strongly heating a mixture of magnesium dust and boron trioxide. On heating this mass with hydrochloric acid, a colourless gas was evolved, spontaneously inflammable, burning with a green flame, and of disagreeable odour.

Zoological Society, November 19.—Mr. A. Grote, vice-president, in the chair.—Mr. Sclater exhibited and made remarks on an adult specimen, in full plumage, of the black-throated stonechat (*Saxicola stapazina*), which had been obtained in Lancashire, and had been sent for exhibition by Mr. R. Davenport. The species had not been previously recorded as occurring in the British Isles, and was an interesting addition to the list of "Accidental Visitors."—The Secretary read two letters he had received from Dr. A. B. Meyer and Mr. A. D. Bartlett in reference to the communication read at the last meeting from Mr. Everett respecting the supposed existence of the anoa (*Anoa depressicornis*) in the Philippines.—Prof. Owen, C.B., read a memoir on the relative positions to their constructors of the chambered shells of cephalopods.—Sir Victor Brooke, Bart., read a paper on the classification of the Cervidæ, and gave a synoptical list of the existing species of this family. —A second paper by Sir V. Brooke contained the description of a new species of gazelle from Eastern Africa, which the author proposed to name *Gazella walleri*, after its discoverer, Mr. Gerald Waller.—Prof. A. H. Garrod, F.R.S., read a paper on the anatomy of *Indicator major*, and showed that, as regards its soft parts, as in its osteology, *Indicator* is not related to the cuckoos, but to the barbets and toucans.—A communication was read from the Marquis of Tweeddale, F.R.S., containing the eleventh of his contributions to the ornithology of the Philippines. The present paper gave an account of the collection made by Mr. A. H. Everett at Zamboanga, in the Island of Mindando. Ninety-eight species were obtained in this locality by Mr. Everett, of which eleven were new to the Philippine fauna and six were new to science.—Mr. E. R. Alston read some notes supplementary to his paper on the squirrels of the neotropical region.

Entomological Society, November 6.—Mr. H. W. Bates, F.L.S., F.Z.S., president, in the chair.—Mr. Waterhouse exhibited a specimen of *Chauliognathus excellens* (*Telephoridæ*), a new beetle from New Granada.—Mr. H. T. Stainton exhibited a new horn-feeding *Tinea* (*T. orientalis*), which had been reared by Mr. Simmons, of Poplar.—The Rev. H. L. Gorham exhibited some rare British beetles, taken in the neighbourhood of Horsham, Sussex.—Mr. Goss exhibited specimens of a rare dragon fly (*Cordulia curtisi*) from Christchurch, Hampshire.—Mr. Meldola exhibited a male specimen of the moth *Erebus odorus*, from Jamaica, possessing large tufts or brushes on the hind leg, which were considered as probably scent-secreting organs.—Prof. Wood Mason exhibited drawings and made remarks on the flower simulating *Mantidæ*.—Mrs. Randolph Clay exhibited a living specimen of a beetle (*Zopherus bremêi*), from Yucatan, worn as an ornament.—Sir Sydney Saunders exhibited specimens of *Blastophaga psenes* (Linn.), employed in the process of cuprification, received from Mr. J. Lichtenstein, of Montpellier.—Also specimens of *Sycophaga crassipes*, West., from the sycamore figs of Egypt, together with certain apterous associates.—The Secretary read a communication from the Board of Trade with reference to the damage done to the corn crops in the neighbourhood of Mariapol by swarms of the beetle *Anisoplia Austriaca*.—A sub-committee was appointed to draw up a report on the same. —Miss E. A. Ormerod read a paper on *Psila rosæ*, the well-known insect producing the so-called "rust" in carrot crops.

She advocated the use of a phenol preparation for the destruction of this pest.—Mr. C. O. Waterhouse read a paper containing descriptions of new *Telephoridæ* from Central and South America.—Sir Sydney Saunders communicated a paper on the habits and affinities of *Sycophaga* and *Apocrypta* from the sycamore figs of Egypt.—Mr. Distant communicated descriptions of new species of Hemiptera-Homoptera.

Geological Society, November 6.—Henry Clifton Sorby, F.R.S., president, in the chair.—Arthur Goodger, Rev. Walter Howchin, Lieut.-Col. C. A. McMahon, Oswald Milton Prouse, and M. G. Stuart, were elected Fellows of the Society.—The following communications were read:—On the range of the mammoth in space and time, by Prof. W. Boyd Dawkins, F.R.S. The author expressed his opinion that the result of the evidence collected since the death of Dr. Falconer has been to establish the view of that palæontologist as to the mammoth having appeared in Britain before the glacial epoch. The evidence as to the occurrence of the mammoth in the south of England was first examined. The remains found beneath the bed of erratics near Pagham belonged, not to *Elephas primigenius*, but to *E. antiquus*. But in 1858 remains belonging to the former were found by Prof. Prestwich under boulder-clay in Hertfordshire. In Scotland remains of *E. primigenius* have been found under boulder-clay, but whether under the oldest boulder-clay is uncertain. In 1878 a portion of a molar was brought up from a depth of sixty-five feet near Northwich. It was in a sand beneath boulder-clay, which the author considered to be undoubtedly the older boulder-clay. The author now assents to Dr. Falconer's opinion (which he formerly doubted) that *E. primigenius* was a member of the Cromer forest-bed fauna. It is also clear that it was living in the southern and central parts of England in post-glacial times. It has not been found north of Yorkshire on the east and Holyhead on the west, probably because Scotland and north-west England were long occupied by glaciers. Its remains have been found on the continent as far south as Naples and as far north as Hamburg, but not in Scandinavia. Its remains, as is well known, abound in Siberia, and it ranged over North America from Eschscholtz Bay to the Isthmus of Darien, *E. columbi*, *E. americanus*, and *E. Jacksoni* being only varieties. The author then discussed the relations of *E. primigenius* to *E. columbi*, *E. armeniacus*, and *E. indicus*, and came to the conclusion that it is the ancestor of the last.—The mammoth in Siberia, by H. H. Howorth, F.S.A. Communicated by J. Evans, LL.D., F.R.S. The author discussed the theories which account for their presence:—1. That the animals lived much further south, and were carried down by rivers to where they now lie; 2. That they lived on the spot. As there are physical difficulties in the way of the transport theory, as the mammoth was covered with dense hair and fed on plants growing on the spot, and as the remains are not confined to the vicinity of rivers, it is probable that the second view is the correct one. It seems probable that the climate of Siberia has become more severe. The author considered the cause of the mammoth's extinction. This he held to have been sudden. The remains must have been preserved after death. He therefore maintains that they were destroyed by a flood due to some sudden convulsion which also changed the climate.—On the association of dwarf crocodiles *Nannosuchus* and *Theriosuchus pusillus*, *e.g.*) with the diminutive mammals of the Purbeck series, by Prof. R. Owen, C.B., F.R.S. The author noticed an objection which had been raised to his view of the origin of the differences between the mesozoic and neozoic crocodiles by the adaptation of the latter to the destruction by drowning of large mammalia (*Q. J. G. S.*, xxxiv. p. 422), namely, that mammals were coexistent with the mesozoic forms, and remarked that from their small size they would hardly constitute a suitable prey for the crocodiles to which he then specially referred, but would be more likely to perform the same part as the ichneumons of the present day, which check the increase of crocodiles by destroying their eggs and newly-hatched young. He stated, however, that in waste slabs of "feather-bed" marl which accompanied the Becklesian Purbeck Collection to the British Museum, the remains of small crocodiles were detected in considerable abundance; and he gave a description of these, and especially of one which he named *Theriosuchus pusillus*. This reptile, which is estimated to have been about eighteen inches long, had scutes presenting the "peg and groove" character of those of *Goniopholis*, with which genus it further agreed by having the antorbital part of the skull of the broad-faced alligator type. In the dentition it resembled the triassic theriodonts more than any other crocodiles. The vertebræ are amphiplatyan. In conclusion, the author indicated the conditions which have to be fulfilled in the case of recent crocodiles to enable them to drown a large mammal without inconvenience to themselves, and showed that these conditions were realised also in the neozoic forms, whilst there was no reason to suppose that any mesozoic crocodiles possessed the adaptations in question.

Anthropological Institute, November 12.—Mr. John Evans, D.C.L., LL.D., F.R.S., president, in the chair.—The following new Members were announced:—Mr. M. J. Gabriel, and Mr. George H. Radford.—Mr. Robert Cust read a report on anthropological proceedings at the Oriental Congress, in which he gave a digest of all the papers and discussions at that Congress which appertained to the science of anthropology.—Mr. Park Harrison read a paper on some characters which are still in use as tattoo-marks by the Motu, a people located in the South-Eastern Peninsula of New Guinea, and described by the Rev. Dr. Turner as a superior race to the Papuans, from whom they differ both in colour and customs. About half of the more distinctive forms tattooed on a Motu girl, carefully copied by Dr. Turner, correspond with letters in the Asoka inscriptions in India, which are believed to be allied to Phœnician, whilst several others resemble letters admittedly derived from the same stock, but independently acquired. The marks are mostly arranged in groups of three; on the right arm, however, nine or ten are apparently connected by a line running above them all. The characters are twenty-three in number, and are formed of straight lines in the following combinations; viz., five of 2 lines, nine of 3 lines, five of 4 lines, and three of 5 lines, much in the same proportion as in the Rejang and Lampong alphabets of Sumatra, the letters of the former of which have been shown to be identical with Phœnician characters *reversed*. Archaic forms of letters have also been met with in several islands of the Indian Archipelago and Melanesia, but are now without meaning. The Motu characters are used simply for ornament or as charms. As an example of the use of letters for tattoo-marks, the case of the Austrian subject was cited, who, having been taken prisoners in Burmah, a few years ago, was there tattooed with letters and other patterns. Besides the characters on the Motu girl, there were various pictures, or hieroglyphics, consisting of eyes and eyebrows, a lunar crescent, and other forms.

Meteorological Society, November 20.—Mr. C. Greaves, F.G.S., president, in the chair.—Rev. T. L. Almond, Rev. T. C. Beasley, F. T. Bircham, H. F. Blanford, G. Chatterton, E. Easton, W. L. Fox, G. F. Lyster, Lieut.-Col. W. Stuart, R. Tennent, and H. Yool were elected Fellows of the Society.—The following papers were read:—Report on the phenological observations for 1878, by the Rev. T. A. Preston, M.A.—Upbank thaws, by the Rev. Fenwick W. Stow, M.A.—Comparison of thermometric observations made on board ship, by Capt. H. Toynbee, F.R.A.S.

PARIS

Academy of Sciences, November 11.—M. Fizeau in the chair.—M. Loewy presented a memoir by M. Stephan and himself, on determination of the two difference of longitude, Paris-Marseilles and Algiers-Marseilles. He remarked, on the difference of velocity in transmission of signals through air and under water, that this velocity was found about 36,000 kilom. per second in the former case and 4,000 kilom. in the latter, numbers agreeing closely with those got lately by Dr. Albrecht, in Prussia, from shorter lines.—On the vision of colours, &c., second extract from work by M. Chevreul.—On the dilatation of heated bodies and the pressures they exercise, by M. de Saint Venant.—On the energy of a body and its specific heat, by M. Clausius.—Report on a memoir of M. Popoff, entitled, "New Researches relative to Expression of the Conditions of Motion of Water in Sewers." This shows the necessity of new formulæ, involving either change of known numerical coefficients or consideration of the movement as being generally varied. Several problems are enunciated as needing solution.—On measurement of the magnifying power in optical instruments, by M. Govi. It is inexact to say such and such a lens or microscope magnifies a certain number of times the image of objects, while it is not added at what distance the image must be for this magnification to take place. The distance of distinct vision is variable.—On the possibility of obtaining, with protoxide of nitrogen, an insensibility of long duration, and on the harmlessness of this anæsthetic, by M.

Bert. He recommends putting patients in an apparatus with the pressure raised to two atmospheres, and making them breathe a mixture of 50 per cent. protoxide of nitrogen and 50 per cent. air; thus long anæsthesia is had, while the normal quantity of oxygen is kept up in the blood.—Observations on M. Levy's memoir on a universal law relating to the dilatation of bodies, by M. Massieu.—On the transformation of linear forms of prime numbers into quadratic forms, by M. Oltramare.—Artificial crystallisation of orthose, by M. Meunier. The author obtained this (which MM. Fouqué and Levy are now seeking to effect) some years ago, by devitrification of the vitreous masses called retinites.—New process for application of galvanoplasty to conservation of nervous centres, by M. Oré. A hardened brain is dipped in fused gutta percha, and the gutta percha, on hardening, is divided and separated, forming a mould; this is lined with black lead and put in a nickelising bath; thus a hollow piece is had faithfully reproducing the brain.—Resistance of some wild types of American vines to phylloxera, by M. Millardet.—On the reduction of certain differential equations of the first order to linear form with reference to derivatives of the unknown function, by M. Halphen.—On the form of integrals of differential equations in the neighbourhood of certain critical points, by M. Picard.—On the theory of machines of the Gramme order, by M. Breguet. To obtain the best possible effect from a system formed by a movable circuit rotating in a magnetic field (1) if the motion is caused by a current of foreign source, the diameter of the points of contact should be displaced in the direction opposite to the rotation, and through a greater angle the greater the intensity of the current and the weaker the magnetic field; (2) if the motion has to generate a continuous current in the apparatus the same diameter should be displaced in the direction of the rotation.—Chemical researches on tungstates of earthy and metallic sesquioxides, by M. Lefort.—Analysis of different metallic fragments from the Peruvian burying-places of Ancon, near Lima, by M. Terreil. This reveals the presence of brass in these tombs belonging to the sixteenth century.—Synthesis of uric derivatives of the alloxane series, by M. Grimaux.—On some causes of inversion of cane sugar, and on the consecutive alterations of the glucoses formed, by M. Durin. The causes referred to are heat, water, and time (without pre-existent glucose), the phenomenon being purely chemical.—On the hatching of bees, by M. Girard.—Specific determination of fossil or ancient bones of Bovides, by M. Sanson. The bones of Bovides found in beds before the present geological epoch belong to the groups of bisons and bulls: the first, all to one species, now living (*B. americanus*), the second to four living species (specified).—On the presence of alcoholic ferment in air, by M. Miquel. Sterilised must exposed among the vineyards of the south of France always ferments in a few days; this is attributed to conveyance of wine-yeast by insects. He shows that the air really transports yeast. In the Montsouris Park, Paris, not a single case of spontaneous alcoholic fermentation was met with.—Organisation of *Hydrocrosis arsenicus*, Bret., by M. Marchand.

November 18.—M. Fizeau in the chair.—The following papers were read:—Meridian observations of small plants at the Greenwich and Paris Observatories, during the third quarter of 1878, communicated by M. Mouchez.—On a fresh discovery of Silurian terestrial plants in the slaty schists of Angers, by M. Crié; note by M. de Saporta. This is the frond of a fern resembling most nearly *Cardiopteris polymorpha*, Gœpp., which characterises the carboniferous limestone of Silesia; but it has also special features. (A figure is given.)—Means of measuring the manometric value of the pressure of the blood in man, by M. Marey. This consists in producing on a part of the body surface a known counter-pressure with water, capable of overcoming the blood-pressure in the vessels. The simple immersion of a finger in a suitable apparatus suffices; it has shown that in some adynamic fevers the blood pressure may fall to 3 ctm., while in interstitial nephritis it may rise above 20 ctm.—New remarks on M. Levy's communication, on a universal law relating to dilatation of bodies, by Prof. Boltzmann.—Observations on MM. Gruey and Hirn's notes regarding a gyroscopic apparatus, by M. Sire.—On an alterating gyroscopic tourniquet, by M. Gruey.—On a new system of electric lamp, by M. Werdermann.—Artificial reproduction of felspars and of a complex volcanic rock (pyroxenic labradorite) by the method of igneous fusion, and prolonged maintenance at a temperature near fusion, by MM. Fouqué and Levy.—Migration of pucerons of galls of lentiscus to the roots of Gramineæ, by M. Lichtenstein.—M. Oder presented (through M. du Moncel) an electrophone, with which words and notes can be heard 5 m. off. On one end of a sort of drum is fixed a diaphragm of parchment paper, having at the centre six small bars of white iron, fixed circularly, on which act six very small horseshoe electro-magnets connected together and actuated by a carbon microphone. The strong effects are attributed to the smallness of the magnets, giving more rapid magnetisation or demagnetisation.—Intra-Mercurial planets observed during the solar eclipse of July 29. Letter from Mr. Watson. A reply to questions.—On the development of surfaces whose linear element is expressible by a homogeneous function, by M. Levy.—Note on the determination of imaginary roots of algebraic equations, by M. Farkas.—Action of hydracids on sulphate of mercury; action of sulphuric acid on the haloid salts of this metal, by M. Debray. Sulphate of mercury gently heated in hydrochloric gas absorbs it with liberation of heat, and yields a matter fusible and volatile without decomposition, condensing in fine white needles; it has the formula $HgO,SO_3 + HCl$. It may be had directly by union of mercuric chloride and monohydrated sulphuric acid.—Peculiar action of platinum wire on hydrocarbons; modification of the grisoumeter, by M. Coquillion. Bicarbide of hydrogen mixed with air is more detonant than protocarbide; palladium gives a less detonation than platinum; and these two metals can equally burn at red-white small quantities of gas. Thus platinum may be substituted for palladium where there is no fear of detonations.—On the alkalinity of carbonates and silicates of magnesia, free, mixed, and combined, by M. Pichard.—Action of the cervical sympathetic on the pressure and velocity of the blood, by MM. Dastre and Morat. An unforeseen result is that the initial constriction on stimulation of the nerve is always followed by a dilatation greater than that which follows section of the nerve.—On the toxical power of the extract of seeds of hemlock, by MM. Bochefontaine and Mourrut. The common extract obtained from the whole plant is often almost without action; not so extract from the dry seeds; it is in them the active principle specially resides.—On a disease of lettuce (*Peronospora gangliiformis*, Berk.), by M. Cornu.—On the morphology of dicotyledonous stems, by M. Guinier. He applies the graphic method. *Inter alia*, at heights under 1,400 metres, stems bulge out about the middle; as you go higher, the swelling disappears, and about 1,700 m. height, it is replaced by a concavity. From the leafy head of trees may be deduced the form of the stem.—Observations on the orography of the chain of the Pyrenees, by . Schrader.

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