THURSDAY, FEBRUARY 22, 1883

## *PROFESSOR HENRY SMITH*

ON Friday, the 9th inst., we lost one of our most gifted men. By the death of Prof. Henry Smith there has dropped out from our roll-call a name which was already known among a wide circle of friends and admirers, but which would assuredly have been more widely known and more fully recognised if he had remained longer in our ranks.

Henry John Stephen Smith was born in Dublin, but when he was about two years old his family, at his father's death, removed to England. His precocity from the earliest age was remarkable; but what was perhaps still more remarkable, the talents which he thus showed did not, as is so often the case, fail him in after life. He was a fair-haired child, and was known among his relations as the "white crow." When he was two years old it was understood that he could read; and on his third birthday it was agreed that he should be tried, on the condition that, in the case of failure, the white crow should be allowed to fly out of the window, which was set open for the purpose. It is needless to add that there was no occasion for flight. At the age of four he was found one day lying flat on the floor, with his face raised slightly above his book (his sight being, even then, short) teaching himself Greek from an old-fashioned grammar full of antique contractions in the characters. His subsequent education was carried on until he was eleven by his mother, and then by tutors. For an account of the rapidity with which he galloped over the ground with one of them, we are indebted to an interesting letter in the *Times* of the 12th inst. With a view to his education the family removed to Oxford in 1840, whence he was transplanted to Rugby. He entered the school in August, 1841, the commencement of the last year of Dr. Arnold's Head Mastership, and was in the Boarding House of the late Rev. Henry Highton, who was himself an old Rugbeian, a pupil of Arnold, and Co-Exhibitioner from the school with the present Dean of Llandaff and the late Dean of Westminster, and had lately graduated at Oxford, taking a First Class in Classics and a Second in Mathematics. Henry Smith had been Highton's private pupil at Oxford, and was so well taught that when he entered Rugby he was (although only then fourteen) placed in the fifth form, which is the highest form but one below the sixth, and which, by the rules of the school, is the highest in which a new boy can be placed. He was distinguished at Rugby for his unvarying gentleness of character, and was a favourite alike with masters and boys. An old schoolfellow writes of him thus: "I was a young boy in the house, and remember being struck with his great gentleness and amiability. It did me good at once, and I felt it, as I believe, to my lasting benefit." He was always much attached to his old friend and tutor, Highton; and ever since the latter's death, in December, 1874, no one has shown more kindness to his widow and children than Henry Smith. At Rugby he progressed as rapidly as elsewhere, and was kept back from entering the sixth form under Arnold, only on account of his age. He was the first boy promoted to that form under Dr. Tait, Dr. Arnold's successor. Nothing in fact seemed capable of stopping his intellectual career. The death of his only brother and his consequent withdrawal from school, which would have thrown most boys entirely out of gear, did not interfere with his gaining, at the age of eighteen the scholarship at Balliol. A severe illness delayed his residence at college, but neither the malady itself, nor absence from England, nor severance from books prevented him in 1848, winning the blue ribbon in classics among Oxford undergraduates—the Ireland Scholarship. In 1850 he took his degree, obtaining an old-fashioned "Double First," namely, in classics and mathematics. The next year he gained the Senior Mathematical Scholarship; and if in this he had but few competitors, it was because his strength and powers were already known. After such a University career, almost unparalleled in the annals of Oxford, it seems but a natural consequence that he should be elected, as was the case, to a Fellowship at his College. In 1861 he was elected successor to the late Baden Powell in the Savilian Professorship of Geometry, which chair he retained until his death. With a view to relieving him from the labour and duties of College tuition, which he had faithfully discharged for five-and-twenty years, Corpus Christi College offered him a Fellowship free from such duties. Notwithstanding his regret at leaving (although, as it subsequently proved, temporarily) his old college, he decided, having reference to the growing calls upon his time, to accept the offer. But Balliol, unwilling to lose all connection with its distinguished alumnus, afterwards bestowed upon him an honorary Fellowship, and, under the recent Statutes, a full Fellowship without emolument.

The malady under which he ultimately sank may be considered hereditary, for his father died from the same cause, and the son showed symptoms of it even at an early age. It is idle now to speculate whether a quieter or less exhausting life would have prolonged his years. There is some truth in the idea that a man can first and last perform a certain amount of work and no more. On this supposition it may be even a gain to the individual to have performed his task in the minimum of time, while those who remain must rest thankful at having lived in his day, and having retained him amongst us as long as was the case.

The testimony of his friends to his ability and other qualities is from all quarters abundant. Prof. Huxley writes: "Henry Smith impressed me as one of the ablest men I ever met with; and the effect of his great powers was almost whimsically exaggerated by his extreme gentleness of manner, and the playful way in which his epigrams were scattered about. They were so bright and sharp that they transfixed their object without hurting him. I think that he would have been one of the greatest men of our time, if he had added to his wonderfully keen intellect and strangely varied and extensive knowledge the power of caring very strongly about the attainment of any object." Although the present writer is not likely to differ much from Prof. Huxley in his estimate of the man, he would still suggest that Henry Smith's care for the attainment of an object was measured rather by his estimate of its ultimate value than by its present advantage. For those who knew him best were most fully aware of the effort which it cost him to postpone (as he often did, with apparent readiness) his beloved mathematics to other claims. Another friend says: "He was a man of rare powers, and as guileless as he was richly gifted."

Of some men it is said that they were never young, of others that they became old while their contemporaries were still lads; and it has been stated as a general law, in scientific thought at least, that the best and most original ideas have always been conceived before the age of thirty. But whatever may be the case in this respect with the generality of men, Henry Smith was as young and vigorous in intellect at the age of fifty-six, the limit to which he attained, as he was when he gained the first of his many University honours. It was his freshness of mind, his vivid appreciation and intelligent enjoyment of everything going on, not only in science, but also in life, whether social or political, which made us forget that his years, like ours, were passing away, and that the number of them was finite. It was his genial presence, his sympathetic attention, his ready counsel, his sound judgment, his happy mode of dealing with both men and things, which make us already feel a loss which we cannot as yet fully appreciate, but which we can never hope again completely to replace.

Of many Greek towns it is related that each has claimed for itself the honour of having been the birthplace of Homer; in like manner, many branches of knowledge, and avocations of life, might claim to have been the favourite pursuit of Henry Smith. But however proficient, or even prominent he may have been in other subjects, it was in mathematics that he mainly showed the originality of his genius, and that he has left any permanent record of work of the highest kind.

Among the great works which it was long hoped that he would have accomplished was his treatise on the Theory of Numbers. This subject, which during the present generation has been so marvellously generalised as to undergo a complete transfiguration since it was presented to us in the work of Barlow and in the ordinary educational books on Algebra, formed for many years a serious study on the part of Prof. Henry Smith. The papers in which the researches of mathematicians on this subject are recorded are scattered through the pages of various periodicals, so that it is not easy to realise the steps which each writer has contributed to the general progress, nor to assign to each his relative position. But this is not all, nor even the worst; it has been a prevailing custom, too prevalent we think, among mathematicians of late years, to publish results alone, without proof of their statements, and even without indication of the train of argument which led them to their conclusions. This naturally entails on the part of the reader either a strong act of faith or a difficult and, as we hold, unnecessary effort. It need hardly be added that in endeavouring to digest and present to his readers what had been done by others in his subject, Henry Smith adopted the latter course; and, with a sagacity in which few could have rivalled him, he assimilated all these fragments, and utilising the valuable among these *disjecta membra*, and rejecting the worthless, he brought them into harmony, and was in a fair way to produce from them a structure intelligible in itself, and capable of forming a groundwork for further developments. But while our author was discussing what had been already done, the very materials upon which he was engaged were growing apace, and his self-imposed task accumulated upon him. Of unfinished work, or of "ragged ends" as he used to call them, he was as nearly intolerant as he could be of anything; and it is not clearly known whether he ever made up his mind to complete what he had undertaken up to a certain date or not. In any case what he had already long ago achieved in this matter must have been a gigantic work; and it remains only to hope that his manuscripts have been left in such a state that others may be able to wield the weapons which he had forged.

The results of his preliminary studies were given in his six invaluable Reports on the Theory of Numbers, published in the volumes of the British Association for 1859 and following nearly consecutive years; and these alone are sufficient to show the extent of his reading and the firm grasp which he had of the subject. The following extracts from the first and third of these Reports indicate both the wide range of the theory and the magnitude of the portion which still remains to be achieved:—

"There are two principal branches of the higher arithmetic: the Theory of Congruences and the Theory of Homogeneous Forms. In a general point of view these two theories are hardly more distinct from one another than are in algebra the two theories to which they respectively correspond, namely, the Theory of Equations and that of Homogeneous Functions; and it might, at first sight, appear as if there were not sufficient foundation for the distinction. But, in the present state of our knowledge, the methods applicable to, and the researches suggested by, these two problems, are sufficiently distinct to justify their separation from one another."

"It is hardly necessary to state that what has been done towards obtaining a complete solution of the Representation of Numbers by Forms, and the Transformation of Forms, is but very little compared with what remains to be done. Our knowledge of the algebra of homogeneous forms (notwithstanding the accessions which it has received in recent times [1861]), is far too incomplete to enable us even to attempt a solution of them co-extensive with their general expression. And even if our algebra were so far advanced as to supply us with that knowledge of the invariants and other concomitants of homogeneous forms, which is an essential preliminary to an investigation of their arithmetical properties, it is probable that this arithmetical investigation itself would present equal difficulties. The science, therefore, has as yet had to confine itself to the study of particular sorts of forms; and of these (excepting linear forms, and forms containing only one indeterminate) the only sort of which our knowledge can be said to have any approach to completeness are the binary quadratic forms, the first in order of simplicity, as they doubtless are in importance."

Prof. Smith's sphere of utility was, as indeed is pretty well known, not confined to his University, nor to science as such, but extended, among other directions, even to departments of the State. Passing over the Royal Commissions on Scientific Education and on the University of Oxford, of both of which he was a leading member, mention must not be omitted of the Meteorological Council of which he was chairman. That body, nominated by the Royal Society, but appointed by the Government, holds a position intermediate between a public department and an independent institution. While on the one hand this intermediate position presents some advantages, at all events in the present stage of the subject as a science, it undoubtedly, on the other, requires no inconsiderable tact and judgment in its management. For the yearly administration of a large sum of public money, for the management of a considerable staff at home, and of a variety of observers at out-stations in all parts of the country, and for communication with similar departments of State in foreign countries, science alone would not have sufficed. But at the same time few branches of natural knowledge stand more in need of a strong scientific guide to keep it from the crotchets of dabblers in the subject, or from relapsing into an indiscriminate accumulation of loose observations from which no valuable result can ever be derived. For this post the President and Council of the Royal Society unanimously nominated him, nor had they ever reason to regret the step which they then took.

The case of the Meteorological Council was, however, but one instance out of many in which his name came uppermost in the minds of men when they were looking for a leader, or a chairman, or a president. Whether as President of the Mathematical Society (1874-6), or of the Mathematical and Physical Section of the British Association (1873), or as Chairman of Committees too many to enumerate, he always succeeded in commanding the respect of those with whom he was associated, and in carrying through the business to a satisfactory issue.

In one matter only did he fail of success; but in that case the failure was not really his, but that of those who should have given him support. The case was that of his candidature for the representation of the University of Oxford, when, in 1878, Lord Cranbrook received his peerage. Instances of the candidature of leading University men, both in Oxford and in Cambridge, have not been unknown, from the time of the late Sir John Lefevre to that of Prof. Stuart; but all have terminated in the same result, namely, the total defeat of every man of University distinction, whatever other qualifications he may have for the office. With these instances we may compare, not without interest and instruction, the choice which has been made by the University of London on the only two occasions on which a vacancy has yet occurred.

It was sometimes thought that his mind became diverted from mathematics by his many other distracting avocations; there are, however, reasons for doubting this. It is true that he did not pour out the amount of mathematical papers of which he was certainly capable; but those which he did publish showed that he cared little to add fringe-work to the borders of our knowledge, and that he reserved himself for questions of real importance. We remember his alluding to the subject of one of his later papers contributed to the Mathematical Society, on Modular Equations, as relating to "a point on which people had puzzled themselves for a long time," and the following passages from his address to the London Mathematical Society were certainly not penned by a president for whom that subject had lost its charm. "Of all branches of mathematical inquiry, this is the most remote from practical applications; and yet, more perhaps than any other, it has kindled an extraordinary enthusiasm in the minds of some of the greatest mathematicians.'' Then he quotes Gauss as having held Mathematics to be the Queen of the Sciences, and Arithmetic to be the Queen of Mathematics. I do not know that the great achievements of such men as Tchébychef and Riemann can fairly be cited to encourage less highly gifted investigators; but at least they may serve to show two things—first, that nature has placed no insuperable barrier against the further advance of mathematical science in this direction; and secondly, that the boundaries of our present knowledge lie so close at hand that the inquirer has no very long journey to take before he finds himself in the unknown land. It is this peculiarity, perhaps, which gives such perpetual freshness to the higher arithmetic. It is one of the oldest branches perhaps the very oldest branch, of human knowledge; and yet some of its most abstruse secrets lie close to its tritest truths. I do not know that a more striking example of this could be found than that which is furnished by the theorem of M. Tchébychef. To understand his demonstration requires only such algebra and mathematics as are at the command of many a schoolboy; and the method itself might have been invented by a schoolboy, if there were again a schoolboy with such an early maturity of genius as characterised Pascal, Gauss, or Evariste Galois."

The following is another instance of the interest which he retained in mathematics to the very last. In the address above quoted he alluded to a problem, at that time still unsolved, in the following terms:—"It was first shown by M. Liouville that irrational quantities exist which cannot be roots of any equation whatever, having integral coefficients. We may perhaps be allowed to designate by the terms arithmetical and transcendental the two classes of irrational quantities which M. Liouville has taught us to distinguish; and it becomes a problem of great interest to decide to which of these two classes we are to assign the irrational numbers, such as $\epsilon$ and $\pi$, which have acquired a fundamental importance in analysis. To Lambert, the eminent Berlin mathematician of last century, the first great step in this direction is due. He showed that neither $\pi$ nor $\pi^2$ is rational; with regard to $\epsilon$ he was even more successful, for he was able to prove that no power of $\epsilon$, of which the exponent is rational, can itself be rational. There (with one slight exception) the question remained for more than a century; and it was reserved for M. Hermite, in the year 1873, to complete, by a singularly profound and beautiful analysis, the exponential theorem of Lambert, and to prove that the base of the Napierian logarithms is a transcendental irrational. But, in a letter to M. Borchardt, M. Hermite declines to enter on a similar research with regard to the number $\pi$. 'Je ne me hasarderai point,' he says, 'à la recherche d'une démonstration de la transcendence du nombre $\pi$. Que d'autres tentent l'entreprise; nul ne sera plus heureux que moi de leur succès; mais croyez m'en, mon cher ami, il ne laissera pas que de leur en coûter quelques efforts.' It is a little mortifying to the pride which mathematicians naturally feel in the advance of their science to find that no progress should have been made for a hundred years and more toward answering the last question, which still remains unanswered, with regard to the rectification of the circle."

Last year, Lindemann, starting from Hermite's researches, succeeded in supplying the proof required with reference to the number $\pi$. And while speaking of this achievement with the satisfaction which his generous nature prompted, Henry Smith added that it was a problem on which he had long fixed his eye with a view to attacking it seriously so soon as he had leisure for the undertaking.

He was doubtless then looking forward to some University vacation; for vacation time formed the period for his original investigations, while term time was devoted to current work and to society, which he himself so keenly enjoyed, and in which he was always an honoured and a welcome guest.

It has been much the fashion of late years to raise memorials to the departed; and in some cases it may be doubted whether a wise discrimination has been exercised in the matter. No one, however, who has any interest in science, would doubt for a moment that the memory of Henry Smith was in the highest degree deserving of perpetuation. But in our opinion the best and only suitable memorial of him will be the publication of his works, in the fullest and most complete form of which they are now capable. And it is sincerely to be hoped that his MSS. may be placed in the hands of a mathematician who may prefix to them an introduction as worthy of these works as was Prof. Smith's introduction to the remains of Clifford.

During his last few years he lived, as Keeper of the University Museum, at the house adjoining the main building, previously occupied by his predecessor, John Phillips. His companion was his sister, whose useful and sympathetic life worthily supplemented his own. It is to be hoped when the wave of sorrow which is now passing over her has in some degree subsided, and when time has brought an alleviation which may now seem impossible, that she may derive satisfaction, although it be a melancholy one, in having learnt through the event how much her brother was appreciated and beloved by many, and by some even unknown, friends.

W. Spottiswoode

## *PUBLIC ELECTRIC LIGHTING*

MUCH attention is being given at the present moment to the operation of the Electric Lighting Act passed during the last session of Parliament. Under the terms of that Act, licenses and provisional orders will be granted to local authorities, companies, and private individuals to supply electricity for the purpose of electric lighting over definite areas. A large number of applications for licenses and provisional orders have already been submitted to the Board of Trade, in a few instances by local authorities, but in the majority of cases by joint-stock companies formed for working one or other of the different systems for electric lighting. A number of the "Provisional Orders" now being promoted lie before us, the majority of them being drawn in almost identical terms. A perusal of these documents cannot fail to impress the reader, firstly, with the great complexity of the question, secondly, with the extreme difficulty of striking a fair balance between vested interests and public convenience, thirdly, with the great amount of knowledge and skill displayed in the drafting of these provisional orders. It is an open secret that not only the main outlines but also most of the details of these orders are from the hand of Mr. J. Fletcher Moulton, F.R.S., whom we must congratulate upon the success with which he has applied himself to the task of preparing them. Now that Parliament is once more in session we shall probably hear of further legislative proposals; but if all provisional orders are as well and as wisely drawn as the majority of those before us appear to be, there can be little doubt that the necessity for separate further legislation and for the promotion of private bills for electric lighting will be removed.

As to the provisional orders themselves it would be impossible within reasonable limits to deal with a tithe of the important topics which are therein set forth. Many of the provisions are naturally directed toward questions of municipal rights and parochial law. Leaving aside all these matters we come to the more scientific points. Four separate systems of distribution are recognised in the provisional orders. These are (*a*) "direct" system, more familiar under the name of distribution in parallel arc, with "distributing mains" throwing off "service lines" for individual consumers; (*b*) "storage" system, with service lines in parallel arc from storage batteries charged in series intermittently from a generating station; (*c*) either of the above with "earth" returns; (*d*) "series" system, supplying customers in one undivided circuit. We may remark in passing that it appears to us that the use of "earth" for return should be in every case forbidden. If currents of the intensity employed for electric lighting are sent through earth in our crowded cities we shall have constant derangements of telegraphs, telephones, electric bells, in fact of all electric appliances which work by feeble currents and use earth returns. Moreover, as "earth" in practice means usually the employment of existing gas-pipes or water-pipes as returns the proposal to utilise "earth" for electric light returns, is doubly to be deprecated. Amongst other limitations set forth in the provisional orders are some which bind the "undertakers" to lay down their mains within two years, some which prescribe the hours during which the supply of currents must be maintained, and some which limit the conditions of supply. Amongst the latter we observe in several of the orders before us that it is proposed that "the potential at corresponding points of the positive and negative distributing mains shall differ at each point by a constant difference, not being less than thirty volts, and not being more than four hundred volts." And that "such constant difference of potential" is to be termed "the standard pressure." It is to be hoped that the Board of Trade will be much more precise in its limitations. Thirty volts is so low a "pressure" as to be practically out of the question except with a gigantic outlay in copper conductors, whilst four hundred volts is equally inadmissible on account of the danger to person. No less an authority than Sir W. Thomson has said that nothing above two hundred volts should ever be admitted into a dwelling-house. The provision that "the standard pressure may be different for different points of the said mains, and for different hours during the period of supply" is bad, and if permitted will greatly militate against convenience and uniformity in using the current both for light and for motive-power. Where the undertakers distribute "alternating" currents it is provided that the mains should have a "constant (?) difference of potential" or standard pressure of not less than forty-five and not more than six hundred volts. Here again we think that the Board of Trade might very wisely insist on a further restriction. If steady currents at a pressure of four hundred volts are dangerous, alternating currents at four hundred are far more so. Yet here the undertakers talk of six hundred! Indeed, considering the risks involved, and the difficulty in distributing alternating currents through long lines or lines where there is great self-induction; and also considering that the supply of electric currents is not for lighting alone but for the providing also of motive-power, it would not be any loss to the public if the use of alternating currents under the provisional orders were absolutely disallowed. It is true that the patentees of certain specific forms of machine might cry out loudly against such a prohibition; but the public would be guaranteed against one source of danger and difficulty. According to the orders the undertakers may charge consumers either by the amount of electric energy consumed, or by the quantity of electricity supplied, or by time, or by a yearly agreement. In connection with the first of these methods the proposal is made to call by the name "one unit" the energy contained in a current of 1000 amperes flowing under an electromotive force of one volt during one hour. Most of the provisional orders name sevenpence per unit as the price of electrical energy. We have here for the first time an actual quotation-price for *energy;* a fact which should be interesting to those who have striven so hard to drive into the popular mind exact ideas concerning energy and its conservation. One "unit" thus defined for commercial purposes being 1000 volt-amperes (*i.e.* 1000 watts) for one hour, and one horse-power being 746 watts, we see that the scale of payment is about 5¼ pence per hour per (electrical) horse-power.

Into the further provisions for the inspection and testing of mains, the inspection of meters, the testing of insulation, provisions for safety, and penalties for default in supply, we cannot here enter. Suffice it to say that there is no detail that does not appear to have had thought expended upon it, no provision that is really superfluous or harassing, no possible want or eventuality that does not appear to have been anticipated. Such masterly treatment cannot but greatly facilitate the work of the Board of Trade in agreeing to orders and licenses, and will tend to bring about unity of method in the organisation of the actual work of laying down town supplies so soon as such orders and licenses shall have been granted. If it be true that the effect of the Electric Lighting Act has been to produce a temporary lull in the progress of electric lighting, we are convinced that such a lull will be in the end an unmixed good, since it gives the opportunity for thought to ripen, and for projects and inventions to mature, if not to survive. Two dangers indeed seem yet possible in the future of public electric lighting, and either of them may be sufficiently serious to damage public confidence in this new industrial factor. Firstly, some better guarantees ought to be insisted on that the Companies or other parties who obtain orders or licenses as undertakers should be possessed of capital adequate to carry out the projects in hand. A very hasty glance at the list of applicants for provisional orders will suffice to show that this fear is not unfounded. Secondly, it ought to be made impossible for a Company which has obtained an order for any limited district to delegate the responsibility of supplying any section of such district to a subcompany. No Company should be allowed to hold a monopoly (if the limited monopoly created by the provisions of the Electric Lighting Act be a monopoly at all) of a single square yard of territory which it cannot with its own resources supply under the terms of the order or license which has been granted. If this principle be not upheld, serious abuses will creep in, to the detriment of progress and in contravention of the interests of the public.

## *CRYPTOGAMIC FLORA OF GERMANY, AUSTRIA, AND SWITZERLAND*

*Dr. L. Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich, und der Schweiz.* Zweiter Band: Die Meeresalgen Deutschlands und Oesterreichs. Bearbeitet von Ferdinand Hauck. 1–3 Lieferung. (Leipzig: Eduard Kummer, 1883.)

SINCE the appearance of the original work (1845-53) the systematic study of living algæ has, through a more accurate knowledge of the structure and fructification of these plants, led to great changes in their diagnosis and classification. Hence the necessity of a new edition of Rabenhorst's work.

In order to render it more valuable, the preparation of the parts of which it is composed have been intrusted to authors specially conversant with the subjects of which they treat. The first volume, five numbers of which have already appeared, contains the Fungi, and is edited by Dr. G. Winter of Zurich; the second comprises the Marine Algæ (exclusive of the Diatomaceæ); then will follow the Fresh-water Algæ, edited by Herr Paul Richter of Leipzig; the Diatomaceæ, by Dr. A. Grunow of Vienna; and the Frondose Mosses and Hepaticæ, by Herr G. Limpricht of Breslau. To these will succeed works on the Lichens, Chariceæ, and Vascular Cryptogams.

The second volume, which forms the immediate subject of this notice, has been intrusted to M. F. Hauck, who, from his residence on the coast at Triest, has, during many years, had opportunities of studying marine algæ in a living state; and by his connection with German and other algologists, has been able to obtain authentic examples of most of the species. It may also be mentioned that M. Hauck has published "A List of the Algæ of the Adriatic" (*Beitr. z. Kenntn. d. adriat. Algen*, Wien, 1878).

The present work, of which three numbers have appeared, includes not only the algæ inhabiting the Austrian coast and islands of the Adriatic, but also those of the Baltic and North Seas, and the coasts of Heligoland with the adjacent islands: the latter have been found especially rich in species.

In the Introduction to his work, M. Hauck gives instructions for the collection and preparation of the various kinds of marine algæ. The list of instruments and appliances used in collecting is rather formidable, but it must be remembered that the object of the algologist is to obtain specimens in as perfect a state as possible, for the purpose of instituting a searching examination into the structure and fructification of the plants; and this cannot be done without much labour and pains. In the case of small plants which adhere closely and spread over rocks and other objects, M. Hauck recommends that, instead of scraping off the algæ, portions of the rocks on which they grow should be chipped away with a geological hammer, and preserved with the growing plants upon them. Directions are also given for the treatment of the Corallinæ and other algæ which are covered with carbonate of lime, in order to divest them of the lime, and thus prepare them for microscopic examination. There are also instructions for preparing and mounting specimens of algæ for the microscope.

Every one who has endeavoured to cut sections of algæ for microscopic observation, must be aware of the difficulty, occasioned by the different structures of the plants, of performing this operation. The author shows how some of these difficulties may be avoided; but he has omitted to mention whether the sections should be made with a machine, or in the old-fashioned way, by holding the portion to be cut firmly with the forefinger nail of the left hand, while cutting the section with a sharp, thin knife.

We now come to the work itself. M. Hauck thus classifies the marine algæ: I. RHODOPHYCEÆ, plasma coloured red; II. PHÆOPHYCEÆ, plasma coloured brown; III. CHLOROPHYCEÆ, plasma chlorophyll-green; IV. CYANOPHYCEÆ, plasma bluish-green. Commencing with the Rhodophyceæ, he treats of the Florideæ, describing their structure and fructification. A summary of the families, with the names of the genera contained in each family, follows. M. Hauck's classification of the Florideæ is novel; it remains to be seen whether it will meet with the general approval of algologists. We have next a description of the genera and species. This part of the work is illustrated with figures drawn on zinc, of at least one species of each genus, as seen by transmitted, not reflected, light, the objects being represented as if transparent. Some of these illustrations are original, but the greater part are borrowed from Kützing, Thuret, Zanardini, and others. They are inserted in the text near to the species delineated,—an extremely convenient arrangement.

Besides these illustrations, there are five plates, representing different species of Lithophyllum and Lithothamnion. They were printed by the "Albertotype" process, from negatives executed under the supervision of the author. These plates are admirable, and give more correct and characteristic figures of these singular and in this country but little-known vegetable productions than can be obtained by any other process. Several species of Lithophyllum and Lithothamnion have been found in our seas, and it is probable that more would be found if sought for. They abound in the Adriatic and Mediterranean, and some species are known on the French coast.

M. Hauck seems to have bestowed much pains and care in the preparation of the work, and it will be seen that he has added very considerably to our knowledge of the fructification of numerous species. It may, however, be as well to remind him that the cystocarpic fruit of *Callithamnion Thuyoides*, *Call. polyspermum*, *Call. Borreri*, *Ceramium tenuissimum*, and *Grateloupia filicina*, which he does not mention, were described and figured in Harvey's *Phyc. Brit.* (Pls. 269, 281, 259, 90, 100). Also that the tetraspores of Nemaleon, which M. Hauck says (pp. 14, 59) are unknown, were described by Dr. Agardh, who had examined the living plant (see "Sp. Gen. et Ord. Algarum," vol. ii. p. 417 (1852).

It is to be hoped that we have found in this work the solution of a problem which for a long time has exercised the minds of algologists, namely, Does Porphyra belong to the Chlorosperms or to the Florideæ?

Although the colouring of Porphyra assimilates it to the Florideæ, yet the apparent agreement of its vegetative structure with that of the Ulvas, and especially of some of the species of Monostroma, had induced the elder algologists to place Porphyra among the Chlorophyllaceæ. The discovery of the fructification of the plants of both genera has however shown that they are widely separated. In Monostroma the only kind of fructification known consists of zoospores, which, when they first issue from the mother-cell, are endowed with active motion. In Porphyra the tetraspores were first discovered, then the antheridia; the antherozoïds are motionless. Algologists, however, still hesitated to admit Porphyra among the Florideæ, because no cystocarpic fruit had yet been found. M. Hauck now tells us that the cystocarps of some species are known (p. 21), and he describes those of *P. leucosticta*, as well as the tetraspores and antheridia of this plant (p. 25). There can, therefore, be no longer any hesitation as to including Porphyra among the Florideæ, of which it constitutes the lowest family.

On looking through the present instalment of this work, it will be seen that out of the 122 species, or thereabouts, which are described in it, about seventy are found on the British coasts—nineteen of the latter are common to the North Sea and Adriatic—twenty-seven of them inhabit the Adriatic, and twenty-four the North Sea. The work, when complete, cannot fail therefore to prove of great interest to algologists in this country.

The type is good, as well as the figures with which it is illustrated, and readers will no doubt be glad to know that in the printing German characters have not been used. MARY P. MERRIFIELD

## THE CHURCHMAN'S ALMANAC

*The Churchman's Almanac for Eight Centuries* (1201 *to* 2000), *giving the Name and Date of every Sunday*. By W. A. Whitworth. Pp. 23. (London: Wells Gardner, Darton, and Co., 1883.)

THERE never surely was such an age of almanacs. The social change whose effects meet us on every side has worked a revolution here. Some of us can call to mind the time when "Old Moore" ruled the reckoning in his peculiar, old-fashioned way, and Murphy blazed out like a meteor to expire like a farthing candle, and Zadkiel "Tao Sze" began to trade on human curiosity and credulity. But those days are past. Instead of being left, as of old, to make our own quiet, though limited, choice, as the year draws to its close we find ourselves surrounded by a swarm of calendars; the insurance-office, the journalist, the general-storekeeper, the stationer, the watchmaker, the grocer, all vie in pressing on our acceptance something to remind us how time flies; often padded with most irrelevant pieces of innovation, but sometimes, it must be owned, got up in a very attractive form. We do not quite see how all this can be made to pay. We should have thought it a very expensive and often uncalled-for mode of advertising. But that is no affair of ours. Living in "a nation of shopkeepers," whatever may be our private impressions, we are bound to believe that it is found a remunerative mode of expressing gratitude, or anxiety, as the case may be. But whatever may be the donor's purpose it is not quite easy to see what corresponding purpose is, generally speaking, to be answered on the part of the receiver: for, with certain exceptions, it really signifies very little to the bulk of the community, how the fifty-two ensuing weeks are arranged. One great exception of course is the festival of Easter, and the others that depend upon it. But as to these there is always a sufficient general understanding, as there was in our least educated days, when there were comparatively few that knew how to use a calendar: and as to the phases of the moon, the only other leading feature in ordinary almanacs, their notification is rather convenient than necessary, excepting for those who believe, as old-fashioned people still do, with Prince Bismarck at their head, that the moon has an influence distinct from its attractive power. But, say what we will against the necessity of a general diffusion of almanacs, public feeling is on the other side, and even those who could do very well without these favourite articles, and seldom refer to them, would not feel satisfied if they did not possess them.

One curious feature in the case, however, is that so few comparatively have any correct idea of the principles on which almanac-making proceeds. We suspect that even among such as pass for educated people it would be easy to find those who would not be very comfortable if they were required to explain the want of correspondence between the reckoning by weeks and that by months, the unequal length of the latter, the necessity of intercalation, or the cause of the difference between the "styles"—important as that was thought in its day, even to the excitement of popular indignation. As to such matters, if it is true that "we take no note of time but by its loss," it is nearly as true of a large portion of even civilised society, that they take no note of the arrangement of time—except perhaps by misunderstanding it. However, there is no excuse for such ignorance (if we may be forgiven the expression) for the future, if people will take the trouble of referring to the little work whose title we have quoted above. It will not indeed enlighten us much as to the root of all the difficulties—the incommensurable durations of the day and month and year, or help us to make out the strange old machinery of cycles and epacts and golden numbers by which the calendar was kept right, but it will do what is practically of much more value, set before us something of the processes, and all needful results, of the most accurate computations.

The title was a puzzle to us at first, for we had been for so many years acquainted with a very unpretending though most useful *Churchman's Almanac*, that we did not comprehend how it should now find its place in NATURE, till we remarked the continuation of the title; this, promising perennial instead of annual information, at once made a claim to attention which we find is well deserved. There are a good many curious and out-of-the way pieces of information in the three pages of introduction—among which we may mention the explanation of the reason, hitherto to us so incomprehensible, why the accounts of the public revenue are made up to the odd-looking epoch of April 5—and this is followed by a perpetual calendar, as far as Sundays are concerned, to a period that the youngest now living will never see; while, for historical purposes, the retrospective portion is an authentic and valuable resource as to many indefinite matters in chronology, the correct determination of which, as antiquaries well know, often involves considerable trouble. The author has fulfilled his undertaking, as far as we can judge, with especial care and attention; and if his work, which is one of the thinnest of folios, is so far less in accordance with the ideas of this "handy-book"-loving age, we must bear in mind that the form was imposed by the extent of its tabular matter, and that though there is little to attract in its formidable array of figures, its intrinsic value is, for those who need such aid, of a high and enduring character.

## *LETTERS TO THE EDITOR*

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

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

### Hovering of Birds

MR. AIRY asks for a diagram explaining my views as to the hovering of the kestrel and of other birds, asserting at the same time that these views would establish a "miracle."

If Mr. Airy will be so good as to look at the beautiful drawing of a kestrel in the act of hovering, by Mr. W. Wolf, at p. 160 of the "Reign of Law," he will see an illustration far better than any diagram. Mr. Wolf is an excellent naturalist as well as an accomplished artist, and his drawing of the kestrel was made to represent his own knowledge and observation of the act of hovering, and not to set off any theory of mine.

It will be seen that the body of the bird is represented as at a considerable angle to the horizon, and (of course) to any horizontal current of wind.

It is by placing itself in this position to the wind, and by a wing-action accurately proportioned to the strength of the breeze, that the bird accomplishes the feat of hovering—which is no miracle, but the mechanical result of the "resolution of forces."

The hovering of a boy's kite is a miracle of the same kind. The element of weight is here represented by the string, held at the surface of the ground.

Mr. Airy is, however, mistaken in his description of the facts. He speaks of hovering being performed with "wings motionless, not fluttering." Now I have never seen a kestrel's wings motionless when hovering. Always when the air is still, and always when the breeze is only moderate, the wings have a rapid and tremulous action, varying from moment to moment according as the "muscular sense" directs it, and feels it to be needed for the "poise." But sometimes when the breeze is very stiff this action may be suspended for a moment or two. I have seen this occasionally. But even in this case I could detect the quivering of the quills.

The sea-swallows perform the evolution perpetually over the water when it is as still as a millpond. In all cases the inclined position of the body of the bird to the plane of the horizon is observable. The miracle is always performed by the use of the appropriate means. ARGYLL

Cannes, February 12

I AGREE with "J. R." that the term "hovering" is likely to be misunderstood. I used it because it had been used in the earlier correspondence in NATURE to which I referred. If "J. R." (or any other of your correspondents on this subject) has never seen a hawk hanging in motionless poise above a hill-side, I would ask leave to refer him to NATURE, vol. viii. pages 86 and 324, for a description of the act.

February 19 HUBERT AIRY

I HAD once a very unusual opportunity of observing accurately the flight of buzzards, from the summit of Acro-Corinthus. As this unique natural fortress rises sheer from the plain, on the side toward Attica, to the height of eighteen or nineteen hundred feet, a group of these birds, hanging at that height above the surface, were thus brought in a line with the eye. I could detect the minutest movement of wings or tail. Again and again there were considerable intervals, of many seconds' duration, during which one bird and another would hang, with pinions horizontally outstretched, absolutely motionless, neither descending nor drifting, but as if his balance in the air were one of delicately adjusted equipoise. And when, by a just perceptible movement of wing, he stirred again, it seemed rather to be to change his position than that he needed any kind or degree of effort to maintain it. The kestrel is an unfortunately chosen bird for Mr. Hubert Airy's observation, because though it hangs for a minute or two over the same spot watching its prey, it is always "by short and rapid motion of its wings"; from which fanning motion it has acquired, I think, its popular name of windhover, and not because, as Mr. Airy supposes, it is upborne by the wind. But were my Corinthian buzzards upborne by the wind? There was none. The day was one of dead calm. No doubt of necessity there was some upward current of air from the sun-warmed surface of the ground by which the birds profited; but if at all sufficient to sustain them, their actual gravity, when in that position and so willing it (by which I mean nothing so absurd as that gravitation can be counteracted by the *vis vitæ*, but that by inflating its lungs, and perhaps suspending its respiration, the bird may have the power at will of lessening its comparative weight in the air), must be very near to that of the atmosphere around and underneath them. It is evident that Mr. Airy could only claim my observation as being in favour of his theory if there had been a breeze from Attica striking against the face of the citadel. There was none perceptible; and I drew the attention of my companions to the curious problem presented by such an ease of flight. HENRY CECIL

Bregner, Bournemouth, February 13

P.S.—Will you allow me just to mention that the letter reprinted from NATURE by Dr. George J. Romanes in his "Animal Intelligence," as mine, is by Mr. Merlin, our present Consul in Athens. I sent it, but he wrote it, and the observation is wholly his.

## The Auroral Meteoric Phenomena of November 17, 1882

MR. BACKHOUSE remarks in his letter (NATURE, vol. xxvii. p. 315): "It would be well to ascertain whether such a motion (in a curve) would not agree better with the observations of the beam than Dr. Groneman's hypothesis that it was a straight line."

When a straight line lies within or without the (celestial) sphere, on whose surface we wish to trace the perspective projection of that line (the eye being placed in the centre of the sphere), the perspective of the line will of course always be a great circle. When inversely the apparent path of the same meteor, seen from *one* place of observation is a great circle, the true path must lie in a plane. When the apparent paths, seen at the same time from two different places, not situated in the direction of the apparent path, are both great circles, the true path lies in two different planes, and *must be a straight line.* Now Prof. Oudemans at Utrecht says positively that the apparent path of the phenomena of November 17 was a great circle, cutting the horizon (and also the equator) in two opposite points. Of the English observers I will cite Mr. Saxby (p. 86), who describes "the trajectory as much flatter than that of the stars." Moreover the general fact is, as I proved in my paper, that this trajectory, having been seen of regular form and consequently probably of equal curvature in its whole length, intersected the great circle of the horizon in two opposite points, and therefore must have been a great circle itself. The above-mentioned condition being fulfilled, I was under the necessity of taking the true path as a right one. I think this peculiarity indicates the meteoric nature of the phenomenon and of all the auroral arcs (*les arcs proprement dites* of my theory) showing as great circles of the sphere. In fact a curve cited by Mr. Backhouse, lying at equal height above a terrestrial parallel, will show itself *but in one case* as a great circle, namely where the observer is within its plane. From all other places it will be seen as a small circle of the sphere. In this case is the apparent boundary of an aurora in the north, the arch of the dark segment cutting the horizon in two not opposite points.

I dare not occupy more space to answer Mr. Backhouse further on the influence exercised by cosmic matter on terrestrial magnetism, and the consequence of the general direction east to west of these currents when passing in the neighbourhood of the earth, but I think that this direction east to west *must* be deduced from the observed facts.

I am much obliged to Messrs. Petrie and Muirhead for their information. As to the remark of the former on the spectrum observed by Dr. Rand Capron, I think that the auroral character of some phenomena will be proved the best when it shows the auroral lines, whatever may be the origin of its light. When its other properties point out its meteoric character, a strong argument is found in favour of the cosmic theory of auroræ. H. J. H. GRONEMAN

Groningen, Netherlands, February 14

## The Orbit of the Great Comet of 1882

I AM very much obliged to those gentlemen who have kindly given me the information required in my letter published in NATURE, vol. xxvii. p. 314.

They all agree on the same point, which confirms my opinion that in all the good observations the same or very nearly the same point of the head was observed during the brightest appearance of the comet.

I remarked especially in the sketches shown to me by Mr. A. A. Common, who was the first to see the comet in England, on September 16, and who continually made careful observations of it, that, although the nucleus was seen since October 30 divided into two parts, always one of these (which I shall call the main part next to the following end of the nucleus) remained the brightest. Mr. Common in every drawing marks this part with the word "brightest." At the Washington Observatory also this same bright point was always observed with the transit instrument, as it is stated by Mr. W. C. Winlock in his letter (NATURE, vol. xxvii. p. 129).

Mr. W. L. Elkin, Cape Observatory, in a communication to the *Astronomische Nachrichten*, No. 2490, speaks about this orbit. He used the first observation made at the Cape on September 8, the observation [of the] disappearance of the comet at the sun's limb on the 17th of the same month, and a normal observation on November 17, to calculate either a parabolic orbit or an elliptic one; but none of these gave the positions of the comet according to intermediate observations.

Mr. Elkin believes it is possible to take as the most probable value of $\frac{1}{a}$ the value 0·0075, and consequently the comet has a very long period, while Mr. Morrison in his calculation of the orbit had $e = 0·9998968$, and a period of 652·5 years.

As errors of observations are of course inadmissible, it is now the question to study what produces such great differences in calculating the orbits.

Are they due to disturbances during the comet's passage through the solar system, and especially at its passage through the sun's corona? or are they due to the hypothesis specified by Mr. Elkin and others that the centre of the nucleus is not the point gravitating around the sun? This question cannot be decided but by a careful discussion of all the positions of the comet during the whole period.

The observations before perihelion are of course very important. Unfortunately at the Cape the astronomers were prevented making observations between September 8 and September 17 because of bad weather; but there are some observations made in Melbourne and in other observatories before September

17; and besides, the important observation of the disappearance of the comet at the sun's limb is very valuable. Now then, if it will be possible to secure some observations in the remaining days the comet will be visible, I am sure we shall have a large amount of material to study upon.

I may add that Mr. Common and I saw the comet a few days ago. With magnifying power of 120 and 150 we were not able to distinguish the division of the nucleus, but with a higher power we saw five bright points; one of these, corresponding to that seen before, remains the brightest. The comet has all the appearance of a little curve convex to the horizon, and is still a very bright object, as Mr. Common was able to see it pretty well with only six inches aperture and in moonlight.

13, Pembridge Crescent, Bayswater, W. E. RISTORI

### Aino Ethnology

LET me hasten to assure Herr Rein that nothing could have been further from my intention than to question the "love of truth," which is conspicuous in his work on Japan. I trust he will consider as absolutely withdrawn any expression of mine which he fancies might at all bear such a construction. His authorities I did not quote, because I attached much more importance to the weight of his name than to theirs. The almost unanimous opinion of original observers is opposed to their conclusions, which I was certainly somewhat surprised to find adopted by Herr Rein. But as he has not himself visited the Aino people, the question of their affinities need not be further argued here. I may state, however, that to Steube and von Siebold must now be added Herr Kreitner, of the Szechenyi expedition, who emphatically removes them from the Mongolic, and "assimilates them to the Caucasic type" ("Im Fernen Osten," Vienna, 1881, p. 318). A. H. KEANE

### Auroral Experiments in Finland

IN the note in NATURE, vol. xxvii. p. 322, in which you refer to my telegrams from Sodankylä, there is a misunderstanding concerning the apparatus which I made use of in the experiments. This apparatus, which I call in Swedish "Utfrömningo-apparat" (streaming apparatus), was constructed of uncovered copper wire, provided at each half-metre with fine erected points. That wire was led in slings to the top of the hill, and reposed on the usual telegraph insulators. From one end of this wire was conducted a covered copper wire on insulators to the foot of the hill (600 feet high), and there joined a plate of zinc interred in the earth. In this circuit was put a galvanometer.

It was this apparatus which produced both the yellow-white halo at Oratunturi and the straight beam of aurora borealis at Pietarintunturi, as the positive current in the galvanometer at both places. The terrestrial current diminishes (or ceases) below the belt of maxima of the aurora borealis. S. LEMSTRÖM

Helsingfors

### Flamingoes and Cariamas

IN NATURE, vol. xxvii. p. 334, an account is given of the curious behaviour of a flamingo towards a cariama. May I point out that this habit of the flamingo was observed in 1869 by Mr. Bartlett, and will be found in a P.S. to a paper of his entitled "Remarks upon the Habits of the Hornbills," read before the Zoological Society, February 25, 1869. The liquid was examined by Dr. Murie, and is said to have consisted almost entirely of blood. A short notice of the habit, communicated by Mr. Bartlett, appears also in Buckland's Edition of "White's Selborne." JAMES CURRIE

Cambridge, February 19

## *THE APPROACHING FISHERY EXHIBITION*

FROM the cheerful note of preparation which is now being sounded, we presume the opening of the International Fisheries Exhibition will take place punctually on the day which has been fixed for that event—May 1. That the Exhibition will be successful, both in a pecuniary sense and as an exposition of fishery economy and of the natural history of our food fishes, may, we think, be even now predicted. The two exhibitions by which it has been preceded, those of Edinburgh and Norwich, not only paid all expenses, but left a handsome surplus; so that, with the vast population of London and the strangers who daily come within its gates to work upon, the promoters of the exposition are warranted in believing that it will prove a success. It will undoubtedly be the greatest affair of the sort which has yet been designed, and will occupy a site twice as large as the Norwich and Edinburgh exhibitions joined together. The fishery exhibition which was held at Berlin three years ago was visited by nearly half a million persons, but it was only open for ten weeks, whilst the show to be held at South Kensington will remain open for six months, and as the population of London is more than four times greater than that of Berlin, we may calculate on the visitors to the Fishery Exhibition running into big figures;—two million persons at a shilling each would represent a sum of one hundred thousand pounds. Already a large guarantee fund has been subscribed by corporations and private persons, and there is no reason why Parliament should not be asked for a grant in aid, although any money that might be granted may not be required. It is right to say that as a nation we play a rather "mean" part in such matters, and are quite outdone in liberality by other countries. America, for instance, is sending us an "exhibit" which will cost that country ten thousand pounds, and other foreign countries are acting in an equally liberal spirit. If we were asked on any occasion to reciprocate, what answer could we make? We have positively nothing that we could send. With the exception of the toy museum left to the country by Mr. Frank Buckland, we possess nothing in the shape of a national collection illustrative of fishery economy; hence the Exhibition which is about to open assumes very much the shape of a commercial enterprise, and becomes a gate-money show. But that is better than nothing, and it is to be hoped that from the debris of the approaching exposition a substantial addition may be made to the Buckland Museum of economic fish culture, and if we may be permitted to make such a suggestion, the aquarium should, if that is possible, be so arranged that it could be left as a permanent attraction for all who are interested in the natural history of fish and in the proper ingathering of the harvest of the sea.

Great expectations are entertained as to the value of the lessons to be taught at the approaching Exhibition. We are undoubtedly in need of knowledge of all kinds regarding the natural history of our fishes. From the whitebait to the whale we are singularly deficient in those details of fish life that would prove valuable to persons engaged in fishery enterprise. In the matter of well-planned investigation into the natural history of the British food fishes we are far behind America, where information of the most valuable kind is systematically collected and disseminated. As a matter of fact, we have (as a nation) done almost nothing in respect of adding to the knowledge of the public. Some individuals have been toying with the subject of *Pisciculture*, whilst in the seas that pertain to the United States fish-breeding on an extended scale has been long in operation under the auspices of the Government. It will not be the fault of the promoters of the approaching Exhibition if attention is not aroused to our want of interest (as a people) in the sea-fisheries of the country. We have therefore every reason to be grateful to those who have stepped to the front in order to promote this enterprise; the men who have assumed the lead have nothing to gain personally by its success—they are working in the interests of the public, knowing well that the fisheries of the surrounding coasts contribute largely to the commissariat of the country.

A portly prospectus, so far as its contents are concerned, has been issued, indicative of what will be shown in the Exposition, and from that document we gather that a large sum of money will be distributed in prizes for inventions and improvements of fishing gear; the special prizes in this department alone will number over 100, ranging in value from 600*l.* to 2*l.* 10*s.* Over 1000*l.* will also be given for essays on various topics connected with the economy of the fisheries and the natural history of our more important food fishes, as also for papers on fishery legislation. The dissemination of the knowledge to be obtained from such essays as may be awarded prizes is important. None of the essays contributed to the Norwich Exhibition have been published, except that of Sir James Maitland, printed presumably at his own expense, so that whatever information was contained in the Norwich prize essays remains only in the cognisance of those who read them. The Edinburgh prize essays are, we believe, being printed. Surely they might have been published ere this, and it might be taken into consideration by the executive of the present Exhibition, whether it is possible to have the essays judged, the prizes awarded, and a print of such as are worthy of being published on sale in the building in the course of the summer: a popular "handbook" to the Exposition will, we may presume, be issued. As to "exhibits" of a useful kind, such as those of fishing gear of every description, men with a practical turn of mind will be able to take stock of them and perceive at a glance how far they can be utilised. As a class, fishermen are slow to learn and chary in the way of trying experiments, but it is not impossible that the approaching Exhibition may contain the germs of some new ideas which may prove alike practical and profitable.

## THE PROGRESS OF TELEGRAPHY

THE first of the series of six lectures on the Applications of Electricity was delivered on Thursday evening, February 15, at the Institution of Civil Engineers, on "The Progress of Telegraphy," by Mr. W. H. Preece, F.R.S., M.Inst.C.E., of which the following is an abstract:—

Telegraphy is the oldest practical application of electricity. It grew about the railway system, and was rendered a practical agent by the foresight of Robert Stephenson, I. K. Brunel, Joseph Locke, and G. P. Bidder, who were its godfathers in England. Electric currents are, as a rule, maintained for telegraphic purposes by the combustion of zinc, and in the innumerable forms of batteries in use, the conversion of zinc into sulphate of zinc is the root of the transformation of energy into that form which was utilised as electric currents. There are three forms of battery in use in the British Post-Office Telegraph system, and in the following numbers:—

| | |
|---|---|
| Daniell ... ... ... ... ... ... | 87,221 cells. |
| Leclanché ... ... ... ... ... | 56,420 ,, |
| Bichromate ... ... ... ... ... | 21,846 ,, |

Every administration has its own adopted form, differing in design, but based on one or other of these types. Magneto-electricity is employed for some forms of apparatus, and dynamo-machines are sometimes used to supplement batteries. Experiments are now being made with secondary batteries. The various terms employed—electromotive force, resistance, induction, and current—though measurable in definite units, have not yet become household words; but, being admitted into commercial, legal, and Parliamentary lore, they will soon be as familiar as feet, gallons, or pounds.

Electric currents are conveyed from place to place either overground, underground, or submarine.

*Overground.*—Wooden poles preserved in creosote are employed in England, but iron poles are extensively used in the colonies. The conducting wire is almost universally of iron, but copper wire is much used through smoky places where iron is liable to rapid decay. Phosphor-bronze wire is under trial, and is a very promising material, as it possesses the conductivity of copper with the strength of iron. The improvements made in the quality of iron wire have been very great, and it conducts now fully 50 per cent. better than it did a few years ago. Electric tests have had a marvellous effect upon the production of pure metallic conductors; copper has improved in even greater ratio than iron; samples have been produced better even than the standard of purity. The insulators remain principally of porcelain, and their forms vary nearly with the number of individuals who use them; the only improvement of any value recently made is one which facilitates the very necessary process of cleaning.

*Underground.*—Wires are almost invariably carried underground through towns. Copper wire, insulated with gutta-percha, incased in iron pipes, is the material used. There are 12,000 miles of underground wire in the United Kingdom. There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snowstorms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth; so that overground are, commercially, sixteen times better than underground wires. To lay the whole of the Post-Office system underground would mean an expenditure of about 20,000,000*l.* Hence there is no desire to put wires underground except in towns. Besides snowstorms are few and far between, and their effects are much exaggerated. Of the numerous materials and compounds that have been used for insulating purposes, gutta-percha remains the oldest and the best for underground purposes. It, like all other materials used for telegraphy, has been improved vastly through the searching power that the current gives the engineer.

*Submarine.*—The past ten years has seen the globe covered with a network of cables. Submarine telegraphs have become a solid property. They are laid with facility and recovered with certainty, even in the deepest oceans. Thanks to such expeditions as that of H.M.S. *Challenger*, the floor of the ocean is becoming more familiar than the surface of many continents. There are at present 80,000 miles of cable at work, and 30,000,000*l.* have been embarked in their establishment. A fleet of twenty-nine ships is employed in laying, watching, and repairing the cables. The Atlantic is spanned by nine cables in working order. The type of cable used has been but very little varied from that first made and laid between Dover and Calais; but the character of the materials, the quality of the copper and the gutta-percha, the breaking strain of the homogeneous iron wire, which has reached 90 tons to the square inch, and the machinery for laying, have received such great advances, that the last cable laid across the Atlantic, by the Telegraph Construction and Maintenance Company, was done in twelve days without a hitch or stoppage.

Ideas are conveyed to the mind by electric signals, and in telegraphy these signals are produced at distant places by using two simple electrical effects: (1) that a magnetic needle tends to place itself at right angles to a wire when an electric current passes through it; and (2) that a piece of iron becomes a magnet when a current of electricity circulates around it. An innumerable quantity of tunes can be played on these two strings. Various companies were established at different times to work certain systems, but when the telegraphs were absorbed by the State the fittest were selected to survive, and their number consequently declined.

The A B C instrument is the simplest to read, for it indicates the letters of the alphabet by causing a pointer to dwell opposite the desired letter. There are 4398 in use. Its mechanism is, however, complicated and expensive, and it is being rapidly supplanted by the telephone. The needle instrument is the simplest in construction, but it requires training to work it. There are 3791 in use in the Post Office, and 15,702 among different railway companies. As a railway instrument it is the simplest, cheapest, and most efficient ever devised. The Morse instrument, of which there are 1330 in use in the Post Office and 40,000 on the Continent, records its letters in ink, in dots and dashes on paper tape, and, like the needle and A B C, appeals to the consciousness through the eye; it also indicates the letters of the alphabet by sound, and thus utilises the organ of hearing. Sound-reading is gaining ground in England with great rapidity. There are now 2000 sounders in use: in 1869 there were none. In America scarcely any other instrument is used. On the Continent there is scarcely one.

Acoustic reading attains great perfection in Bright's bell instrument, where beats of different sound replace the dot and dash of the Morse alphabet. Sound-reading is more rapid and more accurate than any system of visual signals or permanent record. In fact no record is kept in England, for the paper tape is now destroyed as soon as it has been read. Errors are of course inherent in all systems of telegraphy. A telegraphist cannot see what he writes, or hear what he says, and who is there that does not make mistakes whose eye follows his pen, or whose ear takes in his own words? The Hughes type-instrument, which prints messages in bold Roman characters, is much used on the Continent; it is, in fact, recognised as the international instrument, but it has had to give way in England to a more rapid system of telegraphy. It is, however, solely used for the Continental circuits by the Submarine Telegraph Company. All long cables are worked by Sir William Thomson's beautiful siphon-recorder.

In ordinary working only one message can be sent in one direction at one time; but by a simple and ingenious contrivance, by which the neutrality of opposite currents is utilised to convey signals, duplex telegraphy is rendered possible, so that two messages can be sent on the same wire at the same time; and by a still further improvement, where currents of different strength are utilised, four messages are sent on one wire—two simultaneously in opposite directions—at the same time. There are in England 319 duplex and 13 quadruplex circuits at work.

The acme of efficiency in telegraphy is attained in the automatic system, in which manual labour is supplanted by mechanism in transmitting the messages. There are 71 circuits worked by these instruments, and 224 instruments in use, and a speed of working of 200 words per minute is easily maintained upon them. When the hand alone is used, from 30 to 40 words per minute is the maximum rate attained, but by automatic means the limit is scarcely known. Since this system can be duplexed, and in many cases is so, 400 words per minute on one wire are easily sent. By the use of high-speed repeaters, the length of circuit for automatic working is scarcely limited; it would be easy to send 100 words per minute to India.

The growth of business since the telegraphs have been acquired by the State is enormous: 126,000 messages per week have grown to an average of 603,000; but the mileage of wire has not increased in anything like the same proportion, the excess of traffic having been provided for by the great improvements made in the working capacity of the apparatus. In 1873, the average number of messages per mile of wire was 147, it is now 256. It is in press work that the greatest increase has taken place: 5000 words per day at the time of the Companies have grown to 934,154 words per day now. 340,966,344 words of press matter were delivered in the year ending March 31, 1882.

The development of railways has necessitated a corresponding increase in the telegraphs required to insure the safety of the travelling public, and while 27,000 miles of wire in England, Scotland, and Wales were used for that purpose in 1869, at the end of December, 1882, the total had increased to 69,000 miles, equipped with 43,176 instruments, against 8678 in 1869.

The growth of business is equally discernible in the great cable companies. In 1871 the number of messages dealt with by the Eastern Telegraph Company was 186,000; in 1881, it was 720,000. This growth is equally striking in all civilised countries, and even in Japan 2,223,214 messages were despatched last year, of which 98 per cent. were in the native tongue. The mode of transacting the trade of the world has been revolutionised, and while wars have been rendered less possible, their conduct has been expedited, and their penalties alleviated.

## *CENTRAL AND WEST AFRICA*[1]

THE brilliant journey of Major Serpa Pinto across Africa from Loanda, by the Zambesi to Natal, must be fresh in the recollection of our readers. The present narrative may be regarded as complementary of the major's exciting story. Captains Capello and Ivens were members of the original expedition along with Major Pinto, and for the first part of the journey the three companions worked together. The object of the expedition, which was organised by the Portuguese Government, was to thoroughly survey the great artery which—a tributary of the Congo—runs from south to north between 17° and 19° E. of Greenwich, and is known as the Cuango, as also to determine all the geographical bearings between that river and the west coast, and make a comparative survey of the hydrographical basins of the Congo and Zambesi. The three travellers started from Benguella in November, 1877, but had not proceeded far on their journey, when a difference of opinion arose as to the future route of the expedition. Messrs. Capello and Ivens did not feel at liberty to depart from the original letter of their instructions, while the bold Major Pinto conceived that he would be carrying out the spirit of their instructions by making a dash across the continent. We have nothing to do with the quarrels of the travellers; experience proves that in such an expedition there should be one supreme head, and that the best exploring work has often been done by a white traveller single-handed. Major Pinto's presence with the other two was really unnecessary, and it was certainly to the advancement of geographical knowledge that he took an entirely different route. Messrs. Capello and Ivens are evidently two pleasant and agreeable gentlemen, though we have some doubts if exploration is exactly the *métier* to which they are best adapted. At all events they have written a narrative that contains much pleasant reading, and some additions to our knowledge of the geography and natural history of the limited region which they traversed. Their real work lasted for about two years, during which they traced the Cuango northwards to about 5° S. lat., when they were compelled to turn back, partly owing to the exhaustion of their supplies, and partly to the arid nature of the country beyond their farthest point. During their journey they crossed innumerable streams, some of them adding their waters to the Cuango and others joining the Cuanza, which discharges into the Atlantic south of Loanda. The sources of the Cunene, Cuanza, and Cuango were visited and determined, and a pretty careful survey of the region all along the route made. The country traversed is mostly mountainous, cut up by innumerable streams and valleys, rich in many parts in vegetation, and even in metals, and having a considerable population clustered in villages, each of which is ruled by its chief. With each of these chiefs much diplomacy had to be used in order that the

[1] "From Benguella to the Territory of Yacca; description of a journey into Central and West Africa." By H. Capello and R. Ivens. Translated by Alfred Elwes, Ph.D. Two vols. (London: Sampson Low and Co., 1882.)

explorers and their followers might obtain provisions and be allowed to pass; but the repetition of the same story of petty troubles and difficulties becomes ere long somewhat tiresome. The habits and dwellings, the implements and weapons, the dispositions and superstitions of the people in this region are pretty much the same as those of the other Bantu tribes with which Pinto, Stanley, Cameron, and other recent explorers have made us familiar. Among the Ganguella we find considerable

FIG. 1.—A Muata of the T'chiboco.

manufactures of iron, while Bihé is rich and fertile, and its inhabitant the greatest native travellers in Africa. In reference to the Bihenos the authors have some curious remarks on the well-known African prefix in its varying forms *ma*, *ba*, &c. They seriously lament the ignorance of ethnologists who call the Kafirs "Bantu," a word, they tell us, which simply means "persons." This is in strict analogy with the customs of nearly all peoples, who almost invariably refer to themselves by terms which mean *the people*, *the men*, &c. Bantu has come to have a well-defined ethnological significance, and is not likely to be displaced by the not too well-informed criticisms of our travellers.

Among the people of this region we find the same elaborate methods of dressing the hair, so common in Central and Western Africa, and with which readers of recent African travel must be familiar. We have some interesting details as to the history of some of the leading tribes of the region, from which it is evident that for centuries the various African peoples have been in a state of almost constant migration, that the so-called states are exceedingly unstable, and that even here it would be hazardous to regard any one race as unmixed.

FIG. 2.—Woman of Cangombe

We give here two types: Fig. 1, a Muata, or ruler, of the T'chiboco; and Fig. 2, a woman of Cangombe.

The sources of the Cuango were found at a height of 4756 feet, at about $11\frac{1}{3}°$ S., and a little east of 19° E., in one of the most extraordinary watersheds to be met with anywhere. It is thus described:—

"An extensive tract of land, all hill and dale, marks this culminating point, a sort of St. Gothard of the African waters. On the north, running through a narrow and tortuous valley, appeared the Cuango, which, shortly after its birth, flows at the foot of the plantations of manioc and massambala, growing abundantly upon the slopes, and at that time filled with girls and women engaged in hoeing and other field labours. A bluish

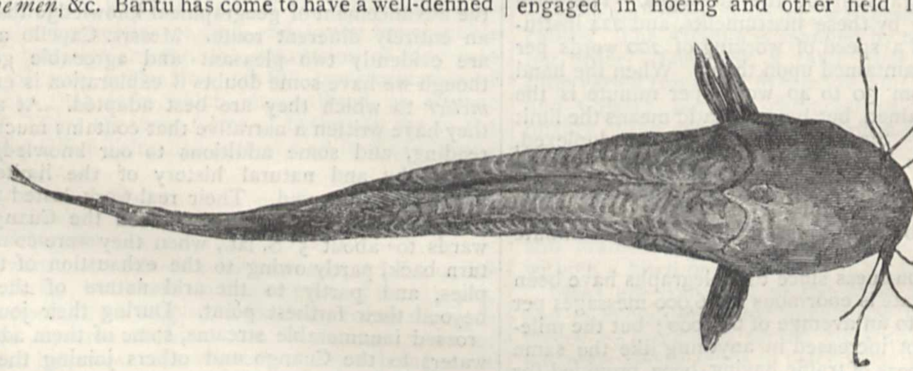

FIG. 3.—Ébande (Fish of the Cuango).

streak of land was visible in a south-west direction, and on the western slope, in *Canica*, appeared the sources of the Caùeu rivulet, which constitutes the modest commencement of the great Cassai. To the north-east stretched out the T'chibungo range, on whose eastern slope were visible the sources of the T'chipaca at about twenty-five miles from the point of observation, and whose latitude was 11° 27′ and longitude 19° 11′ 30″. Finally, the eye took in at various distances, approximately determined by the compass, an infinity of springheads, the sources of various affluents of the T'chipaca, the Cuango, the Cassai, the Lume, and the Loando, which, glittering in all directions, poured their ever-increasing waters to the Congo-Zaire, the Cuanza and the Zambese, till they were lost to sight in the valleys and ravines, where a denser vegetation still hinted at their sinuous course. The aspect of the country was magnificent. In the east, extended as far as the eye could reach, the rich green valley of the upper Cassai, clothed with numerous senzalas of *ma-quioco* and *ma-cosa*, indicated by the white patches of manioc flour spread to dry upon the *luandos* or mats of the *mabu*."

Speaking again of the same remarkable region, the writers say:—

"In a lofty position—the mean altitude being 1531 feet—the intense heat of the tropics is far from predominant, and the breeze which is stirring during a part of the year renders the climate soft and salubrious to the European. Standing upon a granitic plateau, the region may properly be described as the *Mother of the African Waters*,

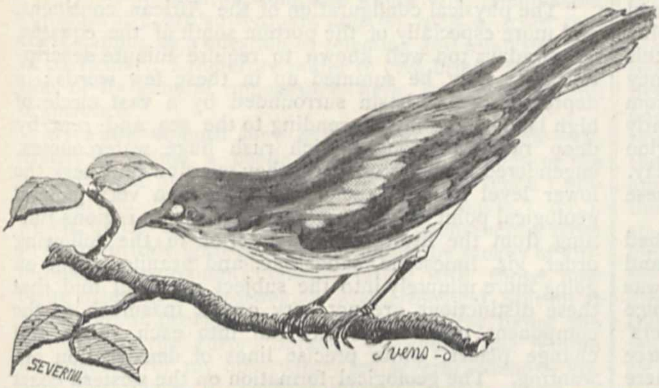

Fig. 4.—Fiscus Capelli (Cassange).

a veritable hydrographic centre whence issue, through deep gullies, the streams that flow to the two great oceans by the channels of the Congo-Zaire, the Cuanza, and the Zambese. Its mineral wealth is considerable, abounding chiefly in oligist iron; native copper exists more to the eastward, where, if we may rely upon the reports of the natives, the lodes are easily worked. The vegetable products, more especially upon the banks of the great rivers, are important. There are *Apocinaceas*, or india-rubber trees; *Burseraceas*, which yield aromatic resins such as the *Eleni; Herminieras*, used in the building of canoes; *Rubiacias*, or teak, mixed with *Erythrinas*, producing

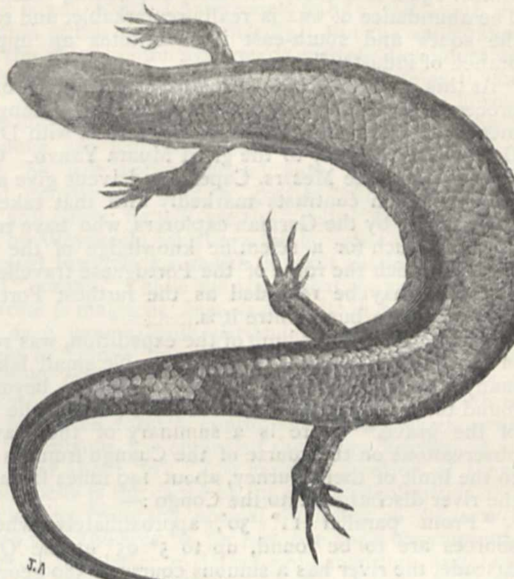

Fig. 5.—Euprepes Ivensi (new species), River Cuanza.

cork; several *Euphorbias*, acacias used for dyeing purposes; *Typhas*, and a species of *Borassus;* grasses of various kinds, such as the *panicum* and *andropogon*, the

Fig. 6.—The Cuango in Yacca.

*penisetum*, both smooth and barbed (massango), hemp, and a large number of *Convolvulaceas;* all these we ourselves saw. Among the variety of wild fruits of T'chiboco are distinguishable the *fungo*, not unlike a plum, but less pulpy and more sour, which grows upon a medium-sized tree; the *macolla*, of the granular species, having the shape and size of an orange, but resembling internally the American muruenia, that produces purgative effects when taken in large doses; the *tongo*, similar in form and dimensions to the white plum; and the *tundo*, almost equal to a cherry in taste, and having black seeds. The abundance of wax is really remarkable, and towards the south and south-east it constitutes an important branch of industry."

At this point the two travellers separated in order to proceed northwards on different sides of the Cuango, and met again at Cassange, where they fell in with Dr. Max Buchner, on his way to the great Muata Yanvo. Of this famous potentate Messrs. Capello and Ivens give a fancy portrait, which contrasts markedly with that taken from the original by the German explorers who have recently done so much for a scientific knowledge of the region through which the route of the Portuguese travellers lay. Cassange may be regarded as the furthest Portuguese outpost, and a busy centre it is.

Yacca, the furthest limit of the expedition, was reached in May, 1879, and although innumerable small lakes and many streams had been passed, the region beyond was found to be an arid desert, brooded over by "the silence of the grave." Here is a summary of the travellers' observations on the course of the Cuango from its source to the limit of their journey, about 140 miles from where the river discharges into the Congo:—

"From parallel 11° 30′, approximately, where its sources are to be found, up to 5° 05′ at the Quicunji cascade, the river has a sinuous course of 580 geographic miles, and a total fall between its extreme points of about 3 feet 4 inches per mile. Rocks, stones, rapids, and cataracts interrupt the stream, and twelve of the points at which they do so are known to us, namely, the first at parallel 10° 17′, to the east of Muene-songo; the second at 10° 25′, near the Camba rivulet; the third at 10° 08′, Caxita rocks; the fourth at 10° 05′, the Louisa falls; the fifth at 10° 05′, a cataract a little above Port Muhungo; the sixth at 9° 20′, Zamba; the seventh at 19° 19′, Tuaza; the eighth at 9°, cataract Cunga-ria-Cunga; the ninth at 7° 42′, Suco-ia-Muquita or Suco-ia-n'bundi; the tenth at 7° 38′, just below the Camba; the eleventh at 7° 35′, in the midst of numerous islands; and the twelfth at 5° 05′, the Quicunji waterfall, which is only passable after the heavy rains. The greatest navigable tract, therefore, is that space which lies between the cataract at 7° 35′ and Quicunji, or about 190 geographic miles. The river there is of variable width, never less than 76½ yards, and from 5 to 20 feet in depth. The current loses a little of its speed in the upper section, where the stream in the summer season has a fall of about 3 feet 2 inches per mile. We think it well to mention that our longitudes being strictly correct, as the record, partly chronometric, was compared both on departure and arrival at the Portuguese station of Duque de Bragança, and the latter again at the terminus on the coast, it appears to us that the point of affluence of the Cuango (or Ibari-N'Kutu) as marked upon the maps, just above Stanley Pool, is erroneously placed considerably to the eastward."

Major von Mechow, who has been exploring the river further down its course, has found it equally unnavigable, and we may say that the maps illustrating Mr. Stanley's last journey to the Congo place the mouth of the river further west than on those of his famous trans-African expedition. It was this river which Mr. Stanley ascended in his little steamer, and found it expanding into a broad lake. Messrs. Capello and Ivens came to the conclusion, confirmed by Major von Mechow, that no such lake as Aquilonda exists in this quarter. The travellers returned by a somewhat different route, staying for some time at Pungo N'Dongo, with its famous rocks, and reaching Loanda in October, 1879.

The work abounds with illustrations of the country and the people, many of them devoted to natural history. On the animal and plant life of the district traversed there are many valuable notes, and in the appendix will be found, besides tables of geographical observations and heights above sea-level, lists of additions to the fauna and flora, tables of African dialects, and a N'Bunda Vocabulary. There is a good summary of the general results in the concluding chapter, in which the authors have the following observations on the geology of the continent:—

"The physical configuration of the African continent, and more especially of the portion south of the equator, is nowadays too well known to require minute description. It may be summed up in these few words: a depressed central basin surrounded by a vast circle of high land, gradually descending to the sea, and rent by deep ravines, through which rush huge watercourses, engendered in the interior, till they overflow and seek the lower level fronting the ocean. From a very general geological point of view we may define the regions running from the littoral to the interior in the following order, viz. limestone, sandstone, and granite. But on going more minutely into the subject we shall find that these distinctions are not very exact; inasmuch as the component parts frequently run into each other and change places, while precise lines of demarcation are wanting. The geological formation on the western coast at the points observed by us between Loanda and Mossamedes, and even further to the north, exhibits generally near the sea a belt of tertiary deposits, with abundant masses of sulphate of lime and sandstone, from which they are separated by beds of white chalk alternating with primary rocks, for the most part gneiss, abounding in quartz, mica, hornblende, granite, and granulated porphyry. Towards the south large tracts of feldspar become visible. At Mossamedes whole mountains are composed of sulphate of lime; while carbonate of lime, accumulated in shells, is very frequent. Both rock-salt and nitrate of potash are found in stratification. Along the Mocambe chain, we were informed, there exists a basaltic line of great length. From that point the shifting soil may be said to commence, extremely abundant in sand, constituting true *saharas*, as in the parallel of Tiger Bay. In the transition from the lower zone towards the interior, for instance at Dondo, vast tracts of schist rock, in perfect laminæ, compose the soil; and sandstone, reddened by oxide of iron, is visible in every direction. Proceeding further into the interior we find, in a perfectly mountainous region, the ground to be composed of granite-quartzy rock, extremely hard and compact; this is the case throughout the belt crossed on the way and up to Pungo N'Dongo, the surface soil being formed by the disintegration of the granite itself. These geological characteristics will naturally be repeated to the south and north in identical parallel regions, with variations in the high table-land, where we meet occasionally with hard and tough red sandstone and rocks of feldspar as in the basin of the Lucalla."

In the same chapter will be found abundant notes on the various tribes visited, which, although the authors' ethnology appears to us by no means sound, are still a valuable contribution to a knowledge of the African peoples. As evidence of the important contributions to the natural history of West Africa, we give a few of the illustrations bearing on the subject.

## ON THE AURORA BOREALIS[1]

HAVING been requested by this journal to give an account of my latest researches into the nature of the aurora borealis, I must explain that my lateness in

[1] In reference to the present interesting communication from Herr Sophus Tromholt, from his station in Ultima Thule, we ought to point out that Herr Tromholt was, at the time of writing, not aware of the important discovery as regards the nature of the aurora made by Prof. Lemström at the Finnish station of Sodankylä during December last, and of which an account appeared in NATURE, vol. xxvii. p. 322.

complying with this request arises from the fact that I had this winter changed my residence from Bergen, where the communication was directed, to this spot—Kautokeino, in Ultima Thule.

Since September last I have, for the sake of the aurora borealis, been residing here in North Finmarken (69° N. lat., 23° E. long ), in a quarter, therefore, where the auroræ attain their maxima, and where the phenomena, consequently, are so frequent and on such a scale that there cannot be a question of selecting and analysing one in particular. I therefore prefer to give briefly a description of its general appearance here, its character and occurrence.

My winter sojourn here has two objects in view—viz. firstly, to frame a pendant to the observations of the auroræ made at Bossekop, 1838-39, by the French Commission du Nord ("Voyages en Scandinavie," &c.), which, by the bye, later students of the phenomenon seem to have entirely ignored; and secondly, by means of altitudinal measurements corresponding with those now being made at the Norwegian Meteorological Station at Bossekop, to procure sufficient materials for fixing the parallax of the aurora borealis. I choose the remote Kautokeino for my observatory for several reasons—viz. that this place is situated almost exactly south of Bossekop, while the distance between the two places is very nearly a degree, a distance which is exactly suited to the opinion I have formed as to the height of the aurora, viz. 150 kilometres, and also for the reason that Kautokeino possesses a very free horizon, and that its situation, very far inland, would insure favourable weather conditions.

As previously stated, observations are made simultaneously here and at Bossekop on a common prearranged plan, and measurements made in the common vertical plane by the so-called auroral theodolite, constructed by Prof. Mohn. A similar arrangement has also been effected with the Finnish Meteorological Station at Sodankylä, which is, however, situated at a great distance from this place and in a somewhat unfavourable direction (about 45° S.E.). We shall not, of course, be able to compare notes before the spring, so I am unable at present to lay before the reader the final results; but judging from my own researches here, I feel convinced, in spite of assertions made by scientists to the contrary, that the exact height of the aurora may be ascertained by the method I advocate, and that from the observations made at these three stations we shall glean sufficient materials to solve a problem hitherto deemed an insoluble one.

Auroræ occur here, I may say without exaggeration, every night, and an evening without them would be a phenomenon as remarkable as their appearance under the equator. Unfortunately, however, unfavourable weather has during the last two months, accompanied by cloud masses unusual in these latitudes, sadly interfered with the number and completeness of my observations. Still, the magnitude of the auroræ is not the same every night. Sometimes they appear as short, faint, arc-shaped phenomena, similar to those so frequently seen in South Norway, while at others they assume an extent and grandeur which mocks every attempt at description.

In one respect my researches here have been of great moment to me, *i.e.* with regard to understanding the various types of the auroræ, their real strike and shape, and their exterior appearance, which changes in the different altitudes above the horizon; while on account of their frequency, and the circumstance that they now appear in the north, then in the south, and at last in zenith, there is a splendid opportunity to study the modifications which one particular form of aurora is subjected to when changing its position to the observer. It appears now conclusive to me that the many forms usually described in researches may be reduced to a few, almost similar, types. In most instances the aurora runs in zones, belts, in the direction of the magnetic east-west, and either as a more or less diffuse luminosity, or as thin shining bands, which I have found to be parallel with the indication of the inclination needle. But the appearance which the phenomenon assumes is entirely dependent on the relative position which the observer occupies to the same. If he is thus greatly distanced from the aurora he will only observe, a few degrees above the horizon, a continuous arc with streamers, but if he approaches nearer, he will notice several such arcs with clearly defined constituents and a greater vibratory motion, and if still closer, he will see the "belts" or bands mentioned by Weyprecht far above the horizon; and if these then travel towards *his* zenith, he will distinctly see the auroral "corona." I have just stated that the main strike of the auroræ is magnetic east-west; this is, however, only stated as a general rule, particularly with those of the luminous or "glory" type, while the "belts" may, besides their slight folds, be twisted and slung in almost any direction. I have thus seen them stretch from north to south, and even form a continuous circle, which, with zenith as centrum, has engirdled the entire heavens at an elevation of about 30°. The variable position of these luminous belts is the cause of the many peculiarities and the deviations from the normal which are so *frequently* observed with the arcs, as, for instance, their unsymmetrical position in relation to the magnetic meridian, and their uneven shape, viz. that they are often bent ecliptically back at the points, or even take the appearance of regular eclipses. I ought, however, to point out that the faint retrograding bend which great arcs assume near the horizon is due simply to optical causes. The study of the auroral corona here is very instructive. When a belt of streamers travels towards the magnetic zenith, the radiations seem to become shorter and shorter, caused by the circumstance that they are seen obliquely, and when the belt passes the magnetic zenith, its lower rim only is seen, which makes it appear as a bent and folded luminous belt. In this position one may observe that every individual streamer has only a very limited depth, but that the belt consists of several, sometimes of a great number, of luminous "sheets" in a parallel position to one another.

Besides this form of aurora, which thus embraces two kinds, viz. the continuous and the radiating, I know only one more of a character distinctly differing from the same. I do not thus consider the individual knots of ray-auroræ, or the streamers, as anything but incomplete belts; while the luminous gatherings I consider are merely remnants, so to say, of previously radiant auroræ. I may also here state that the large purple auroral clouds peculiar to this phenomenon, when observed during considerable electrical disturbances in southern climes, I have never seen at Kautokeino.

Of quite a different nature is, however, the phenomenon which I have named "coruscation." This phase of the aurora, which almost without exception belongs to the earliest hours of the morning, and after large and extended oscillations of the aurora, is developed, I believe, by the luminous clouds. But while these remain quiet, or show at least subdued oscillations, the "coruscation," as I term it, is so violent and of such a peculiar nature, that I have not even yet succeeded in ascertaining whether the motion is horizontal or vertical, or whether it is the luminous clouds themselves which flood the heavens, or their merely momentary "blazing up" under the influence of some passing waves of energy. The entire heaven is sometimes for hours a bath of liquid fire by this force, which seems, by the bye, to possess the same remarkable rapidity around zenith as at lower elevations.

As regard the colours of the auroræ, I have only noticed, when the substance of light is great, and when the oscillations are very rapid, two well-known forms, viz. green and red. These are, however, only seen in the arcs as their lower rim, and by the forward movement one part assumes a red, another a green tint. The red colour sometimes changes into violet or ochre.

The spectroscope I have not had much opportunity of using here, but the well-known auroral "line" I can always see; any others I have not observed.

With regard to the height of the aurora I have, judging from observation, come to the conclusion that it does not appear at a lower elevation here than it does in the south of Norway, while I am convinced that its plane is to be found far above that of the clouds. There has often enough been an opportunity of observing auroræ and clouds simultaneously, but never has there been the slightest indication of the auroræ having descended to the sphere of the clouds, not even under the most violent oscillations and the most intense luminosity and play of colour. In fact I have come to the conclusion that the auroræ which I have watched at Kautokeino are identical with those I have studied in southern latitudes, while their plane is at the elevation which I estimated when choosing Kautokeino as my station of observation.

I may in conclusion state that I have never myself heard the slightest approach to any auroral "noise," and this in spite of my most earnest attention to this so-much-disputed question. Still if I ask the native people (Lapps) about here as to the "noise" there is not a single one who doubts its existence, while several even assert that they have heard it.

I have several times attempted to photograph the aurora borealis, but without success. Thus even by using the most sensitive English "dry" plates, and exposing them from five to seven minutes, I have not obtained a trace of a negative. The cause of this is, I believe, the exceedingly limited substance of light possessed by the auroræ: were thus even the entire heavens flooded by the most intense auroræ, their aggregate lighting capacity would not equal that of the moon when full. I may therefore assume that photographing the aurora borealis is an impossibility. SOPHUS TROMHOLT

Kautokeino, Finmarken, Norway, January 28

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## *PROFESSOR HUXLEY ON EDUCATION*

ON the 16th inst., Prof. Huxley gave an address in connection with the distribution of prizes at the Liverpool Institute, a revised report of which will appear in the next number of the *Journal of Education*. By the courtesy of the editor of that journal, we are enabled to give a few extracts from Professor Huxley's address. He began by referring to certain propositions which he laid down in the address he gave in Liverpool fourteen years ago as to the practical value of instruction in physical science, its superiority to any other study as a mental discipline, and the certainty that in the future physical science would occupy a much larger share in the time allotted to teaching than had been the case previously. He also laid special stress upon the fact that he was no advocate of the exclusion of other forms of culture from education, but, on the contrary, insisted that it would be a serious mistake to cripple them for the sake of science. He had no sympathy, he said, with a kind of sect or horde of scientific Goths or Vandals who think that it would be proper and desirable to sweep away all other forms of culture and instruction except those in physical science. After referring to the great variety of his past experiences, his familiarity with every form of society, from the uncivilised savage of Papua and Australia, to the occasionally somewhat over-civilised members of our upper ten thousand, and to his interest in every branch of knowledge and form of art, Prof. Huxley insisted on the vast importance of science in education, when properly taught. He pointed out, however, that unless the knowledge conveyed in the teaching of science or in the teaching of history were actually realised to themselves by the learners, it would be worse than useless.

"Make it as little as you like, but unless that which is taught is based on actual observation and familiarity with facts it is better left alone. There are a great many people who imagine that elementary teaching might be properly carried out by teachers provided with only elementary knowledge. Let me assure you that that is the profoundest mistake in the world. There is nothing so difficult to do as to write a good elementary book, and there is nobody so hard to teach properly and well as people who know nothing about a subject; and I will tell you why. If I address an audience of persons who are occupied in the same line of work as myself I can assume that they know a vast deal, and that they can find out the blunders I make. If they don't, it is their fault and not mine; but when I appear before a body of people who know nothing about the matter, who take for gospel whatever I say, surely it becomes needful that I consider what I say, make sure that it will bear examination, and that I do not impose upon the credulity of those who have faith in me. In the second place, it involves that difficult process of knowing what you know so well that you can talk about it as you can talk about your ordinary business. A man can always talk about his own business. He can always make it plain; but if his knowledge is hearsay he is afraid to go beyond what he has recollected and put it before those that are ignorant in such a shape that they shall comprehend it. That is why, to be a good elementary teacher, to teach the elements of any subject, requires most careful consideration if you are a master of the subject; and if you are not a master of it it is needful you should familiarise yourself with so much as you are called upon to teach—soak yourself in it, so to speak—until you know it as part of your daily life and daily knowledge, and then you will be able to teach anybody. That is what I mean by practical teachers, and although the deficiency is being remedied to a large extent, I think it is one which has long existed, and which has existed from no fault of those who undertook to teach, but because until within the last score years it absolutely was not possible for any one in a great many branches of science, whatever his desire might be, to get instruction which would enable him to be a good teacher of elementary things. All that is being rapidly altered, and I hope it will soon become a thing of the past."

Then as to the important question of time, Prof. Huxley said that all he asked for was that scientific teaching should be put into what politicians and statesmen call the condition of the "most favoured nation"; that is to say, that it shall have as large a share of the time given to education as any other principal subject. On the important question as to what should be regarded as "principal subjects," Prof. Huxley remarked as follows:—

"I take it that the whole object of education is, in the first place, to train the faculties of the young in such a manner as to give their possessors the best chance of being happy and useful in their generation; and, in the second place, to furnish them with the most important portions of that immense capitalised experience of the human race which we call knowledge of various kinds. I am using the term knowledge in its widest possible sense, and the question is what subjects to select, by training and discipline in which the object I have just defined may be best attained. I must call your attention further to this fact, that all the subjects of our thoughts, feelings, and propositions, leaving aside the mere materials and occasions of thinking and feeling—our sensations as all our mental furniture—may be classified under one of two heads: as either within the province of the intellect, something that can be put into proposition and affirmed or denied, or as within the province of feeling, or that which, before the name was defiled, was called the æsthetic side of our nature, and which can neither be affirmed nor denied, but only felt and known. According to the classification which I have put before you then, the subjects of all knowledge are divisible into two groups, matters of science and matters of art; for all things with which the reasoning faculty alone is occupied come under the province of science, and, in the broadest sense, and not in the narrow and technical sense in which we are now accustomed to use the word art, all things feelable, all things which stir our emotions, come under the term of art, in the sense of subject matter of the æsthetic province. So that we are shut up to this,—that the business of education is, in the first place, to provide the young with the means and the habit of observation; and, secondly, to supply the subject matters of knowledge, either in the shape of science or of art, or of both combined. Now, it is a very remarkable fact—but it is true of most things in this world—that there is hardly anything one-sided or of one nature, and it is not immediately obvious what, of the things that interest us, may be regarded as pure science, and what may be regarded as pure art. It may be that there are some peculiarly constituted persons, who, before they have advanced far into the depths of geometry, find artistic beauty about it, but, taking the generality of mankind, I think it may be said that when they begin to learn mathematics their whole souls are absorbed in tracing the connection between the premisses and the conclusions, and that to them, geometry is pure science. So I think it may be said that mechanics and osteology are pure science. On the other hand, melody in music is pure art. You cannot reason about it; there is no proposition involved in it. So, again, in the pictorial art, an arabesque, or a 'harmony in grey,' touch none but the æsthetic faculty. But a great mathematician, and even many persons who are not great mathematicians, will tell you that they derive intense pleasure from geometrical reasonings. Everybody knows that mathematicians speak of solutions of problems as 'elegant,' and they tell you that a certain mass of mystic symbols is 'beautiful, quite lovely.' Well, you do not see it. They do see it, because the intellectual process, the process of comprehending the reasons symbolised by these figures and these signs, confers upon them a sort of pleasure, such as an artist has in visual symmetry. Take a science of which I may speak with more confidence, and which is the most attractive of those I am concerned with. It is what we call morphology, which consists in tracing out the unity in variety of the infinitely diversified structure of animals and plants. I cannot give you any example of a thoroughly æsthetic pleasure more intensely real than a pleasure of this kind —the pleasure which arises in one's mind when a whole mass of different structures runs into one harmony as the expression of a central law. That is where the province of art overlaps and embraces the province of intellect. And if I may venture to express an opinion on such a subject, the great majority of forms of art are not in the sense what I just now defined them to be—pure art; but they derive much of their quality from simultaneous and even unconscious excitement of the intellect. When I was a boy I was very fond of music, and I am so now; and it so happened that I had the opportunity of hearing much good music. Among other things, I had abundant opportunities of hearing that great old master, Sebastian Bach. I remember perfectly well—though I knew nothing about music then, and I may add know nothing whatever about it now—the intense satisfaction and delight which I had in listening by the hour together to Bach's fugues. It is a pleasure which remains with me, I am glad to think; but of late years I have tried to find out the why and wherefore, and it has often occurred to me that the pleasure, in musical compositions of this kind, is essentially of the same nature as that which is derived from pursuits which are commonly regarded as purely intellectual. I mean that the source of pleasure is exactly the same as in most of my problems in morphology—that you have the theme in one of the old masters' works followed out in all its endless variations, always appearing and always reminding you of unity in variety. So in painting; what is called truth to nature is the intellectual element coming in, and truth to nature depends entirely upon the intellectual culture of the person to whom art is addressed. If you are in Australia, you may get credit for being a good artist—I mean among the natives—if you can draw a kangaroo after a fashion. But among men of higher civilisation the intellectual knowledge we possess brings its criticism into our appreciation of works of art, and we are obliged to satisfy it as well as the mere sense of beauty in colour and in outline. And so the higher the culture and information of those whom art addresses, the more exact and precise must be what we call its 'Truth to nature.' If we turn to literature, the same thing is true, and you find works of literature which may be said to be pure art. A little song of Shakespeare or of Goethe is pure art, although its intellectual content may be nothing. A series of pictures is made to pass before your mind by the meaning of words, and the effect is a melody of ideas. Nevertheless the great mass of the literature we esteem is valued not merely because of having artistic form, but because of its intellectual content, and the value is the higher the more precise, distinct, and true is that intellectual content. And if you will let me for a moment speak of the very highest forms of literature, do we not regard them as highest simply because the more we know the truer they seem; and the more competent we are to appreciate beauty, the more beautiful they are? No man ever understands Shakespeare until he is old, though the youngest may admire him; the reason being that he satisfies the artistic instinct of the youngest and harmonises with the ripest and richest experience of the oldest. I have said this much to draw your attention to what, to my mind, lies at the root of all this matter, and at the understanding of one another by the men of science on the one hand, and the men of literature and history and art on the other. It is not a question whether one order of study should predominate or that another should. It is a question of what topics of education you shall select which will combine all the needful elements in such due proportion as to give the greatest amount of food and support and encouragement to those faculties which enable us to appreciate truth, and to profit by those sources of innocent happiness which are open to us, and at the same time to avoid that which is bad and coarse and ugly, and to keep clear of the multitude of pitfalls and dangers which beset those who break through the natural or moral laws."

Professor Huxley then went on to point out the worthlessness of the kind of literary education that used to prevail in English schools, and gave his idea of what a literary education ought to be. If, he said, he could make a clean sweep of everything, and start afresh, he would in the first place secure the training of the young in reading and writing, and in the habit of attention and observation both to that which is told them and that which they see; and he would make it absolutely necessary for everybody, for a longer or shorter period, to learn to draw, and there is nobody who cannot be made to draw more or less well.

"Then we come to the subject-matter, whether scientific or æsthetic, of education, and I should naturally have no question at all about teaching the elements of physical science of the kind I have sketched in a practical manner; but among scientific topics, using the word 'scientific' in the broadest sense, I would also include the elements of the theory of morals and of that of political and social life, which, strangely enough, it never seems to occur to anybody to teach a child. I would have the history of our own country and of all the influences which have been brought to bear upon it, with incidental geography, not as a mere chronicle of reigns and battles, but as a chapter in the development of the race and the history of civilisation. Then with respect to æsthetic knowledge and discipline, we have happily in the English language one of the most magnificent storehouses of artistic beauty and of models in literary excellence which exists in the world at the present time. I have said before, and I repeat it here, that if a man cannot get literary culture of the highest kind out of his Bible, and Chaucer, and Shakespeare, and Milton, and Hobbes, and Bishop Berkeley, to mention only a few of our illustrious writers—I say if he cannot get it out of those writers, he cannot get it out of anything; and I would assuredly devote a very large portion of the time of every English child to the careful study of the models of English writing of such varied and wonderful kind as we possess, and what is still more important and still more neglected, the habit of using that language with precision and with force and with art. I fancy we are almost the only nation in the world who seem to think that composition comes by nature. The French attend to their own language, the Germans study theirs; but Englishmen do not seem to think it is worth their while. Nor would I fail to include in the course of study I am sketching translations of all the best works of antiquity or of the modern world. It is a very desirable thing to read Homer in Greek; but if you don't happen to know Greek, the next best thing is to read as good a translation of it as we have recently been furnished with in prose. You won't get all you would get from the original, but you may get a great deal, and to refuse to know this great deal because you cannot get all seems to be as sensible as for a hungry man to refuse bread because he cannot get partridge. Finally, I would add instruction in either music or painting, or if the child should be so unhappy, as sometimes happens, to have no faculty for either of these, and no possibility of doing anything in an artistic sense with them, then I would see what could be done with literature alone; but I would provide in the fullest sense for the development of the æsthetic side of the mind. In my judgment these are all the essentials of education for an English child." Prof. Huxley concluded by saying that if the educational time permitted, there were one or two things he should be inclined to add to these essentials (which fitted an Englishman to go anywhere or to enter on any career); among these additional subjects he mentioned Latin and German. Beyond that, let each man take up his special line.

## NOTES

THE Emperor of Germany has raised Prof. Helmholtz to noble rank.

THE two English observers, Messrs. Lawrence and Woods, detailed to secure photographs of the total eclipse of the sun on May 6, left Southampton for Panama on Saturday last. The operations will be exclusively photographic. The Treasury only determined to grant the necessary funds some fifteen days before the last date on which the observers could sail; the instruments sent out, therefore, were most hurriedly put together; and the greatest praise is due to Messrs. Hilger and Meagher for their work against time. Detailed instructions and a time table stating the work to be done for every second from ten minutes before totality till ten minutes afterwards, have been sent with the observers. If all goes well more than fifty photographs will be secured.

IN reply to the Memorial addressed to the Council of the British Association on the subject of the proposed meeting of the Association in Canada in 1884, signed by 144 members of the General Committee, Mr. Bonney states that the Council of the British Association are fully alive to the difficulties which will attend the visit to Canada decided upon by the General Committee at Southampton in August last. As this decision was obtained in accordance with the usual forms and does not appear to contravene the express wording of the rules of the Association, the Council feel bound to recognise it as a valid one, and believe that they would not be justified in summoning a special meeting of the General Committee to reconsider the question. They have, however, in effect already taken steps to ascertain the general feeling of the members of the Association. In the month of November last, after a consultation with Sir A. T. Galt, the High Commissioner for Canada in this country, the officers of the Association addressed to their intending hosts in Montreal a number of questions, upon the answers to which the success of the projected visit must greatly depend. To these questions they are now daily expecting a reply. As soon as this is received, information will be given to the Members of the Association, and inquiries made as to their willingness to visit Canada. The replies will enable the Council to judge whether it will be possible to hold a successful and fairly representative meeting at Montreal.

M. RAOUL PICTET has recently tried, on the Lake of Geneva, a specimen of his "rapid vessel," the general idea of which was indicated a short time ago. The vessel is figured in *Archives des Sciences* for January, and M. Pictet gives details of the theory and working. With a length of about 67 feet, and a width of 13 feet, this vessel is peculiar chiefly in having a bottom that is of parabolic form lengthwise, the concavity downwards; transversely the bottom is nearly straight; the sides are vertical. A keel reaching from about the middle of the length, incloses a screw shaft. Among other results M. Pictet shows that the force of traction of this vessel is always less than that of an ordinary vessel of the same general form and going at the same rate. The advantages of the parabolic curve only become apparent at a certain speed, depending on the width, length, and tonnage, and the parameters of the parabolic curve. The force of traction passes through a maximum, at a certain velocity for each vessel; beyond that point, the work of the motor, and so the expenditure of fuel, diminishes, though the speed increases. Experiment has yet to decide the limits of this second period. The emergence of the vessel, very small for small velocity, grows very quickly when a speed of 5 metres (say 17 feet) per second has been reached; and it converges rapidly towards an upper limit. The recoil of the screw for different velocities increases to a maximum, then constantly diminishes and tends to become *nil* for an infinite velocity. For other features of the action we must refer to the original. The engine we note proved faulty, and in several of the experiments the vessel was towed by a steamer, at velocities rising to 27 kilometres (say 17 miles); when this last is reached, an economy of one-half is realised (growing from 16 kilometres).

THE recent death of the Rev. Titus Coan, an aged and much-esteemed missionary at Hilo, Hawaii (where he laboured nearly forty-eight years), has been announced (*Am. Journ. Sci.*). He took a deep interest in the volcanic mountain at whose foot he lived, and at each eruption was generally the first on the ground to observe and report on the movements. Three times he ascended to the scenes of the eruptions connected with the summit crater. Though not a geologist, his accounts (many of them in the journal named) have always been of geological value. He was the principal historian of the great eruption of Kilauea in 1840, and the summit eruption of 1843, when the flow was uninterrupted for twenty-five miles and continued six weeks. It was after the latter eruption that he made the very important observation (since confirmed) that

Kilauea, though 10,000 feet lower in level than the summit crater, showed no change, no signs of sympathy whatever.

A DEPUTATION from a number of the Scientific Societies of London had an interview with Sir John Lubbock on Tuesday, for the purpose of asking him to oppose the Bill to authorise the construction of a railway through Epping Forest. It was stated that the line would greatly destroy the natural beauty of the Forest, and that the existing means of access to it were abundant. Sir John Lubbock said he would be prepared to assist in opposing the Bill; but it was pointed out that, as the Corporation and the Verderers had given their sanction to the scheme, it would be difficult to secure its rejection.

THE death is announced of Herr Thomas Dickert, well known by his geographical relief-maps. He died on January 11 at Poppelsdorf, near Bonn, aged eighty-two. Also of Dr. Bohdalek, formerly Professor of Descriptive Anatomy at Prague University, who died at Leitmeritz on February 2.

AT a public meeting held in Glasgow last week, called at the suggestion of Sir William Thomson and Mr. John Burns of Castle Wemyss, it was agreed to collect the money to establish a permanent and efficient observatory on Ben Nevis. The building will cost 2000*l.*, the instruments 1000*l.* In all 5000*l.* are required, and of that sum 1400*l.* has already been subscribed. The Government has refused to assist in the matter.

M. TRESCA read before the Paris Academy of Sciences on Monday his report on the experiments of M. Marcel Deprez; the distance being exactly 17,000 metres instead of 20,000 as at first asserted, and the motive-power 6·21 horse instead of 5, the percentage is exactly 0·326, a little less than one-third. It may be supposed that the percentage of primary engines, telegraph wires, and secondary engines is 0·70, so that the result obtained is just $(0\cdot70)^3=0\cdot343$, almost exactly the real value. The measurements have been taken with accuracy, and no error can be adduced. The number of revolutions of the primary machine was 588 in a minute. Others were tried on Monday with 814 revolutions, but it is too soon to judge of the result. M. Tresca having declined to do so, an Academical Commission has been appointed to report upon M. Deprez's theories. M. Tresca praised Mr. Hutchinson who made the electrical measurement with apparatus brought from London for measuring differences of potential and number of amperes. The electrical measures were verified with dynanometers.

DR. WARREN DE LA RUE has been elected by the Committee a Member of the Athenæum Club under Rule 2, which provides for the admission of persons eminent in literature, science, or the arts, or for public services.

THE usual sitting of the Congrès des Sociétés Savants will take place in Paris on March 27, 28, and 29 next. The Minister of Public Instruction will preside over the concluding meeting on the 30th. For the first time the Academy of Aërostation has been summoned to send delegates.

FROM the beginning of the next financial year Kew Gardens will be opened an hour earlier than at present, viz. at 12 o'clock instead of 1.

AT the Technical College, Finsbury, the introductory address was given by Mr. Philip Magnus, Director and Secretary of the Institute, on Monday evening last. Sir Frederick J. Bramwell, F.R.S., was in the chair.

WE are glad to see that the new and spirited Scottish quarterly, the *Scottish Review*, does not neglect science. In the February number, which is just out, there appears an article on Medical Reform and an appreciative estimate of the late James Clerk Maxwell.

THE *Journal Télégraphique du Bureau Central de Berne*, summarising the principal lacunæ in the universal system of telegraphy, notes as one the construction of a line to Iceland for recording the principal atmospherical events observed in the Polar regions.

A DISTINGUISHED Swedish entomologist, Gustaf Wilhelm Belfrage, has recently died in Texas, where he had been for some years residing. The deceased had collected and forwarded a number of entomological specimens to the Swedish Academy of Sciences in Stockholm, for which he had received a State grant.

AN International Exhibition of Garden Produce and a Botanical Congress will be held in St. Petersburg this summer.

REPORTS from Lower Bavaria announce the discovery of auriferous and argentiferous sand deposits. They are confined to a layer of gneiss which occurs in the granitic rocks for a length of about fifteen or eighteen miles, between the villages of Innernzell and Zenting. It appears that 100 kilogrammes of the sand contain about 10 to 15 grammes of pure silver and between 2 and 10 grammes of pure gold; the sand from 4-6 metres depth is even richer. The weathered gneiss partly carries gold and silver and partly gold only; no special form is marked in the occurrence of the auriferous sand; there are deposits that seem to be alluvial, others which occur in the firm rocks, others again in distinct veins of mica slate, and still others in exposed gneiss which is many yards high.

IN a recent communication to the Vienna Academy, Prof. Graber, of Czernowitz, describes a long series of experiments with regard to the "skin-vision" of animals; affording exact proof that certain animals, without the aid of visual organs proper, can make not only quantitative but qualitative distinctions of light. These experiments relate chiefly to the earthworm, as representing the eyeless (or "dermatoptic") lower animals, and to the *Triton cristatus*, as representative of the higher ("ophthalmoptic") eyed animals. In a table Prof. Graber presents columns of numerical "coefficients of reaction," indicating how many times more strongly frequented a space illuminated with bright red, green, or white without ultra-violet, is, than one illuminated dark blue, green, or white with ultra-violet respectively, the conditions being the same as regards light-intensity, radiant heat, &c. In one set of experiments, the animals were in the normal state; in another, the anterior end of the worm, and the eyes of the triton were removed.

"CATALOGUES of the New Zealand *Diptera, Orthoptera*, and *Hymenoptera*, with Descriptions of the Species," by F. W. Hutton, F.G.S., Professor of Biology at Canterbury College, N.Z., have been published by the Colonial Museum and Geological Survey of the Colony. They consist of reprints of the original descriptions of such species in the orders named as have been described from New Zealand, without, as a rule, critical remarks, and form an amplification of Lists already published in the *Trans. N.Z. Institute*. Only 227 species for the three orders are enumerated. Although this publication is dated 1881, it has only just been received in England. In some respects it is already obsolete, especially in *Hymenoptera*. Mr. Kirby in 1881 enumerated 81 species in this order, Prof. Hutton enumerates about 71, which should be still further reduced from synonymic considerations.

THE Belgian Academy offers a prize of 3000 francs (120*l.*) for the best treatise on the destruction of fishes by the pollution of rivers. Several points are to be treated of which relate to the impurities which find their way into rivers from the principal branches of trade and the manufactures, and also to the practical means for rendering these impurities harmless. The treatises competing for this prize are to be sent in before October 1, 1885.

EARTHQUAKES are reported from Silesia and North-Eastern Bohemia. Two shocks were noticed on January 31, at 2.40 p.m., at Trautenau. Their direction was from south-west to north-east. They were also felt at Braunau, Jungbuch, Freiheit, Marschendorf, Grossaupa, Spindelmühle, and Johannisbad, and also at Görbersdorf and Landeshut. The motion was undulatory and asted from three to five seconds. No damage was done.

THE Paris papers report the extraordinary run of a small hydrogen gas balloon, capacity about two gallons, which, having been liberated at Bercy, was discovered at Grodno in Poland, having travelled more than two thousand miles; it is the longest air journey on record for so small an object.

THE French gas companies have instituted at their common expense a laboratory for testing the several inventions reported in electric lighting, and proving whether they are valuable or not. After alluding to this foundation, and the much-spoken-of experiments tried at the French Great Northern Railway Station, a French scientific periodical says: "Mieux vaut un sage enemi qu'un imprudent ami."

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus* ♂) from West Africa, presented by Mr. J. F. Williams; a Punjaub Wild Sheep (*Ovis cycloceros* ♂) from North-West India, presented by Lieut.-Col. C. S. Sturt, C.M.Z.S.; a Thar (*Capra jemlaica*) from the Himalayas, presented by Lieut.-Col. Alex. A. A. Kinloch, A.Q.M.G., C.M.Z.S.; a Blyth's Tragopan (*Ceriornis blythi* ♂) from Upper Assam, a Fythch's Partridge (*Bambusicola fythchi*) from Upper Assam, presented by Capt. Brydon; a Small Hill Mynah (*Gracula religiosa*) from South India, presented by Dr. Rogers W. Taylor; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, a Common Cormorant (*Phalacrocorax carbo*), British, deposited; three Stump-tailed Lizards) *Trachydosaurus rugosus*) from Australia, purchased.

## *OUR ASTRONOMICAL COLUMN*

THE GREAT COMET OF 1882.—The following places for Berlin midnight are derived from Dr. Kreutz's ellipse :—

| 1883. | R.A. h. m. s. | Decl. ° ′ | Log. Distance from Earth. | Log. Distance from Sun. |
|---|---|---|---|---|
| February 26 | 5 52 10 | −15 43·3 | 0·4551 | 0·5122 |
| 28 | 5 51 43 | 15 17·1 | 0·4629 | 0·5158 |
| March 2 | 5 51 23 | 14 51·5 | 0·4705 | 0·5193 |
| 4 | 5 51 8 | 14 26·5 | 0·4781 | 0·5227 |
| 6 | 5 51 0 | 14 2·1 | 0·4856 | 0·5261 |
| 8 | 5 50 57 | 13 38·4 | 0·4930 | 0·5295 |
| 10 | 5 51 0 | −13 15·4 | 0·5003 | 0·5329 |

Mr. E. E. Barnard, of Nashfield, U.S., reports that on the morning of October 14 he found to the south of the comet a large, distinct cometary mass, fully 15′ in diameter, and a similar but less bright object close beside this, their borders touching, and on the opposite side of the first a third fainter mass: the three were almost in a line, east and west. More of these cometary masses were found towards the south-east: there were at least six or eight within about 6° south by west of the head of the great comet. Their appearance was that of distinct comets with very slightly brighter centres, several being in the field at once. They were not seen again after being obscured by daylight on the morning of October 14.

Dr. Julius Schmidt's observations of a cometary mass near the head of the great comet are already published in No. 2468 of the *Astronomische Nachrichten.*

On the 5th inst., with the large refractor at Strasburg, the comet had two stellar nuclei, the fainter of the two on an angle of 246°, and 38″ distant from the brighter, which was observed for position. On January 27, Mr. Ainslie Common, of Ealing, with his large reflector, saw the nuclear part of the comet larger but less bright than previously, and resolved into a string of brightish points, the second and third of which were much the brightest. The position-angle was 240° 20′, and the distance between the brighter points was 31″·5, so that they doubtless correspond to the two "fixternartige Kerne" observed at Strasburg. In a sketch with which Mr. Common has favoured us, five points of condensation are shown; it was made at 9 p.m. on January 27.

VARIABLE STARS.—Dr. Julius Schmidt has published his usual summary of results of observations of variable stars, made at Athens in 1882. Minima of Ceraski's variable U Cephei occurred on November 25 at 8h. 57·2m. mean time at Athens, and on November 30 at 8h. 36·5m. Minima of Algol on November 29 at 11h. 30·4m., and December 2 at 8h. 7·1m., the first determined from observations extending over 5·4h., and the second from an interval of 7·5h. R Hydræ was at maximum on March 8, when it attained 4·3m. Mira Ceti at minimum on February 4, magnitude 9·5; the statement in some of our popular treatises on astronomy, that this star disappears at minimum is erroneous; its average brightness at that time is about 9m. on Argelander's scale, according to the most experienced observers. χ Cygni was at maximum September 1·5, the predicted date being August 25. The variations of α Herculis during the year were small, but well fixed by numerous observations; the period, as usual, irregular; the same may be said of *g* Herculis. T Cephei at maximum on January 11, 6·7m., the increase of light much quicker than the decrease; V Coronæ at maximum September 15·6; the fine variable R Leonis was at maximum on May 20, 6·5m., and at minimum on November 6, 9m.; R. Piscium at maximum on December 5·3, the increase of light slower than previously; Palisa's variable in Scorpio at maximum July 9·7, 12m.; of R Scuti, a maximum occurred October 11, well-determined minima, on June 21 and December 6; Harding's variable R Virginis was at maximum April 16·6, and at minimum June 30·5, the limits of brightness being 7m. and 11·7m.

It is much to be desired that the number of observers of these interesting objects should be largely increased; their observation opens up a field of useful work, even to an amateur with the most modest of optical appliances. At present our knowledge of the subject is mainly due to the systematic labours of the indefatigable director of the Observatory at Athens.

A NEW NEBULA.—Mr. Barnard notifies his discovery of a new nebula 1° 48′ north, and 5m. 39s. west of φ Virginis. It was observed with the 15-inch refractor at Harvard College by Mr. Wendell, and described as "rather diffuse and faint, but gradually a little brighter in the middle"; its position for the beginning of 1882 is in R.A. 14h. 16m. 19·6s., Decl. +0° 9′ 14″. This nebula is not found in the Harvard Zones, Nos. 53 and 54, observed on May 9 and 11, 1853, and which would overlap its place, though three new and faint nebulæ were first detected in those Zones, viz. Nos. 33-35 of Prof. Auwer's Catalogue of new nebulæ in the Königsberg observations. This object may be worth watching, on the score of possible variability.

## *GEOGRAPHICAL NOTES*

IN NATURE last week we announced that an Arctic expedition this summer had been decided on in Sweden. This expedition, which has been promoted by the well-known Swedish Mæcenas, Dr. Oscar Dickson, will be in command of Baron Nordenskjöld, whose intention it is on this occasion to explore the east and north-east coast of Greenland. It was originally his intention to have proceeded this summer into the Siberian seas, but seeing the delay caused to the Danish Polar Expedition, which will now be there during the summer, this idea was abandoned and Greenland decided on instead. Baron Nordenskjöld, having formerly visited the country, is of the opinion that some kind of "break," or oasis, is to be found in the interior of Greenland. He purposes to proceed along the east coast of Greenland, as far as the ice will allow, and then to penetrate into the interior, some 300 miles across the inland ice. The country inland is nearly the whole year covered by ice and snow, which, during the summer months, render it almost entirely one bog. The enormous stretch of inland ice has also always been a barrier to exploration. Another object in view by Baron Nordenskjöld is to attempt to find traces of the Norse colonies, which existed in Greenland from about the year 1000 until the end of the 14th century. The ultimate fate of the Norse settlers in Greenland is shrouded in mystery, as there is no authentic record of their existence after the end of the fourteenth century. There has also in later days been great diversity of opinion where to seek for the settlements; thus the Danish explorer Graah, who, in the years 1828-31, searched for remains of the same, sought them west of Cape Farewell, but without success. Baron Nordenskjöld is, however, of the opinion that the Österbygd and the Norse settlements were situated east of the Cape, and it is here that he intends to search for them. It is hardly necessary to enlarge on the interesting and important results to science which would accrue from the discovery of these "dead cities" on the shores of the Arctic Ocean. Baron Nordenskjöld will start on his journey early in May next, and although the general expenses of the expedition, no doubt, will be defrayed by King Oscar and Dr. Oscar Dickson, it is the intention of the latter to apply to the Swedish Parliament for the use of one of the vessels of the Navy for the voyage.

MORE details have now reached us concerning the expedition of the African travellers, Lieut. Wissmann and Pogge. The travellers proceeded along the Kassai River during the autumn of 1881, passed through Kimbunda and reached Kidimba, the residence of Chingenge, the chief of the Tooshilange tribe, in November. Then they proceeded northwards. They reached the frontier of the West African savannah-forests and entered upon the densely populated prairies of Central Africa. In the middle of December they reached the Mukamba Lake. Now they traversed the well-populated country of the Bashilange and reached the Lubi, a magnificent river bordered by rich tropical vegetation, and which is a tributary of the Lubilash river. The opposite shore of the Lubi is inhabited by the Bassonge, a handsome and powerful tribe, which possesses numerous clean and cheerful villages adorned by palm and banana trees. On January 14, 1882, the travellers reached the capital on the left bank of the Lubilash, in 5° 7′ 18″ lat. S. Kachich, the chief of the Kotto district, whose power is based upon his reputation of fetishero (high priest), caused many obstacles to be thrown into their way. At last, on January 29, the expedition crossed the Lubilash, which is identical with the Sankura, and which flows into the Congo. This was in 5° 13′ lat. S. Then they passed through well-watered prairies, inhabited by the warlike Bassonges, by the Beneckis, who have villages 17 kilometres in length, and the Kalebues, reaching and crossing the Lomami River on March 8. All these tribes are cannibals. Between the Lubi and Lake Tanganyika, Wissmann found remains of what must once have been the natives of these parts, viz. the Batuas, little, undergrown, slender, dirty, and savage-looking people, who live only by the chase and on wild fruit, speak a curious language, and whose arms and implements indicate a very low state of civilisation. The Lomami was crossed in 5° 42½′ lat. S. The direction towards Nyangwe was now taken through flooded prairies and marshes, alternating with parts where the grass had grown to a perfect carpet resembling felt. The Lufubu River was crossed on April 2. By April 11 two canoes had been made. On April 16 the expedition reached the Lualaba River, and Nyangwe on the 17th, where they were well received by the Arabs. Here they resolved to separate. Pogge was to return to the Mukenge Station with the caravan, and Wissmann to the east. On May 5 Pogge left. Wissman started on June 1 with only a few companions, and eventually reached Cassongo and then Lake Tanganyika. At Manyema he had gone south of Stanley's and Cameron's route, and afterwards crossed it at Ca=Bambarre, passing northward into the land of the Wasi-Malungo and Ubngwe tribes towards Ughula. On the shores of Lake Tanganyika Wissmann rested for fourteen days, staying at the missionary station of Ruande. He made an excursion to the Lukuga River and crossed the lake to Ujiji. On August 9 he left the caravan track, proceeding in a northerly direction to Uhha, to visit the renowned chief, Mirambo. Passing through many great dangers he reached Mirambo's residence, and was most hospitably received. On September 3 Wissmann reached the French mission-station at Tabora, from whence he made an excursion to the German African Society's station at Gonza. There he considered his geographical work as completed, inasmuch as Dr. Kaiser had proceeded to Gonza from the east coast. Wissmann found Dr. Boehm and Reichard both in good health, Dr. Kaiser having left a few days before. On November 18 Wissmann reached the east coast near Saadani.

IT is announced by the hon. secretaries of the Egyptian Exploration Fund that Sir Erasmus Wilson, LL.D., F.R.S., has accepted the office of President of the Society, and has headed the subscription list with a donation of 500*l*. Thus launched, the Society has commenced excavations at Tel-el-Maskhuta, in the Wady Tumilat—this mound being the supposed site of Raamses, one of the two cities specified in the first chapter of Exodus as built by the forced labour of the Hebrews. M. Edouard Naville, the eminent Swiss Egyptologist, in co-operation with Prof. Maspero, has undertaken the direction of the excavation on this important site, where he is now at work, aided by an experienced engineer, and a gang of eighty labourers. The results to be anticipated from discoveries at Tel-el-Maskhuta are inscriptions which shall enable Egyptologists to identify the Pharaoh of Moses, to assign a dynastic date to the period of the oppression, and to settle the much-disputed question regarding the route of the Exodus. More funds are needed for the prosecution of the work already begun, and it is hoped that the public will liberally support the action of Sir Erasmus Wilson. Pending the election of a treasurer, subscriptions will be received by the hon. secretaries, Mr. Reginald Stuart Poole, British Museum, and Miss Amelia B. Edwards, the Larches, Westbury-on-Trym, Bristol.

IN the March number of *Petermann's Mittheilungen* the principal paper is an account of Herr Fr. von Schenck's journey in the United States of Columbia in 1880, an important contribution to the physical geography of a country on which we have no very recent information. Dr. Capus gives some interesting information on the valley of Yagnan and its inhabitants, about 170 versts east of Samarcand. There is a brief sketch of Herr Schuver's journey to the sources of the Tumat, Jabus, and Jal, in the region lying between the Upper Bahr-el-Azrek and Bahr-el-Abiad. This number contains the Necrology for 1882. —In Nos. 10, 11, and 12 (in one) Band xxv. of the *Mittheilungen* of the Vienna Geographical Society is a paper, with map, by Dr. J. Morstadt on the mountain structure of South Tyrol. An important work in ten vols. on the peoples of Austria-Hungary, by many authors (Vienna, Prochaska), is reviewed by Dr. Paulitschke.—Nearly the whole of the *Compte Rendu* of the Paris Geographical Society for December 15 is occupied by M. Desiré Charnay's account of his explorations in Yucatan.

## *ON THE PRESENT CONDITION OF THE SODA INDUSTRY*

AN interesting and important paper with the above title was read by Mr. Walter Weldon, F.R.S., at a meeting of the Society of Chemical Industry held at Burlington House on January 8. The following abstract is condensed from this paper as published in the *Journal* of the Society:—

A few years ago there were twenty-five alkali-works in the neighbourhood of Newcastle-on-Tyne; now there are only thirteen. Seven or eight works are standing idle in Lancashire; in Belgium the manufacture of soda by the Leblanc process has entirely ceased. The following table represents the

*Present Soda Production of the World in tons*

| | Leblanc soda. | Ammonia soda. | Totals. | Ammonia soda per cent. of total soda. |
|---|---|---|---|---|
| Great Britain | 380,000 | 52,000 | 432,000 | 12·0 |
| France | 70,000 | 57,125 | 127,125 | 44·9 |
| Germany | 56,500 | 44,000 | 100,500 | 43·8 |
| Austria | 39,000 | 1,000 | 40,000 | 2·5 |
| Belgium | — | 8,000 | 8,000 | 100·0 |
| United States | — | 1,100 | 1,100 | 100·0 |
| Totals | 545,500 | 163,225 | 708,725 | 23·0 |

The ammonia process for making soda dates, as a practical manufacturing method, from 1866, in which year M. Solvay of Brussels established works at Couillet, near Charleroi. M. Solvay is now manufacturing soda by the ammonia process at the rate of about 75,000 tons per annum.

The production of soda has very rapidly increased on the Continent within the last five years; the greater part, but not the whole, of this increase is due to the introduction of the ammonia process. The production of soda by this process in England is entirely in the hands of one firm—Messrs. Brunner and Mond: in 1875 this firm produced 2500 tons of soda, in

1880 they produced 18,800 tons, and their output is now at the rate of 52,000 tons per annum. The new works now in course of construction in this country and on the Continent, when completed, will at once increase the production of ammonia soda by 65,000 to 70,000 tons annually.

What then can the manufacturer of Leblanc soda expect save utter collapse? But the state of the alkali-maker threatens to become even worse than it is. The source of the sulphur which is used in the Leblanc process is pyrites; the pyrites employed in this country is almost exclusively imported by three large companies from Spain and Portugal; it contains from 2 to 3 per cent. of copper, and very small quantities of silver and gold. When the soda manufacturer has burnt off the sulphur, he sends the residual ore to the copper extractor, who is able to sell the iron oxide which remains when he has taken out the copper at about 12*s.* per ton. Now the French soda-manufacturers make use of pyrites of their own, which contains little or no copper; one of the large companies which supplies the English market purposes, therefore, to start works in France, which shall employ Spanish pyrites, but which shall depend for their profits, not on the soda which they manufacture, but on the copper and iron oxides remaining after the sulphur has been burnt off from the pyrites. This company, which starts with a capital of over a million sterling, speaks of building five large works in France, and one in the neighbourhood of Antwerp.

The Leblanc soda manufacturers have tried to persuade themselves that the price of ammonia must rise considerably, and that thus they may be able to compete with the ammonia soda-makers on more equal terms than at present. But in place of ammonia becoming dearer, its price is steadily falling. New sources of ammonia are being found; a process for collecting ammonia and other volatile products from coke-ovens, which is easily applied to existing ovens, has recently been patented by Mr. J. Jameson of Newcastle-on-Tyne. If this method should be generally applied to the coke-ovens in this country, a quantity of ammonia corresponding to 180,000 tons of ammonium sulphate, worth about three and a half millions sterling, would be annually saved.

Mr. Ferrie—a member of the great iron firm of William Baird and Co.—has also contrived a method whereby the ammonia and tarry matters which are present in the gases of the blast furnace may be condensed; this process has been at work for some time at Gartsherrie, and by its help about 20 lbs. of ammonium sulphate are obtained per ton of coal burnt in the blast furnaces.

Another difficulty which presses heavily on the manufacturer of soda by the Leblanc process consists in the want of an outlet for the great quantities of hydrochloric acid which accumulate during the soda manufacture.

This difficulty is not felt by the Continental manufacturer because he finds a ready market for the chlorine which can be extracted from hydrochloric acid; but in England the supply of chlorine at present much exceeds the demand. But Mr. Weldon holds out hopes to the English chlorine-maker; he says: "I think that our English manufacturers of Leblanc soda will have to cease to devote their hydrochloric acid—when they do not throw it away—exclusively to chlorine making; . . . the difficulty hitherto has been how to turn it to account otherwise. I believe that difficulty is about to disappear. I am not free to enter into that matter now; . . . but I have very great confidence that new applications of hydrochloric acid, admitting of being applied very extensively, at comparatively small expense, are among the things of the immediate future."

Mr. Weldon then considers the ways in which the English manufacturer of Leblanc soda may hope to recover himself and again make soda at a reasonable profit. First of all, he must get his pyrites about 50 per cent. cheaper than the price he now pays for it; the present combination between the pyrites companies will expire at the end of next year; after that time the price of pyrites must, in Mr. Weldon's opinion, fall very considerably.

Secondly, the soda-manufacturer must recover all the sulphur in his alkali waste; if he can recover the sulphur at a cost not exceeding 2*l.* per ton, he will become master of the sulphur market, as the actual cost of Sicilian sulphur delivered at Marseilles is now about 5*l.* per ton.

The third thing which the soda-manufacturer must do is to distil the coal which he now uses as fuel, condense and sell the volatile products, including tar, oils, and ammonia, and employ the residual coke as fuel; he will thus get his fuel for nothing, and at the same time will confer an inestimable boon on the towns where coal is now largely used as fuel.

These three courses, says Mr. Weldon, must be all adopted by the English soda-maker. If, in addition to doing this, the strictest economy in manufacture is practised and the purest and best product that can be made is always turned out, the manufacturer of soda by the old Leblanc method may yet hope to hold his own against the new and wonderfully successful ammonia process. M. M. P. M.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following persons have been elected Members of the Committee for the nomination of examiners in the Natural Science Schools: Prof. R. B. Clifton; Prof. W. Odling; and Prof. H. N. Moseley. The Vice-Chancellor and Proctors complete the Committee. Up till this term the nomination of examiners lay with the Vice-Chancellor and Proctors, who appointed in turn.

The Examiners for the Burdett-Coutts Geological Scholarship have recommended Mr. F. W. Andrews, of Christ Church, for election.

Magdalen College advertises a demyship in Natural Science to be competed for in June.

CAMBRIDGE.—The following further appointments of Boards of Electors to Professorships have been made:—

Mineralogy:—Prof. Story-Maskelyne (Oxford), Dr. H. C. Sorby, Profs. Stokes, Warrington Smyth, and Liveing, Dr. Phear, Dr. Percy, and Mr. Glazebrook.

Mental Philosophy and Logic:—Prof. Croom Robertson (Univ. Coll. Lond.), J. B. Mayor (King's Coll. Lond.), and Adamson (Owens College), Messrs. H. Sidgwick, J. Ward, I. Todhunter, Shadworth H. Hodgson, and the Master of Trinity College.

Music:—Sir F. Ouseley, Messrs. Pole, T. P. Hudson, G. Grove, Sedley Taylor, G. F. Cobb, R. Pendlebury, and E. S. Thompson.

MR. ALBERT SCHAFER, F.R.S., Fullerian Professor of Physiology at the Royal Institution, has been appointed Jodrell Professor of Physiology at University College, London, in the vacancy occasioned by the resignation of Dr. J. Burdon Sanderson, LL.D., F.R.S., appointed Wayneflete Professor of Physiology in the University of Oxford.

## SOCIETIES AND ACADEMIES

### LONDON

**Chemical Society**, February 1.—Dr. Gilbert, president, in the chair.—The following were elected Foreign Members:—F. Beilstein, P. T. Cléve, H. Debray, E. Erlenmeyer, R. Fittig, H. Helmholtz, D. Mendeleeff, Victor Meyer, Lothar Meyer. The following were elected ordinary Fellows:—H. C. Bond, G. C. Basu, J. Brock, A. M. Chance, J. T. Donald, H. C. Foote, W. Fox, W. R. Flett, J. A. M. Fallon, E. C. Gill, F. Gothard, J. Hunter, H. Jones, B. R. Lee, A. H. Jackson, Joowansinghi, T. Jenner, J. E. Johnson, W. W. J. Nicol, F. W. Richardson, E. S. Spencer, C. A. Serré, T. Turner, J. E. Tuit.—The following papers were read:—On derivatives of fluorene, by W. R. E. Hodgkinson and F. E. Matthews. The fluorene was crystallised five or six times from alcohol; it melted at 113°; when pure, it does not fluoresce. A dibrom and monobrom derivative were obtained, and a fluorene sulphonic acid; by the action of caustic potash on the potassium sulphonate, a trihydroxy-diphenyl was formed; and by dropping the hydrocarbon into fused caustic potash, a dihydroxy-diphenyl was procured.—On the action of chlorine on certain metals, by R. Cowper. As observed by Wanklyn, dry chlorine has no action upon melted sodium; the author finds that dry chlorine has no action upon Dutch metal, zinc, or magnesium; it acts very slowly upon silver and bismuth; tin, arsenic, and antimony are attacked rapidly, with evolution of heat.—Some notes on hydrated ferric oxide, and its behaviour with sulphuretted hydrogen, by L. T. Wright. The author found great difficulty in obtaining ferric hydrate, by precipitating the chloride with ammonia, free from basic chloride. Having poured some ferric chloride into an excess of ammonia, he evaporated to dryness at 100°. The residue, when treated with water, gave a reddish solution which would not yield a clear filtrate, some of the iron being probably in the so-called "colloidal" condition. Such ferric hydrate is not turned black by sulphuretted hydrogen; ordinary ferric hydrate is turned black at once, and the sulphide of iron dissolves in excess of potassium cyanide, forming potassium sulphide and ferrocyanide.—On alpha cyanonaphthalene sulphonic acid, by W. K. Dutt. The author first prepared the naphthalene sulphonic acid, then distilled the potassium salt with dry potassium ferrocyanide, and converted the cyanonaphthalene by sulphuric hydrochloride into the above substance.

**The Institution of Civil Engineers.**—February 13, Mr. Brunlees, president, in the chair. The paper read was on "The Design and Construction of Repairing-Slipways for Ships," by Mr. T. B. Lightfoot, M. Inst. C.E., and Mr. John Thompson.

EDINBURGH

**Royal Society**, January 29.—Mr. Thomas Stevenson, M.Inst.C.E., vice-president, in the chair.—Dr. Knott read a paper by Mr. H. R. Mill on the rainband, being a description of the author's observations during the last six months of 1882. The observations were all made with Mr. Hilger's smallest size of pocket spectroscope, in which the presence of the rainband is indicated only by an apparent broadening of the D line. Mr. Mill measured the varying intensities of the rainband by comparing D with the other evident lines in the spectrum—E, *b*, F. The distinctness of the fine lines in the green was also found to be an additional factor in prognosticating the weather; the less distinct these lines the greater the chance of rain. An analysis of the observations showed that of the "rain" predictions 78 per cent. came true; of the "no rain" predictions 64 per cent.—The Rev. J. L. Blake read his third communication on the theory of monopressures applied to rhythm, accent, and quantity.—Mr. John Aitken read a paper on the effect of oil on a stormy sea, in which it was proved by experiment that the presence of the oil film did not calm the waves, but merely prevented them from breaking. The reason given was that the wind had no power to produce wavelets on the oil-surface, since in virtue of the action of surface-tension any forward motion of a portion of the oil-film necessitated the forward motion of the whole. In the case of a clean water surface, again, the wind acting strongly upon any small surface portion would push it *over* the contiguous surface, and so give rise to a wavelet. Some beautiful experiments on the effect of surface-tension were shown as bearing upon the subject.—A note was read from the Astronomer-Royal for Scotland calling attention to the remarkably high temperature maximum which had occurred some time during the preceding night.

CAMBRIDGE

**Philosophical Society**, February 12.—The following communications were made to the Society:—On the isochromatic curves of polarised light seen in a uniaxal crystal cut at right angles to the optic axis, by Mr. R. T. Glazebrook.—On a spectrophotometer, by Mr. R. T. Glazebrook. The paper describes an arrangement for viewing simultaneously the spectra formed by the light from two different sources after traversing the same set of direct-vision prisms. These two spectra are polarised in two planes at right angles and their relative intensity is determined by the position of a Nicol in the eye-piece through which they are observed.—On a common defect of lenses, by Mr. R. T. Glazebrook. The author exhibited some lenses which, when placed between two crossed Nicol's prisms, showed strong elliptic polarisation.—On the motion of a mass of liquid under its own attraction, when the initial form is an ellipsoid, by Mr. W. M. Hicks.—On functions of more than two variables analogous to Tesseral Harmonics, by Mr. M. J. M. Hill.—Observations of the transit of Venus across the sun, taken near Kingston, Jamaica, December 6, 1882, by Dr. J. B. Pearson. In this paper the author described observations taken by himself of the late transit of Venus. He unfortunately missed seeing the first external contact, and only first saw Venus when she had intruded about one-third of her sphere on the sun's disc. On the internal contact he noticed no kind of black drop, or sympathetic attraction or assimilation between the limb of the planet and that of the sun. It seemed to him that when the planet was actually projected on the sun's disc, about 20″ before the time he assigned for actual contact, the black surface of the planet adjoining the atmosphere seemed to begin to be picked out with little white dots commencing very probably from either side. He could not say that he actually saw two horns of light gradually advancing until their points touched, but rather that the segment of the planet nearest the sun's limb, and still obscure, began to be speckled with white dots which in not more than twenty seconds, or twenty-five at the outside, developed into a white line. He saw nothing like an atmosphere around Venus, though he looked carefully for it; it was possible that his telescope, considerably smaller than what might be called the authorised size, was not large enough to show it.

BERLIN

**Physiological Society**, January 26.—Prof. du Bois-Reymond in the chair.—Prof. Fritsch, who, in his study of the torpedo at the zoological stations of Naples and Villafranca, has discovered, in addition to the facts already published, a series of new facts in reference to the development of this electric fish, combined these facts with those already discovered by previous investigators, and thus produced a general sketch of the development of this remarkable animal before the Society, illustrated by numerous preparations. The torpedo exhibits so many different forms in its ontological development that already de Sanctis distinguished a squaliform stage, a raiform stage, and a torpediform stage; and in fact the different stages, as the lecturer demonstrated in his series of preparations, first resemble shark-embryos, afterwards pass over into the form of rays, and finally change into that of torpedoes by the development of the electric organ. The first embryonic beginnings of the electric organ have the greatest resemblance to embryonic muscular fibres. Upon longitudinal section, there are to be seen in the interior of sheaths consisting of connective-tissue cells very distinct longitudinal fibrous striæ, with traces of transverse striation and many oval nuclei. In a later stage, on making a longitudinal section, the longitudinal fibration and transverse striæ are seen to have entirely disappeared; the nuclei have become much more numerous and circular, and in the interspaces the disc-like elements of the pillars that are to be developed are already to be seen as transverse striæ. The whole represents, in a sheath of connective-tissue, a granular mass of protoplasm with numerous nuclei. On making a transverse section, we see in the first stage, in which the organ resembles embryonic muscular-tissue, the cut ends of the longitudinal fibres as circular contours in an homogeneous connective-tissue. When the electric organ is further developed, there is seen, on making a transverse section, a polygonal net of connective-tissue, in whose meshes the round pillars lie, being separated from the walls by cellular masses. Hence Prof. Fritsch believes that the histological development of the electrical organ is analogous to the transformation of normal muscle in myomata, and that it would not be incorrect to call the electric organ a normal myoma. The phylogenetical development of the torpedo has already been described in the account of its ontogenetical development. The electric organ is developed from muscle, and indeed from the outer gill-muscles of the fifth gill-arch. The gill-arch muscle, which develops in rays and sharks into the extraordinarily powerful lower-jaw muscle, is wanting in the torpedo, and in its place we find the electrical organ, which is, comparatively speaking, a more serviceable weapon of offence and defence to the small animal than the lower-jaw muscle of the related predatory-fishes. The lecture was illustrated by a great number of microscopic and macroscopic preparations.

**Physical Society**, February 2.—Prof. v. Helmholtz in the chair.—Dr. Hertz described a series of peculiar light-phenomena which he had observed in the case of electric discharges. When, in a moderately rarefied space (pressure about 20 to 30 mm. of mercury), the electric discharge takes place between electrodes, one of which is fixed in a tube that is closed at one end and drawn out to a small opening at the other end, while the second electrode is placed laterally near the opening of the tube, the spark of discharge springs from the opening, laterally, to the second electrode; at the same time, however, one sees a ray of yellow-brown light break forth from the tube, reaching out a few centimetres in the prolongation of it. With stronger or with weaker pressure, the ray is shorter and less luminous; and if a Leyden jar be inserted, the ray is also shorter, but it is more luminous. The form of this ray (which broadens at the end) is very varied; and if it impinges on the wall of the vessel inclosing the rarefied space, it produces whirling there. The colour of the ray is different according to the gas: yellow with air and oxygen, blue with hydrogen, &c., and spectrum analysis shows that it is the respective gases that glow. If a small mica-disc be introduced into the luminous ray, it enters into oscillation; and a small mill is set in rotation by the ray. This proves that real material particles, glowing masses of gas, are driven forth in the discharge from the tube. The wall on which the ray impinges is strongly warmed, and a thermometer put into the ray rises 10° to 20°. If the ray, which to the naked eye seems quite continuous, be looked at through a slit in a rotating disc, so arranged that the slit, in different, very short intervals of time after each opening of the primary current of the induction-coil, passes before the eye, one sees in the first moment a small ray at the opening, then, at a later moment, a small cloud above the opening, and finally a larger luminous cloud floating at a greater distance from the opening. The light-ray is thus discontinuous; and at each spark-discharge separate clouds of glowing gases are driven out from the tube, which are ever enlarging. Even at atmospheric pressure these light-phenomena may, with careful observation, be perceived. They occur mostly in the air as yellow sheaths about the aureoles of the sparks, and with different electrodes present manifold forms: sheaths, swellings, whirls, and the like. In moist air the phenomenon is quite absent, and in hydrogen it soon ceases. The great variety of the appearances have not yet been brought under one common standpoint.—Dr. Goldstein had observed similar phenomena to those just described by Dr. Hertz, and made a number of experiments regarding them. In spectral tubes he saw the yellow light appear at the places of passage from the thin to the wider parts, in cylindrical tubes, on the other hand, the yellow light always surrounded the red discharge-light as an envelope, which in the neighbourhood of the cathode gradually widened, and from there progressively filled the tube. If evacuation be effected during the discharge, one sees that the yellow light, with the air, is driven out of the tube. This glowing of the gas Dr. Goldstein connects with the long-known after-luminosity of Geissler tubes, which he has sometimes found to last many seconds, and even some minutes, after discharge. The essential thing in the case of phosphorescent Geissler tubes is the change between wider and narrower parts, because only at the places of transition does the after-luminosity develop that light—yellow in air, blue in hydrogen, and other colours in other gases.

### Paris

**Academy of Sciences**, February 12.—M. Blanchard in the chair.—The following papers were read:—On the difference of barometric pressures at two points of a given vertical, by M. Jamin. He shows from records of the double observatory at the base and at the top of the Puy de Dôme, for 1880, that the difference of pressures varies very regularly every day and throughout the year, diminishing till 3 p.m., then increasing till sunrise, also increasing from the summer to the winter solstice. Kaemitz, in 1832, proved such variation with the season in Switzerland. Similar effects, due to temperature, doubtless occur everywhere. We have to conceive an atmospheric enlargement, a kind of air-tide, moving round with the sun. The resulting phenomena are complex. M. Jamin shows how the variations of the difference of pressures in a given vertical, with changes of temperature, pressure, and hygrometric state, may be calculated.—Researches on chromates, by M. Berthelot.—On the groupings of the animal world in primary times (second note), by M. Gaudry. Each of the epochs seems to have had special expansions, beings that began with it and ended with it. The irregularities met with do not favour the idea of a struggle for life in which the victory was to the strongest and best-endowed. There are many striking personalities, *rois de passage* (so to speak), giving the epochs a character of their own, so that as we speak of the age of Charlemagne, &c., we may say the age of *Paradoxides*, of *Pterichthys*, &c. But it is often the most specialised and perfect beings that have disappeared. Other types, representing the just mean, have persisted.—On the numbers of unequal ordinary fractions which may be expressed by using figures which do not exceed a given number, by Mr. Sylvester.—Refutation of a second critique by M. Zeuner, &c. (continued), by M. Hirn.—Researches on the *rôle* of inhibition in a special kind of sudden death, and with regard to the loss of consciousness in epilepsy, by M. Brown-Séquard. The losses of function and activity of the brain, in certain cases, are pure effects of inhibition, arising from irritation more or less distant.—Influence of subterranean humidity and of capillarity of the soil on the vegetation of vines, by M. Barral. The fruitfulness of the vine on the sandy soil of Aigues-Mortes is due to abundant water in the subsoil (from 1 m. depth) rising to the roots by capillarity. The author describes several laboratory experiments.—On treatment of the vine with sulphur in Greece, by M. Gennadius. This treatment (for oïdium) is thought successful only if carried out on a day without wind, rain, or clouds, and with a burning sun. This fine weather must last twenty-four hours. It is the sulphurous vapour, and not the sulphur powder, that kills the spores in the air and on the vine, though the powder may act mechanically (and other fine powders will do the same) by protecting tender parts from contact with spores.—On germinated wheat, by M. Ballard. The gluten is profoundly altered; there is more acidity and more sugar and lignin; less fatty matter.—On the relations that exist between covariants and invariants of binary forms, by M. Perrin.—On the theory and experiments of MM. Mercadier and Vaschy tending to establish the non-influence of the di-electric on electro-dynamic actions, by M. Lévy.—General method for strengthening telephonic currents, by Mr. Moser. He introduces more induced coils.—On chlorides of lead and of ammonia, and oxychlorides of lead, by M. André.—Preparation of ethers of trichloracetic acid, by M. Clermont.—Contribution to the study of isomerism in the pyridic series, by M. Œchsner de Coninck.—On the relative toxical power of metallic salts, by Mr. Blake. His tabulated data of experiments show why he cannot accept the law formulated by M. Rabuteau (that metals are more active the greater their atomic weight and the smaller their specific heat).—Penetration of actinic radiations into the eye of man and of vertebrate animals, by M. de Chardonnet. He finds that no medium of the eye is transparent for the ultra-solar radiations, that is, for waves shorter than T or U, the limits of the ultra-violet solar spectrum. The mitilating membrane in sparrow-hawks and fowls is translucid for part of the ultra-violet spectrum (up to O and Q). The absorbing power of the vitreous humour, cornea, and crystalline lens varies in different species. The general fluorescence corresponds to actinic absorption, but there are exceptions.—New researches on the production of monsters in the hen's egg by the effect of late incubation, by M. Dareste. This takes place more slowly in winter than in summer. Also eggs of the same age grow old more or less quickly.—On the tonic and inhibitory *rôle* of the sympathetic ganglions, and their relation to vaso-motor nerves, by MM. Dastre and Morat.—The mode of fixation of the suckers of the leech studied by the graphic method, by M. Carlet. The movements of the animal on smoked paper were observed. It has been received that the oval sucker is attached first by the centre, then by the borders, but the author finds that the borders are fixed first. Detachment, too (which does not seem to have attracted attention), begins at the borders.—On a new fixed Crinoid, *Democrinus parfaiti*, obtained in dredging from the *Travailleur*, by M. Perrier. This makes only the fifteenth species known. It is distinguished by a long funnel-like cup, formed of five basal pieces.—Geological and chemical researches on the saliferous formations of the Swiss Alps, and especially on that of Bex, by M. Dieulafait. These beds the author regards as products of evaporation of ancient seas.

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