THURSDAY, FEBRUARY 2, 1882

SCIENTIFIC WORTHIES

XIX.—ADOLF ERIK NORDENSKJÖLD

FEW men have done more varied and real service for science than Baron Nordenskjöld, whose portrait we are pleased to include in our Gallery of Scientific Worthies. The present seems an appropriate time to do so, when Nordenskjöld has crowned the labours of half a lifetime by recounting the story of his greatest achievement, and put the finishing touch to centuries of effort. Baron Nordenskjöld is known to most as the successful Arctic explorer and navigator, but his claims to be regarded as a worthy of science rest on a much wider basis.

Adolf Erik Nordenskjöld was born at Helsingfors, the capital of Finland, on November 18, 1832, the third in order of seven children, four brothers and three sisters, all of whom, with the exception of a sister who died young, still survive. His parents were Nils Gustaf Nordenskjöld, a well-known naturalist, chief of the mining department of Finland, and Margareta Sofia von Haartman. The race from which Nordenskjöld sprang had been known for centuries for the possession of remarkable qualities, among which an ardent love of nature and of scientific research was predominant. Its founder is said to have been a Lieut. Nordberg, who was settled in Upland about the beginning of the seventeenth century His son, Johan Erik, born 1660, changed the name to Nordenberg. He died in 1740, leaving two sons, Anders Johan and Carl Frederik, both of whom, though the latter was only lieutenant, were elected members of the Swedish Academy of Sciences when it was founded in 1739. Both were ennobled in 1751. Carl Frederik is the common ancestor of the families bearing the name of Nordenskjöld now living in Sweden and Finland. One of his many remarkable sons, the third in order, Col. Adolf Gustaf Nordenskjöld, became owner of Frugord in Finland. This property, situated in a forest-crowned valley in the department of Nyland, is still in the possession of the Nordenskjölds. Here Col. Adolf Gustaf Nordenskjöld built a peculiar residence, the middle of which is taken up with a hall two stories high, round the upper part of which runs a broad gallery in which collections in natural history are arranged. His youngest son, Nils Gustaf, was born in 1792. After passing his examination in mining at the University of Upsala he was for several years a pupil of Berzelius, with whom he formed the warmest friendship, which was only broken off by death. Nils Gustaf, early known as a distinguished mineralogist, was appointed a government inspector of mines in his native country, and by means of liberal grants of public money was enabled to undertake extensive foreign tours, which brought him into communication with most of the eminent mineralogists and chemists of the day in England, France, and Germany. After three years of foreign travel he returned to Finland, and was promoted in 1824 to be chief of the mining department, and devoted thirty years of restless activity to the improvement of that important branch of the industry of his native land. He travelled through Finland in all directions in the prosecution of his untiring mineralogical and geological researches. His travels extended as far as the Ural. He published his views, discoveries, and experiments, in many scientific periodicals and in several independent works, and a large number of minerals discovered by him afford evidence of his keen research. He was made Councillor of State, and obtained many distinctions for his scientific services from the sovereign and from learned bodies. On February 21, 1866, he ended his active life at Frugord, and was laid to rest in his father's grave.

Adolf Erik while yet a boy was an industrious collector of minerals and of insects, and was permitted to accompany his father on his tours, acquiring thus early the keen eye of the mineralogist. After studying for some time with a private tutor he was sent to the gymnasium at Borgo, where, as at similar institutions elsewhere, there then prevailed, as he tells us in the autobiographical sketch which he wrote for Bejer's "Swedish Biographical Lexicon," an almost unlimited freedom, the teachers taking no oversight whatever of the pupils' attention to their studies.

Nordenskjöld entered the University of Helsingfors in 1849, devoting himself chiefly to the study of chemistry, natural history, mathematics, physics, and above all, of mineralogy and geology. "Already, before I became a student," he writes, "I had been allowed to accompany my father in mineralogical excursions, and had acquired from him skill in recognising and collecting minerals and in the use of the blowpipe, which he, being a pupil of Gahn and Berzelius, handled with a masterly skill unknown to most of the chemists of the present day. I now undertook the charge of the rich mineral collection at Frugord, and besides, during the vacations made excursions to Pitkeranta, Tammela, Pargas, and others of Finland's interesting mineral localities. By practice I thus acquired a keen and certain eye for recognising minerals, which has been of great service to me in the path of life I afterwards followed."

After passing his candidate examination in 1853, Nordenskjöld accompanied his father on a mineralogical tour to Ural devoting most of his attention to Demidoff's iron and copper mines at Tagilsk. Here he planned an extensive journey through Siberia, but the breaking out of the Crimean war put a stop to it.

"After my return," says Nordenskjöld, "I continued to prosecute my chemical and mineralogical studies with zeal, and wrote as my dissertation for the degree of Licentiate a paper 'On the Crystalline Forms of Graphite and Chondrodite,' which was discussed under the presidency of Prof. Arppe on the 28th of February, 1855. The following summer I was employed on a work of somewhat greater extent—'A Description of the Minerals found in Finland,' which was published the same autumn. Various short papers in mineralogy and molecular chemistry were printed in *Acta Societatis scientiarum Fenniæ:* I also published, along with Dr. E. Nylander, 'The Mollusca of Finland' (Helsingfors, 1856), as an answer to a prize question proposed by one of the faculty. In the interval I had been appointed Curator of the Mathematico-Physical faculty, and had obtained a post at the Mining Office as mining engineer extraordinary, with inconsiderable pay, and an express understanding that no service would be required from me in return. A salary was also attached to my curatorship."

Nordenskjöld, however, did not long hold these appointments, having incurred the wrath of von Berg, the governor of Finland, for being present at a dinner at which, with the thoughtlessness of youth, there was some liberal talk and free singing. This was in November 1855, and Nordenskjöld resolved to take advantage of his rustication to travel. He went to Berlin, where he stayed during the spring and early summer of 1854, working in Rose's laboratory at researches in mineral analysis. Returning to Finland the same year, he had hoped to obtain a travelling scholarship, meaning to devote himself to Siberia, but was disappointed. He, however, obtained a stipend for a line of study through Europe in 1857. Before leaving he attended the Promotion Festival of that year, where he was to take his Master's and Doctor's degrees. At the Festival there was more liberal talk, which von Berg construed into "high treason," and Nordenskjöld thought it advisable to leave Finland for a time. He crossed over to Sweden, where he ultimately became naturalised, and rose to eminence both in public life and as a worker in science. Since 1862, however, Nordenskjöld had been allowed to go to Finland as often as he pleased, and would have been, in 1867, appointed Professor of Mineralogy in the University of Helsingfors, had he been able to promise to abjure politics, which he could not do entirely. By this time (July 1, 1863) he had married a Finnish lady (Anna Mannesheim, daughter of ex-President Count Carl Mannesheim). In 1858 Nordenskjöld took part in the first expedition to Spitzbergen, organised by Sorell, the head of the Swedish Geological Survey. To these and other voyages of Nordenskjöld we referred at some length in vol. xx. pp. 606, 631, and further details will be found in Mr. Leslie's "Arctic Voyage of A. E. Nordenskjöld," published by Macmillan and Co. in 1879, to which we are mainly indebted for the details of the present article. On his return from this voyage in the autumn of 1858 Nordenskjöld was appointed successor to Mosander in the Mineralogical department of the Riks Museum at Stockholm. Meantime he had been engaged mainly in the practical study of the mineralogy of Scandinavia.

"Immediately after my return to Stockholm I entered on my new employment and began to work partly at the arrangement of the museum, partly at scientific researches which formed the subjects of several of my papers published either in the Transactions of the Academy of Sciences or of the Geological Society. At Prof. Mosander's death, when the rebuilding of the Academy's house had just begun, the mineralogical collection was stuffed into three small rooms, where there was so little space that the exhibition of the collection could not be thought of. The new spacious apartments intended for the Riks Museum were finished in the summer of 1865, and already by the following autumn the arrangement and removal of the collections were so far advanced that the Museum could be opened to the public. It has since been my constant endeavour to enlarge the collection not only by purchases from dealers in minerals, but mainly by visits to the most important mineral localities in Scandinavia, undertaken on account of the Museum, partly by the Intendent himself, partly by Assistant Lindström, or by students of mineralogy from the Universities. In consequence of the extraordinary richness of the Scandinavian peninsula in rare and remarkable minerals, the Mineralogical Museum at Stockholm, with the help of the collections, valuable in certain directions, which have existed from Mosander's time, has in this way become one of the most considerable in Europe."

Nordenskjöld still continued to travel in search of minerals through various parts of Sweden and Norway. In 1861 he took part in another expedition to Spitzbergen under Torell, and in December, 1862, he crossed on the ice from Sweden to Finland, in order to make some investigations on the formation of sea-ice. In 1864 another expedition was made to Spitzbergen in connection with the measurement of an arc of meridian, and in the following year he was busy with further mineralogical investigations both in Sweden and Finland. In 1867 an agreeable change came in the form of a visit to Paris in connection with the Metric Commission, and the Exhibition of that year gave Nordenskjöld an opportunity of making the acquaintance of many eminent men of science. In the summer of 1868 Nordenskjöld found himself at the head of an expedition on a much larger scale than any of his previous ones, and partly fitted out at the Government expense. Rich and important scientific collections were brought home, and they reached the highest northern latitude which any vessel could be proved to have attained in the old hemisphere at that time. Among the contributors to this expedition was Mr. Oscar Dickson of Gothenburg, whose name is inseparably connected with Nordenskjöld's Arctic researches, and who has continued ever since to contribute to his expeditions with unprecedented liberality. Mr. Dickson, as is evident from his name, is of British origin, his father having been a native of Scotland who many years ago settled in Sweden. Previous to and preparatory for his next expedition, Nordenskjöld in 1870 visited Greenland, in company with Dr. Berggren, with results of the greatest value; some of which he refers to as follows:—

"The collection of new contributions to the flora of the Polar countries during several preceding geological periods of special importance for a knowledge of the history of the development of our globe. The discovery in the Miocene basaltic strata of Greenland at Ovifak, on the island Diskö, of the largest known blocks of meteoric iron, regarding the origin of which an extensive scientific controversy has arisen, and which perhaps will at some future time form the starting point for quite a new theory of the method of formation of the heavenly body we inhabit. The large blocks were brought home the following year by two vessels of war which were sent out to Greenland for that purpose by the Swedish Government, under the command of Baron von Otter.

"An excursion of some length was made into the wilderness of ice, everywhere full of bottomless clefts, which occupies the interior of Greenland, and which, if I except unimportant wanderings along the edge and an inconsiderable attempt in the same direction in the year 1728, by the Dane Dalager, was now, for the first time, trodden by human foot. I had here an opportunity of clearing up the nature of a formation which, during one of the latest geological ages, covered a great part of the civilised countries of Europe, and which, though it has given occasion to an exceedingly comprehensive literature in all cultivated languages, *had never before been examined by any geologist*. The equipment for the journey was exceedingly defective, because everybody with whom I conversed who had any knowledge of the circumstances, declared to me that such a journey was impracticable, and that in consequence my preparations were thrown away. It was on this account that I was compelled to return earlier than would otherwise have been the case."

One object of Nordenskjöld's going to Greenland was to discover whether dogs could be used in Spitzbergen for extensive sledge journeys, with the result that he found that they could not be employed "in long sledge journeys in the regions where no game was to be had."

Nordenskjöld had not ceased to take an interest in public affairs, and represented the capital of Sweden in the Diet for 1869 to 1871, during which he managed to bring about some important legislative measures for the better promotion of science. In the Spitzbergen Expedition of 1872-73 Nordenskjöld spent the winter in Mussel Bay, the state of the ice having been in an unusually unfavourable condition. Among the results of the expedition Nordenskjöld mentions the following:—

"The discovery on the Polar-ice itself of a dust of cosmic origin, containing metallic nickel-iron; researches by Dr. Kjellman on the development of algæ during the winter night, which at Mussel Bay is four months long; researches on the Aurora and its spectrum by Dr. Wijkander and Lieut. Parent, of the Italian Marine; researches by Dr. Wijkander on horizontal refraction in severe cold; a complete series of meteorological and magnetic observations in the most northerly latitude where such observations had up to this time been carried on; the discovery of numerous new contributions to a knowledge of the flora of the Polar countries during former geological epochs; a sledge excursion undertaken under very different circumstances by Palander and myself, whereby the north part of North East Land was surveyed, and a journey, very instructive in a scientific point of view, made over the inland ice of North East Land, &c., &c."

Then, in 1875, followed the expedition to the mouths of the Yennissei and Obi, the first of a series which culminated in the circumnavigation of Europe and Asia, of which we have just had such a full and instructive narrative.

Thus no one man has done half so much as Baron Nordenskjöld for a scientific exploration of the Arctic regions. The most striking characteristics of his various expeditions have been the small expense at which they were conducted, their modest but carefully-considered equipment, the clear and scientific methods on which they were planned, and the wealth and high value of the results obtained. In the intervals between the expeditions, Nordenskjöld was by no means idle. Not only was he occupied with his official duties as chief of the Stockholm Museum, but his researches in mineralogy, on the origin and constitution of meteors, on auroræ, and, in other important departments, are of the greatest moment. In 1876 he took part as a commissioner in the Philadelphia Exhibition; when he returned on July 1 of that year he stepped on board the vessel that was to take him on his second expedition to the Yennissei. We give the first of two articles on his researches on Auroræ, and hope shortly to give some account of his work in connection with Meteors.

As to the personal character of Baron Nordenskjöld we need say little, his modesty and geniality and his aversion to public display are well-known. He has in his adopted country risen to the highest honours, and as a well-earned reward for the success of his last expedition, the King of Sweden, his warm supporter, conferred on him the title of Baron. From scientific societies all over the world he has received honours. He is only yet in his prime; and is now preparing for another expedition to the shores of Siberia, and we trust he may long be spared to carry on the work in which it would be difficult to find a successor.

THE POSSIBILITY OF FINDING WORKABLE COAL-SEAMS UNDER THE LONDON AREA

In a lecture recently delivered at the London Institution, an attempt was made to lay before a popular audience the course of reasoning, by which geologists have demonstrated that productive Coal-Measures may not improbably lie at no great depth beneath the metropolitan districts. The verification of the prediction that a ridge of Palæozoic rocks would be found to extend at a moderate depth beneath London, which has resulted from the borings made by Messrs. Meux and Co. in the Tottenham Court Road, and by the New River Company at Turnford and Ware, has renewed the interest which geologists have long taken in the question; and as the people of the metropolis now pay something like £5,000,000 a year for the carriage of coal from a distance, it appeared to be not unlikely that the general public might also be brought to take an intelligent interest in this important problem.

The discussion of the subject which has since taken place in the newspapers shows that such an expectation was not altogether unreasonable. But it must at the same time be confessed that some of the writers who have dealt with the subject have shown such a total misapprehension of the true nature of the problem, as to render it advisable to give in the pages of NATURE some explanations of the positions taken up by geologists in connection with the whole question.

As long ago as the year 1826, Dr. Buckland and Mr. Conybeare, in describing the features of the Bristol and Somerset coalfield, took occasion to point out how closely the Coal-Measures of that district resemble those of the great Belgian coalfield. This resemblance can be traced not only in the nature and succession of the strata in the two coalfields, but also in their positions and relations.

In the year 1841 MM. E. de Beaumont and Dufrénoy called attention to the fact that coal had been followed under newer beds in the North of France, and that possibly the same ridge of old rocks with coal-strata might stretch right away under the south-eastern counties of England.

In 1846 Sir Henry de la Beche gave much greater precision to the suggestion, and wrote as follows:—"From the movement of the older rocks many a mass of Coal-Measures may be buried beneath the Oolites and Cretaceous rocks on the east (of the Bristol Coalfield), connecting that district with those of Central England and Belgium, rolled about and partially denuded prior to the deposition of the New Red Sandstone."

In 1852 M. Meugy pointed out that it was by no means improbable that the coal basins of Belgium and Northern France would be found to extend right under the London basin.

But it is to Mr. Godwin-Austen that we are indebted for the most complete and philosophical discussion of the whole problem. In his well-known paper read before the Geological Society in 1855, he showed that the Coal-Measures, which had been proved to thin out under the

Chalk near Thérouanne, would probably be found to make their appearance again near Calais, and to be prolonged beneath the Chalk and Tertiary beds along a line parallel to, if not coincident with, that of the North Downs, and thence away towards the Bristol and Somersetshire Coalfield.

In the Report of the Coal Commission, published in 1871, Prof. Prestwich has very ably argued the whole question, and brought forward a large amount of new evidence bearing upon it.

That geologists were right in their prediction of the existence of a ridge of Palæozoic rocks (the Axis of Artois), extending under the metropolitan area, has now been abundantly proved by boring operations. The strata of the Bristol and Somerset Coalfield have been traced and worked for a distance of about six miles under the overlying younger strata. That these overlying strata tend to thin away as they are followed towards the east has been proved by Prof. Hull and other geologists who have studied the Trias, Lias, and Oolites of the Midland district; and Prof. Prestwich has shown from a boring made at Oxford that the whole of the Lias and Oolites, which to the westward are several thousands of feet thick, beneath that city, are reduced in thickness to 420 feet. At Burford, in Oxfordshire, Coal-measure strata have actually been proved to exist at a depth of 1184 feet from the surface, and at Northampton at 830 feet. At Harwich, Carboniferous strata were found at a depth of 1026 feet; at Ostend, Palæozoic rocks were found at 975 feet; and at Vilvorde, near Brussels, at about 600 feet. These facts serve to show that a great attenuation of the Mesozoic strata takes place, as they were followed towards the south-east, and that the Palæozoic rocks are brought by so much nearer to the surface.

To the eastward, where the strata of the Belgian coalfield are found to be covered by overlapping younger strata, the productive measures have been followed by the enterprising French mining engineers, by means of pits sunk through the tertiaries and chalk, and in this way valuable coal supplies have been obtained along nearly the whole of the line from Mons and Charleroi to Lillers. At Hardinghen, between Calais and Boulogne, coal-measures are, in consequence of upheaval and denudation, exposed at the surface, while near the former town, strata of Carboniferous age have been found at a depth of 1138 feet.

The interesting experimental boring put down at Battle in Sussex, in order to prove the depth of the oolites beneath the Wealden, resulted in a very interesting discovery. It was found that in this district the Jurassic strata are of considerable thickness, and that it is therefore hopeless to attempt to reach the Palæozoic axis in that part of the Wealden area.

Five deep borings have however demonstrated the very moderate depth at which the Palæozoic rocks lie in the Metropolitan district. At Tottenham Court Road the Palæozoic ridge was found at a depth of 1066 feet; at Kentish Town at 1114 feet; at Turnford, near Cheshunt, at 940; at Ware at 796 feet; and at Crossness, near Erith, at 1008 feet. The exact age of the beds reached at Kentish Town and Crossness is somewhat doubtful, but at Tottenham Court Road and at Turnford the Upper Devonian was found, and at Ware the Wenlock shales of the Upper Silurian. We are indebted to Mr. Etheridge for a careful study of these borings, and for the determination of the numerous fossils obtained from them.

Another interesting fact demonstrated by these borings is that the strata lie at very high angles, the dip found at Tottenham Court Road being 36°, and that at Ware 30°.

The evidence obtained from these borings proves that the rocks forming the old Palæozoic ridge are bent into a series of east and west folds, and among these folds it is highly probable that Coal-measure strata will be found.

As to the point at which a boring might be put down with the greatest chance of success, several different opinions exist.

Prof. Prestwich thinks that a point in the southern suburbs of London, such as Sydenham or Croydon, is well worthy of being selected as the site for a new trial, and he points out that, even if coal were not found, the Lower Greensand might be met with, and this would in all probability be found to afford such an abundant supply of excellent water that the money expended in the investigation would not be thrown away.

Mr. Godwin-Austen, believing that a probable correspondence will be found to exist between the modern and ancient lines of disturbance, suggests some point near the North Downs, which is the axis of a great post-Cretaceous flexure, as the most hopeful one.

Some authorities have favoured the idea that it will be wise to avoid the task of sinking through the chalk, by commencing south of the North Downs, while others, foreseeing some difficulties in putting down borings and shafts through the loose running sands of the Folkestone beds, are in favour of a renewed attempt in more northern points of the Wealden district. But in face of the facts revealed by the Battle boring and the known thickness of the Wealden, it may well be doubted if it would be advisable to commence so far away from the proved position of the Palæozoic axis.

The coal-basins, if they exist on this Palæozoic ridge, are probably long and narrow in form, like those of Belgium and Northern France, having their longer axes directed from east to west. We now know that the Palæozoic ridge lies at depths varying from 800 to 1200 feet below the surface in the London district. As coal is profitably worked in many pits in this country more than 2000 feet deep, there is no reason why the coal, if discovered, should not be mined under London. We are now, therefore, in a position to state what are the requirements for a systematic search for coal under this city, and the conditions under which that search must be made.

This question, which is one of such paramount importance to the people of London, would probably be completely set at rest, if a series of borings were put down along a line running from Hertford on the north to Redhill on the south, a distance of less than forty miles. Considering the probable narrowness of the coalfields (that of Belgium averages less than four miles in width) the borings ought to be only a few miles apart, and thus at least ten or twelve borings with a probable average depth of 1000 feet would be necessary. But, of these required borings, four have already been executed, those namely at Ware, Turnford, Kentish Town, and Tottenham Court Road; and thus only six or eight more borings would be necessary. With the improved methods of working by the diamond rock-drill, these borings could probably be carried to the depth of 1000 feet at the cost of a few thousands of pounds, and this would be a very moderate sum to pay for settling such a highly important question. It is of course possible that only two or three of these borings would be required, and the order in which they should be executed must be in a great measure determined by the results which were obtained by those first put down. Probably it would be well to commence with the sites suggested by Prof. Prestwich and Mr. Godwin-Austen respectively, namely, Croydon or Sydenham, and a point near the North Downs.

The only chance of this line of borings missing the coal-bearing strata would result from the circumstance that the coal-troughs are not continuous, but are, in all probability, like those of Belgium and Northern France, separated by pre-Cretaceous upheaval and denudation, along lines crossing the great axis, into separate long and narrow basins. It is therefore just possible that a boring might reach a point lying between two such basins. It would follow from this that while the Coal-measures, if they exist, would in all probability be found by such a systematic search as we advocate, yet the failure to discover them would not absolutely demonstrate their absence in the whole of the Metropolitan district.

Since it is the people of London who would mainly benefit by the discovery of coal under their city, it is by them that the effort to raise the comparatively moderate sum of money required for such a systematic search as we have advocated must be made. When the magnitude of the interests at stake is remembered, it is surely not too much to hope that, so soon as the people of this city fully realise the importance of the evidence brought forward by geologists, they will be prepared to make the necessary effort to secure the decision of the question in the only way that is practicable, namely, by actual experiment.

Some of those who have recently engaged in this discussion have taken it for granted that the great smoke-pall that too often rests over this city would necessarily be increased by the discovery of coal beneath London. They have therefore stigmatised geologists as "Philistines," resolutely bent on destroying all the little "sweetness and light" left to the unfortunate inhabitants of London. But it is by no means certain that any such effects would follow from the discovery of coal in the metropolitan area. It must be admitted that the beautiful landscapes of our home counties would not be improved if coal-tips, engine-houses, and winding-gear were to rise in all directions about them, but the reduction of coal and gas bills to one-half or one-third of their present amount would, by most London householders, be regarded as a sufficient compensation for such disadvantages. Judging from the character of the coals found in the Bristol and Somerset and the Belgian coalfields, it is probable that while gas- and caking-coals would not be wanting, a great part of the coal under London would prove to be anthracite and hard coals. Every one who has visited the Smoke Abatement Exhibition must be convinced that there is a great future for such varieties of coal. The people of London who are reluctant to alter the construction of their grates so as to adapt them to the use of such coals, at their present prices, might find it well worth their while to do so if those prices were reduced to one-half or one-third of what they are at present.

In this way the discovery of coal under London might lead the way to that general reform in our domestic hearths, which we all desire, but which we find it so difficult to realise; and thus, perhaps, the discovery of coal at a moderate depth beneath us, paradoxical as the suggestion may appear, may lead to the purification of our London atmosphere.

JOHN W. JUDD

THE ENCYCLOPÆDIA BRITANNICA

The Encyclopædia Britannica. Ninth Edition. Vol. XIII. Inf.—Kan. (Edinburgh: A. and C. Black, 1881.)

IT is impossible to do justice in detail to all the leading scientific articles in this volume; we can only express our satisfaction of the admirable manner in which the publication keeps to the level of its first promise. We have only space to glance at one or two articles, regretting that those on "Instinct," by Mr. Romanes; "Insectivorous Plants," by Mr. P. Geddes; "Iron," by Dr. Alder Wright; "Kangaroo," by Prof. Flower, and others of equally high mark, can only be mentioned.

In Mathematics the *pièce de resistance* is a very carefully digested article upon the *Infinitesimal Calculus*, by Mr. B. Williamson, F.R.S., who has already won his spurs in this field by his two treatises on the Differential and Integral Calculus. In a former notice we expressed ourselves somewhat hesitatingly upon the utility of elaborate articles upon branches of mathematics in a work of this kind, but the "Calculus," we think, lends itself more readily to such treatment than almost any other branch. Certainly the subject, in the hands of Mr. Williamson, is handled in such a way that the student, so far as the text is concerned, will be independent of any of the usual textbooks, and will only require to consult them for exercises to try his hand upon, to test his acquaintance with the principles herein so clearly unfolded and aptly illustrated. The advanced mathematician also will find not only sufficient matter for his purpose, but, what is more serviceable to him, a ready means of reference to the original sources of information. In this respect we cannot speak too highly of the care bestowed on all parts of the two divisions into which the Infinitesimal Calculus bifurcates. The narrative of the contributions of Legendre, Gauss, Abel, and Jacobi to elliptic functions, in the concluding portion of the paper, is an admirably lucid exposition of the relative positions of these great analysts in this department. Mr. Williamson devotes 120 columns to the practical portion of his article: in these he naturally treads on the lines he has pursued in his previous works. He follows the subject of *Envelopes* with a sketch of *Symbolic Methods*, first started by Arbogast, who was succeeded by François, Servois, and in more recent times by Hargreave, Boole, and Crofton. He gives useful reference here also to Hankel and Grassmann, who have treated symbolic methods in a comprehensive manner. Another novel section in this connection is one on Jacobians, in which the elementary properties of these functions are put before the reader.

In Part II., under Frullani's theorem, reference is made to the recent extensions by Messrs. Elliott and Leudesdorf, and the demonstration by M. Zolotareff, that the remainder in Lagrange's theorem is expressible as a definite integral is given. Our Author was not aware that Mr. Emory McClintock had applied the same mode of demonstration to the similar case of Laplace's theorem, as the number of the *American Journal of Mathematics* (vol. iv., No. 1) has reached this country subsequently to the publication of his article. Due importance is assigned to Definite Integrals and to the hyperbolic functions which now play an important part in investigations.

The last 79 articles are devoted to the subject of elliptic functions, upon which we have written above. The whole of this discussion convinces one how well fitted the writer is to bring out a separate treatise on this branch, and we hope that a rumour which has reached us will soon become an actual fact. We may note the appearance within a very recent date of a new edition of Abel's works. Passing now from the *practical* treatment to the *historical*, which rightly is put in the forefront of the communication, we need not dwell in any detail upon the early history of the subject. That has reached its position of equilibrium, and no stormy winds of controversy are likely to disturb its calm. But we did wonder what position Mr. Williamson would take when he came to discuss the *commercium epistolicum* business. We ourselves had long thought that little could be added to De Morgan's summing-up, still we remembered some strong language which once appeared in our epistolary columns (see vol. v. pp. 62, 81, 121). We need hardly say that Mr. Williamson appears to have gone over all the sources of information which we had ourselves recently examined, and he seems to us to have come to the right solution. We append his summing-up:—

"It is the less necessary now-a-days to enter into the merits of this great quarrel, inasmuch as it has long been agreed upon, by all mathematicians who have examined into the controversy; that Newton and Leibnitz are both justly entitled to be recognised as independent discoverers of the principles of the calculus, and that, while Newton was certainly master of the method of fluxions before Leibnitz discovered his method, yet Leibnitz had several years priority of publication."

A VERY effective article is the one on insects by Mr. R. McLachlan, F.R.S. In it we find condensed into a few pages a very correct and instructive history of this immense class of that subdivision of the animal kingdom now known as the Arthropods. As in most of the classes of the animal kingdom, the limits of the class Insecta are not very sharply defined. In general every one thinks that it is an easy task to define an insect, but to do so in the way that we can define a mammal is not possible with our present knowledge; still a fairly satisfactory diagnosis is here given to us, and the certain small aberrant groups are not altogether overlooked. The insects not only form the largest class of the arthropodous sub-kingdom, but, according to the author, possibly outnumber all the other members of the animal kingdom besides. It seems certain that at the present time there are about 80,000 presumably distinct species of beetles described, and it seems safe to assume that the number of known species of other orders is greater, thus giving a total of about 200,000. But as yet we are only on the threshold of our knowledge of the forms that actually exist in Nature—many enormous groups of living forms being still only very partially studied—so that we may pretty confidently anticipate that some day, not very far distant, the number of known forms will not fall far short, the author writes, of 1,000,000, but we would feel inclined to write instead 500,000. As to the antiquity of the group, indications of it appear in the Devonian series, and become more marked and numerous in the Carboniferous. With few exceptions these are those of insects belonging to orders in which the metamorphoses are incomplete, and there seems no evidence that any anthrophilous insects, such as bees or butterflies, were then in existence. As one ascends the geological scale, insect life gradually develops itself, not becoming however at all abundant until Tertiary times. As to their geographical distribution, they would seem to be everywhere on the earth's surface, the more attractive forms are more often denizens of the tropics, but showy butterflies were found during the late Arctic Expedition almost up to 83° N. lat. They occur on land, in freshwater, in hot springs, in brine, in the deep recesses of vast caverns, on the surface of the ocean, and we may add, are at home under the flow and ebb of its waters all around our own shores. The subjects of the duration of their life, their uses to man, the injuries they directly and indirectly inflict on him, their parasitism, their anatomical structure, the wondrous story of their change of form, these are all ably though briefly handled. The systematic portion of the article, though of necessity condensed into the smallest possible compass, is especially interesting. The sequence of the orders is:—

Metamorphosis complete	Hymenoptera Coleoptera Diptera Lepidoptera Neuroptera
Metamorphosis incomplete	Orthoptera Hemiptera
No metamorphosis	Collembola Thysanura.

The stumbling-block of all systematists has been the Linnean order Neuroptera. The author manages it after the method of Erichson, placing those neuropterous forms with an incomplete metamorphosis as the sub-order Orthoptera. He tucks in the Diptera between the Coleoptera and Lepidoptera, a position we doubt very much that they will consent to occupy, though on the author's views as to the absolute value of metamorphosis in classification, this position might stand. The Mallophaga are without hesitation placed as degraded Pseudo-neuroptera, and the Anopleura as equally degraded Hemiptera, despite what veterans in entomological science (*i.e.* people too old to take in new ideas) may say. But, says Mr. McLachlan, there is a breaking point to elasticity even in ideas of classification; and so he avails himself of an assertion of Sir J. Lubbock, that the Collembola and Thysanura—sprightly things—are scarcely within (we note not without) the pale of true insects. Still fearing that no one else might write about them, that they might be overlooked by the writers of the articles on Crustacea, Arachnida, and Myriopoda—as, to speak the truth, was even more than likely—we have a neat little account of them given here. We have written enough to indicate what a freshly-written and interesting though condensed article this is, though on a well-worn theme, and we must be pardoned for so briefly touching on the burning question of classification.

OUR BOOK SHELF

The Year-Book of Pharmacy, and Transactions of the Pharmaceutical Conference. 8vo. Pp. 560. (London: Churchill, 1881.)

THIS year-book is divided into several parts—an introduction, which gives a short account of all that has been done in the year, a section in chemistry, another on materia medica and pharmacy, one on notes and formulæ, another on bibliography, and lastly, the transactions of the British Pharmaceutical Conference at York. A number of short abstracts of interesting papers are included in the work. The excitement caused by the recent case of poisoning by aconitine is likely to make the reader turn first to the papers on this alkaloid. Dr. Wright has furnished his researches on the alkaloids of aconite, the chief being aconitine, which is the active principle of the ordinary monkshood, and the pseud-aconitine, which is the still more deadly alkaloid of the *aconitum ferox*. Powerful as those poisons are, one much more powerful has been obtained by Dr. Langgaard from a species of Japanese aconite. Another paper, of much interest from a forensic point of view, is one on ptomaines, or alkaloidal bodies found in human corpses after exhumation. These are actual poisons, formed in the body by putrefaction, and bearing considerable resemblance, both in their chemical reactions and poisonous effects upon animals, to natural vegetable alkaloids. This subject is one of very great importance, as the condemnation of perfectly innocent persons might result from one of these ptomaines being mistaken for a vegetable poison. There are a number of other researches on the active principles of various plants, remedial and poisonous, but all these yield in interest to those on the synthesis of similar bodies, for the great object of medicine is to cure, not by chance, but with certainty, and towards this object all branches of medical science are as present tending. It was formerly the reproach of medicine that doctors poured drugs of which they knew little into bodies of which they knew less; but now, thanks to experiments made upon animals, instead of upon patients, they now know a good deal both of the bodies they have to treat and the remedies which they are using. Hitherto, however, they have been compelled to use many powerful substances derived from plants, but varying more or less in their constitutional actions. Numbers of these substances have now been examined, and it is probable that before long we shall make them artificially. Prof. Ladenburg has now obtained atropine and hyoscyamine from the nightshade, thorn-apple, henbane, and Duboisia, and has lately got a third principle, hyoscine, from henbane. By decomposing atropine he he obtained tropic acid and tropine, and by recombining these products he again formed atropine. In conjunction with L. Rügheimer, he has now succeeded in making tropic acid synthetically from aceto-phenone, and we now await the synthesis of tropine in order to complete the method of preparing atropine artificially. M. Grimaux has succeeded in converting morphia into codia, another of the alkaloids of opium; and such researches as these, taken in connection with the rapid advance of our knowledge regarding the physiological action of these substances, leads us to hope that the day may not be so far distant when a medical man, wishing to produce a certain effect upon his patient, will no longer have to search haphazard amongst various plants, but will direct the chemist to make the particular body which he requires. We may mention still another paper, less interesting to medical men, but more so to the public at large. Prof. Baeyer succeeded, some years ago, in preparing indigo artificially, but the process was so expensive that it was not likely to be of much practical importance. He has now, however, succeeded in effecting the synthesis in another way, by which he can not only produce the indigo much more cheaply, but can produce it within the fibre of the material to be dyed. The artificial production of alizarin has already wrought a great change in the commercial relations of the South of France, and if indigo be produced synthetically at a lower price than it can be grown, similar alterations may result in some parts of our Indian Empire.

The New Ceylon. Being a sketch of British North Borneo, or Sabah. From official and other sources of information. Written and compiled by Joseph Hatton. (London: Chapman and Hall, 1881.)

IT was hardly to be expected that the new British possession in North Borneo, to which the Queen has recently granted a charter, should long remain without its chronicler. Information at first hand respecting the country is very scarce, but, in the absence of this, Mr. Joseph Hatton in his little volume furnishes us with all that we can expect for the present. The materials placed at his disposal consisted of certain private letters and reports from explorers and the correspondence of the directors of the North Borneo Company. In addition to these he has made use of all that has already been written on Borneo, and the result—"a pioneer volume," he modestly calls it —is such as might have been expected from Mr. Hatton's well-known literary skill. The value of the new colony to science is rather potential than actual. In Labuan and Sarāwak we have only touched the fringes of this vast island; we know but little of its mineral wealth and other natural resources; its geography, geology, fauna, and flora, have never been thoroughly studied. Even Mr. Carl Bock, in the journey described in his recent volume, only crossed a small corner of Borneo. With a settled government, under the British flag, we may expect a great increase in our knowledge of one of the largest and most interesting islands in the world. Mr. Hatton could, had he chosen, have added an interesting account of the early trade of the East India Company to Bandjermassin and other ports in Borneo from the Calendar of State Papers, Colonial Series, edited by Mr. Sainsbury.

LETTERS TO THE EDITOR

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

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

Earth-Currents

THE Astronomer Royal desires me to mention, in regard to Mr. W. H. Preece's communication (p. 289) describing an unusually sudden appearance of earth-currents between 10h. and 11h. p.m. on January 19, that our magnetic and earth-current registers both show, throughout the night of January 19, more or less of unusual disturbance, never however very considerable. The greatest deviation occurred in a sudden wave at 10h. 15m., as Mr. Preece describes. From 10h. 50m. until midnight there was general quiet, and the disturbance afterwards was not great.

WILLIAM ELLIS

Royal Observatory, Greenwich, S.E., January 28

IN a letter to you last week Mr. W. H. Preece called attention to a sudden appearance of earth-currents on the 19th between 10.15 and 10.20 p.m. G.M.T., traces remaining until 10.50. A magnetic storm was in progress at the time, and had commenced shortly after 4 p.m. The declination magnet moved at first slightly towards the west; but the most rapid movement was towards the east, and commenced at 9.40, attaining its absolute minimum, or greatest E. elongation, at 10.9. It then returned as rapidly westward until 11 p.m., but the absolute westerly maximum was only reached at 6.50 the next morning. The whole range of the declination magnet was 53'·0.

The H.F. magnet was not much disturbed, but the chief irregularities occurred between 9.50 and 10.55.

The V.F. magnet showed more clearly the action of the disturbing force, with a maximum at 7.45 p.m., and a minimum at 3.40 the next morning. The V.F. magnet was tremulous between 10.0 and 10.40 p.m., with a slight minimum at 10.15.

S. J. PERRY

Stonyhurst Observatory, Whalley, January 29

THE magnetographs at this observatory registered a small magnetic disturbance during the evening and night of January 19, which lasted over an interval of time considerably greater than the earth-currents observed by Mr. Preece.

The magnets were tolerably quiescent until about 4.35 p.m. G.M.T., when the declinometer became disturbed, and the bifilar indicated a gradual diminution of horizontal force, vertical force at the same time increasing. The latter attained its maximum deviation from the average value at about 8.0 p.m., whilst the horizontal intensity indicated its lowest at the same time. The declination after slightly rising, however, continued to diminish, and between 9.30 and 10.15 p.m. it became reduced 20·7 minutes of arc. Between 10.15 and 11.0 it rapidly moved in the contrary direction 19'·0, after which it gradually rose to a position of maximum at 6.50 a.m. on the twentieth, when the needle stood about 10' to the westward of its normal position at that hour. From that point it gradually fell away, and after 11.45 a.m. it only oscillated slightly about its usual place.

The movement between 9.30 and 11 p.m. of the bifilar indicated an augmentation of intensity followed by an equally abrupt fall, whilst the vertical-force instrument showed that component of terrestrial magnetism to have been but slightly affected.

As is usual in such cases the abrupt disturbance, or as it is called from the aspect of the curves, the peak, under notice was repeated or echoed on several subsequent days.

On the 20th, about half an hour after midnight very faintly, on the 21st it was stronger, and occurred between 9.20 and 9.50 p.m. On the 22nd between 7.50 and 9.40 p.m., its extent then being 10', and finally on the 23rd, from 9.0 to 10.10 p.m., showing then about the same amount.

The daily weather charts for the 20th report bright aurora seen on the 19th in Scotland and Norway.

Kew Observatory, January 30 G. M. WHIPPLE

REFERRING to Mr. Preece's letter of the 24th inst., it may be interesting to note that in the Daily Weather Chart for the 20th inst. bright aurora is recorded as having appeared in North-West Europe on the evening of the 19th, the day when the earth-currents were observed. J. PARNELL

Upper Clapton, January 30

Variations in the Sun's Heat

ALL lovers of science, and more especially those devoted to the study of atmospheric physics, must rejoice to learn that the Government of India has sanctioned Mr. Blanford's proposal to send a properly qualified observer with good instruments to Leh, for the purpose of directly measuring the sun's heating power from day to day.

Meanwhile, as we shall have to wait for another decade before it can be settled with any certainty, how much, and in what way the sun's heat varies, it may be as well to notice the latest and hitherto most valuable indirect evidence, furnished with respect to this question by India.

That country has long been regarded as exceptionally well placed for reflecting in its meteorological phenomena with comparatively little complexity the secular changes in solar radiation, and the only drawback hitherto, has been the lack of good and continuous observations over a large area. This has now been remedied by the excellent organisation introduced by Mr. Blanford, by which the observations made at upwards of 100 regular observatories and more than 350 rainfall stations, are collected and discussed at one central office, and published in one volume. With these it is possible to arrive at average results, in which local variations are eliminated, and which may be accepted with confidence as representing the general conditions over the whole area. In a recent *Pioneer* Prof. Hill gives the following table of the abnormals in the chief meteorological elements for the whole of India during the past few years, which, if indirect evidence is to be trusted, most decidedly favours the hypothesis Prof. Hill and myself have all along regarded as the best working hypothesis, viz. that the sun radiates *most* heat to the earth in the years of *fewest* spots.

Variations of certain Meteorological Elements from their mean Values

Year.	Excess temperature of black bulb thermometer.	Annual mean air temperature.	Mean pressure of water vapour.	Mean proportion of cloudy sky.	Mean annual rainfall.
	°	°	"	Tenths.	"
1875	– ·76	– ·29	– ·004	– ·03	+3·66
1876	– ·33	– ·08	– ·017	– ·20	–4·37
1877	+ ·19	+ ·17	+ ·011	+ ·31	–2·97
1878	+ ·44	+ ·62	+ ·020	+ ·09	+5·66
1879	– ·36	– ·13	– ·014	– ·06	+1·97

Prof. Hill appends the following remarks to this table:—

"The radiation, as measured by a thermometer with a blackened bulb, rose gradually until 1878, and then fell off in intensity; the temperature of the air, which seems the next simplest and most direct effect of the sun's heat among those given in the table, also increased until 1878, and then diminished; the vapour tension and cloud—more remote effects—show a similar, but not so closely coincident variation, and finally, the rainfall, the most distant effect of all, appears to lag just about a year behind; for observations made before the commencement of Mr. Blanford's reports for all India indicate that there was a wave of heat in 1873–74, immediately preceding the cold period at the top of the table."

Now while there is no doubt, as Mr. Blanford has recently shown in the *Journal* of the Asiatic Society of Bengal, and elsewhere, that the temperature at the earth's surface is very decidedly influenced by rainfall and cloud, we see from this table that the year of highest temperature was actually that in which *most* rain fell, and Prof Hill has found that the excesses of temperature and rainfall, though not strictly contemporaneous, were most decided in the *same* regions of the country. It is scarcely necessary perhaps to add that the actual sun-spot minimum occurred in the middle of 1878, in order to show the important bearing of these facts on our hypothesis.

Tunbridge Wells, January 24 E. DOUGLAS ARCHIBALD

Solar Observations

I INCLOSE two letters which I have recently received from Mr. W. A. Holland, chief officer of the ship *Sarah Bell*, and which I think will interest your readers. It is to be hoped that other observers, whether on land or sea, may have important information to communicate on the subject, which they may be induced to give you for publication. WILLIAM THOMSON

The University, Glasgow, January 23

Havre, January 10, 1882, *Ship "Sarah Bell"*

SIR,—Being at Sea last November 22 and 23, and our position at noon being lat., 18° 58' S., long. 1° 53' W., and lat. 17° 32' S., long. 3° 39' W. respectively; and while observing the sun's meridian altitude, I noticed a very remarkable dark spot on the sun's disc; it was about one-third of the sun's diameter, and bearing south-east from ⊙ centre. On the following day it appeared one-fourth of ⊙ diameter, and of bearing west-north-west from centre; by putting down the proper shades of my sextant I could see it very distinctly. I called the captain's attention to the fact at the time, and he says he never saw such a phenomenon in his life; he is a gentleman who has spent his life at sea since the year 1840. Almost at the same time I read from the June number of *Good Words* for 1879 your very valuable article on Terrestrial Magnetism and the Mariner's Compass; but the latter part of the article treating on sun-spots caused me to take this bold step of addressing you, trusting I have not been over-presumptuous in so doing. I have the honour to be, Sir, your most obedient and humble servant,

W. A. HOLLAND,
Chief Officer of Ship *Sarah Bell*

Havre, January 21, *Ship "Sarah Bell"*

SIR WILLIAM THOMSON,

DEAR SIR,—In reply to your very kind letter of the 18th, I am most confident and very careful in what I have already reported to you. With this exception, that I myself estimated the spot on the sun to be $\frac{1}{6}$ diam., but conferring with the captain he estimated it to be $\frac{1}{3}$ diam., it was purely an estimate of the eye. The first time I observed it I could scarcely believe my own eyes; I immediately and properly adjusted my sextant and observed the sun constantly through the day. The spot appeared to move from the sun's upper limb to the lower limb, and nearly through the sun's centre. The captain and myself most particularly noticed the spot both with and without our telescopes, and we feel quite sure there could not have been any mistake, as I have been in the habit of observing the sun's altitude at the least six times during the day at sea; I add the spot appeared quite black. Weather squally, with a very troubled and confused sea; barometer 29°·93 steady. Trusting my notes may be of some use to you, and that you will hear a more explicit account from other navigators.

W. A. HOLLAND,
Chief Officer *Sarah Bell*, Havre

On the Climate of North Northumberland as Regards its Fitness for Astronomical Observations

IN May, 1880, I became possessed of the telescope, observatory, and astronomical instruments belonging to the late Rev. Henry Cooper Key, M.A., F.R.A.S., and I erected the telescope and observatory at my vicarage at Alnwick, Northumberland. The instrument is a silver-on-glass reflector, the speculum being by Mr. Calver, of Chelmsford, of 18¼ inches aperture; as regards perfection of figure, I believe it cannot be excelled. As a specimen of the work it is capable of performing under the best conditions I may say that last November I measured γ^2 Andromedæ, the components of that exceedingly difficult double star being now separated by only 0″·28 according to the Washington observers. The weather, however, for observational purposes during the last six months of 1880 was so bad here, that I determined to keep a record, as far as possible, of every night in the year 1881, as regards its fitness for astronomical work, and this record I now lay before your readers. I may premise that no fault can be found with the situation of the observatory. It is 250 feet above sea-level, four miles from the sea, there are no mountains or streams sufficiently near to affect the definition, no collieries or manufactories in the immediate neighbourhood; and, if the definition be bad, no cause can be assigned for it but atmospheric disturbance. The following is the record for each month:—

January.—In this months there were 11 nights completely overcast; 4 partially overcast; and 16 clear. I opened the observatory on 5 nights, on 4 of which the definition was very bad, and on 1 bad. On 15 nights there was hard frost accompanied by deep snow.

February.—The nights were: Completely overcast, 22; partially overcast, 6. The definition was on 4 very bad, on 1 bad, and on 1 fair.

March.—Completely overcast, 24; partially overcast, 7. The definition was on 1 very bad, on 1 bad, and on 3 fair. On 2 nights hard frost prevented observations.

April.—Completely overcast, 25; partially overcast, 3; clear, 2. The definition was on 2 very bad, and on 2 nights wind, and on 1 snow prevented observations.

May.—Completely overcast, 10; partially overcast, 9; clear, 12. Definition on 15 nights was very bad, on 1 bad, and on 4 fair. One of the partially clouded nights was too cloudy for observations.

June.—Completely overcast, 14; partially overcast, 2; clear, 14. Definition was on 5 very bad. I was away from home on 9, and engaged on 2 nights.

July.—Completely overcast, 26; partially overcast, 1; clear, 4. Definition was on 1 very bad, on 3 bad, and on 1 I was away from home.

August.—Completely overcast, 25; partially overcast, 3; clear, 3. Definition was on 1 very bad, wind or cloud prevented observations on 4 nights, and on 1 I was away from home.

September.—Completely overcast, 25; partially overcast, 4; clear, 1. Definition was on 4 very bad, and on 1 of the partially clouded nights there was too much cloud for observations.

October.—Completely overcast, 19; partially overcast, 6; clear, 6. Definition was on 4 very bad, on 1 very fine, wind prevented observations on 4 nights, and on 3 I was away from home.

November.—Completely overcast, 13; partially overcast, 5; clear, 12. Definition was on 7 very bad, on 2 bad, on 2 fair, and on 1 very fine. Wind prevented observations on 5 nights.

December.—Completely overcast, 15; partially overcast, 1; clear, 15. Definition was on 6 very bad, and on 4 fair. Wind prevented observations on 3 nights, on 2 I was away from home, and on 1 engaged.

The summary for the year is as follows:—229 nights were completely overcast; 51 were partially so (but of these 4 were too cloudy for observations); and 85 were clear. Thus 132 nights ought to have been available for observations. Of these the definition on 54 was very bad, on 9 bad, on 14 fair, and on 2 very fine. Wind prevented observations on 16 nights, frost and snow combined on 15, on 2 frost alone, and on 1 snow alone. On 16 I was absent from home, and on 3 engaged. Total, 132.

I need hardly point out to your readers that the above record is a somewhat melancholy one for the astronomical observer. Ours is a cloudy sky; but in addition to the great amount of cloud, the atmosphere here is almost perpetually in a state of violent disturbance, so that difficult and delicate telescopic work can very rarely indeed be attempted. Last year there were only two occasions on which I found the definition really fine, and on those it only continued so for a short while. When the stars are visible, they are, as a rule, when looked at through the telescope, seen to be flaring, flashing, fluttering, jumping, twirling, or waving—anything in short rather than remaining steady. This is clearly owing to atmospheric perturbation, because on some very rare occasions the images are still, and the definition is superb. I have not been in the habit of using a telescope for a sufficient length of time to say whether last year was an exceptionally bad one for the North of England, but from what I have heard and read, as well as from nine years' residence here, I am afraid it was not. Perhaps others of your readers can throw a little light on this point.

JEVON J. MUSCHAMP PERRY

St. Paul's Vicarage, Alnwick, January 4

Primitive Traditions as to the Pleiades

MY conclusions as to the Pleiades having been believed to be in early ages the centre of the universe, were not in any way based upon the singular name *Alcyone* for the principal star in that group. I can hardly account for my having so long forgotten the meaning of that name, and its connection with the belief I had found vestiges of, as to the Pleiades being the centre of all things. It is probable that at first I regarded its significance as a mere accident, as Dr. Tylor evidently does, and dismissed it from my mind. The best proof of the widespread traces of the belief in question is to be found in the fact that even since this correspondence took place I have met among the Berbers of Morocco a name for Alcyone, which has precisely the same meaning, and which, they tell me, was given to that star because Paradise is in them, and they are the centre of all things. I have also found that the idea, which, as I stated in my last letter, I have for many years entertained, that those stars were observed by means of openings or passages in temples in early ages, is manifestly well founded.

I find that in the Sahara there are temples or ancient mosques, in which the year is still regulated in this way, there being a tube from the top of the building, very small above and larger below, through which the southing of those stars is observed. I have this not only from natives of the Sahara, but also from a European here who has often heard of the system, though he did not know which were the stars that were observed.

Even the Moors have a vestige of the practice in the singular belief that those stars "rest on the top of the mosques." In the feast of tabernacles, too, which is to be found in the Sahara as well as in far-distant quarters of the globe, the Berber tribes build their temporary tents with a hole at the top, so that the young men who are being instructed may see the Pleiades passing overhead. The Jews here have the same custom, and endeavour to explain it by a curious legend as to Jonah's journey to Nineveh. They forget apparently that Moses wrote a good many years before Jonah was swallowed by the whale.

We can now understand the vestiges in Egypt of a popular belief that the Pleiades are in some way connected with the Great Pyramid, the existence of which was observed with a very natural feeling of surprise by Prof. Piazzi Smyth.

I am convinced that the evidence will be regarded as conclusive that the widespread identities which exist as to the year of the Pleiades and its traditions cannot, as Dr. Tylor assumes apparently, have grown up everywhere from the peculiar shape or position of these stars, but that they must be a heritage, if not from a common ancestor, at least from a common source.

Tangier, January 25 R. G. HALIBURTON

ON THE VEGETABLE FOOD OF THE NEW ZEALANDERS IN PREHISTORIC TIMES

WE are indebted to the now venerable Colenso for a deeply instructive and interesting treatise on the vegetable food of the Maoris in the days before Captain Cook's visit. After a residence of almost half a century among these people, during which he has most assiduously studied their ways, manners, and literature, none could write on any subject touching their history with more assurance. Two gross errors have largely and repeatedly been industriously published concerning these Maori—that they were ignorant of all art, and that they suffered from want of food; and from these assumed facts the deduction has been made that therefore they were when first discovered in a savage and starving state, out of which they have been raised by their intercourse with Europeans. As to the want of food, Mr. Colenso asserts that the natives of the North Island had at this time attained to even a high system of agriculture, and that they were passionately fond of cultivating their grounds.

The ancient New Zealander had plenty of good food, but only such as was to be obtained by labour. For them nature had no lavish gifts—no bread-fruit, no cocoa-nuts, no plantains or bananas—fruits from trees growing almost spontaneously and yielding without toil their delights to mankind. But, on the contrary, the Maoris got their vegetable food by constant industry and hard labour, and this was doubtless in favour of the development of the race, helping the "survival of the fittest." And not only were they great cultivators of the soil, but when first known they were in a state of civilisation far beyond that in which our own forefathers were when Cæsar first led his victorious army among them; indeed Colenso doubts if any ancient people had ever—wanting the knowledge of the metals—advanced so far; and he in a very pleasant manner reminds us that, as Xenophon remarked, "Agriculture is the nursing mother of the arts," and that the agriculturist is bound to the soil; it becomes sacred to him; he is compelled to build houses; unlike the nomad shepherd. Hence comes the town, and then the fortified places of strength, all of which the Maoris had, and none of which their neighbours the Australians and Tasmanians ever dreamt of.

One of the oldest legends of the Maoris treats of their favourite and beneficent hero Maui as catching and binding the sun to prevent his travelling so fast, *so that man might have longer daylight to work in.* In their plantations all worked alike—the chief, his wife, his slave. It was a pleasing sight to see the evenness of their tillage, the regularity of their planting and sowing. In planting the *kumara* and the *taro* the plants were generally set about two feet apart in true quincunx order, with no deviation from a straight line when viewed in any direction; weeds were most rigorously kept down. One peculiarity Colenso calls special attention to, one in which they seemed to differ from all other agricultural races—they never used any kind of manure or fertiliser, unless indeed under the latter denomination might come the fresh annual layers of dry gravel which they spread over their kumara plantations. Their whole inner man seemed to revolt against the idea of employing decaying substances, and when the early missionaries first used such substances in their kitchen gardens, it was brought against them as a charge of high opprobrium; and even in later days, when they saw the beneficial effects arising from the use of manure on potato-growing, they could not get over their prejudices, but chose rather to prepare fresh ground every year, doing this generally by felling and burning the timber on the outskirts of the forest, and with all the extra labour of fencing against pigs.

Their, in every respect, most important food-plant was the Kumara (a variety of the sweet potatoe); the use of it would seem to date from prehistorical times, as their many legends evidently show. In good seasons and soils its yield was plentiful, and it is interesting to remark a fact in connection with this crop, that may bring to the reader's mind the memory of the same thing being done in Ireland with the potatoes. Long before the tubers of the Kumara are of a full size, these are laid under contributions, each plant being visited in turn, and the largest tubers are excavated by means of a small sharp-pointed spade, after which the plant is "earthed" up; these stolen tubers are greatly esteemed. The general digging-up occurs in late autumn, but always before there is any expectancy of frost, and the tubers are carefully sorted. Colenso especially noted the number of well-marked varieties of Kumara, several of which were of great antiquity, and permanent. Over thirty varieties are distinguished, and some old sorts are known to be lost. All the sorts came true, and never varied except as to size. As all of these came down from the cultivation of the tubers, the question at once arises, How were they at first derived? The oldest Maoris never heard of the Kumara flowering, nor did they remember of the introduction of a new sort, but always said they had them of old from their forefathers. In the striking story of the murder of Rangiwhakaoma, translated by Colenso, "a lad, son of Te Aotata, is asked, 'Whither art thou going?' and he replies, 'To look at the Kumara in thy store;' but he is persuaded to descend into the unseen world, in order to see the beautiful Kumara there, which, when he saw the great heaps of, and was lost in admiring them, lo! the whole piled-up stack of Kumara was made to fall suddenly upon him, so that he was immediately killed;" and here the translator adds a practical note to the effect that, in order to let the air in and keep the tubers from mould, they were always packed in great loose heaps, and under cover. There is little doubt that, if the growers of potatoes had adopted some such method of storing their crops as these Maori did with their sweet potatoes, the loss from the potato disease would not have been so great as it very notoriously has been among the stored crop.

The second plant most generally cultivated by the Maori was the *taro*—this was propagated by off-sets; but, from its being a perennial, and always in season, its tubers were not stored, but dug up when wanted. Of this plant over twenty varieties were known, which, like the Kumara, differed greatly in size, quality, and in the colour of the flesh. This tuber played a very important part in many of the higher ceremonial observances—as at the naming of a newly-born child of a chief; at the death of a chief; at the exhumation, which in due time always followed; and also at the visits of welcome strangers.

The third food-plant greatly cultivated was a gourd called *hue*. This noble and highly useful plant was annually raised from seed, and was the only food-plant so propagated by the Maoris, and yet curiously enough of this plant, though yielding seed in great plenty, there is only one species and there are no varieties. As an article of food the fruit was only used when young, and always baked, like the *Kumara* and *taro*, in a common earth oven, and it was eaten like these both hot and cold. It came into use in the summer, before the *Kumara* crop was ripe. The ripe and dried fruits were used for holding water, oils, and cooked food. Often these vessels were handed down as heirlooms.

First in importance among their wild or uncultured food-plants is the fern stem (*Pteris esculenta*) *amhe*, *roi*, or *marohi*. Good edible fern root is not to be found everywhere, and in some districts it is very scarce. Colenso describes a hill of loose rich earth in the interior, which had been long famed for its fern root, and for the occupancy and use of that hill for digging the root, several battles had been fought. All fern root "diggings" were rigidly preserved. There was a regular set time for digging these rhizomes in the spring and early summer months, when the starch abounded in the cells. The root was never used green. The dried root was slightly soaked in water, washed a little, then beaten, and when properly finished, it would break with the fracture of a good biscuit. It was a very nutritious food, much eaten with fresh fish, and steeped in the sweet luscious juice of the berry-like petals of the *tutu* (*Coriarea ruscifolia*). It is related that the chief Künui, who had been carried off by Commander de Surville in December, 1769, and who died of a broken heart at sea, March 24, 1770, while he ate heartily of all the ship's provisions, pined after the fern root. It is interesting to note that Capt. Cook, on the first voyage, left Doubtless Bay—Kuniu's home—just a day before de Surville entered it. Most of the old traditions, and some of the deliciously quaint old songs of the Maori, sing the praises of this food, even giving it a heavenly origin. It is not without interest to note that the young fronds called *monehu*, just as they made their appearance in spring, were also eaten as asparagus would be with us. This is also, we believe, the custom in Canada.

As in some manner accounting for Cook's view of their condition, Colenso reminds us that Capt. Cook's first visit was at the very period when their *planting* season was just over, and this, the time of the utmost scarceness of *Kumara* and *hue*, that their plantations were far apart and strictly tabooed. Still, Cook says that he saw at Islaga Bay, "from 150 to 200 acres under crop," and that too in a place where, he adds, "We never saw 100 people." Colenso has no excuse for more modern writers, some of whom by long residence, ought to have known better. As to there ever being a "great want of food," the old and intelligent Maoris of the North Island have always denied this, stating that though they had not such good natural gifts as the Europeans—fruits, roots, and vegetables—and though they could only obtain their food by labour, yet that by labour in some form or other, they could obtain enough for all their needs.

SAMUEL SHARP

WE regret to have to announce the death of the well-known geologist and archæologist, Mr. Samuel Sharp. He was the son of Mr. Stephen Sharp of Romsey, Hants, and was born in the year 1815. During his long residence at Stamford, and subsequently in the neighbourhood of Northampton, he made very extensive and varied collections illustrating the geology and archæology of the midland districts. A portion of his fine geological collection was some years ago purchased by the trustees of the British Museum, while another portion has been for a long time placed on exhibition in the Northampton Museum. This latter collection, which very admirably illustrates the geology and palæontology of the district, has, we believe, been left under certain conditions to the town of Northampton, and it will form a valuable nucleus for a local collection, illustrating the natural history of the surrounding district, such as we may hope in time to see rising in all our principal provincial towns. Mr. Sharp was a man of large culture and varied tastes. His papers "On the Oolites of Northamptonshire," read before the Geological Society, are full of most valuable information concerning a district to which he devoted his life-long studies. He wrote a little text-book, "The Rudiments of Geology," which has passed through two editions, and which we have already had occasion to mention favourably in these columns. As an archæologist Mr. Sharp was not less widely known than as a geologist. On all questions of local antiquities he was one of the highest authorities in the Midland district, and many valuable papers relating to these subjects were contributed by him to the local journals. But it was as a numismatist that Mr. Sharp especially distinguished himself. During the last thirty years he by unwearied exertions succeeded in bringing together an unrivalled collection illustrating the productions of the famous Stamford Mint. His valuable memoir on these interesting coins, with it several supplements, was published by the Numismatic Society, and constitutes the best authority on the subject. As a consequence of failing health Mr. Sharp's familiar face has for some years been missed from the geological and archæological societies, in the affairs of which he so long took an active part. His genial manners and hospitable nature endeared him to a large circle of friends, and his loss will be deeply felt. His wide and varied stores of knowledge were always placed at the service of those who sought his aid, and his influence in encouraging the study of his favourite science was productive of much good in the district where he resided. Many a young collector and student of science was indebted to him for useful and friendly advice, and his energies could always be enlisted in aid of any projects which had for their aim the advancement of science, and the diffusion of sound knowledge in his adopted county. Mr. Sharp was a Fellow of the Geological and Numismatic Societies, as well as of the Society of Antiquaries. Some time ago he conducted the members of the Geologists' Association over the district with which he was so well acquainted, explaining to them those geological features which he had himself so carefully worked out. In spite of increasing infirmities and great sufferings Mr. Sharp steadily laboured on in the cause of his favourite sciences, and only a few weeks before his death read several interesting memoirs before the local Antiquarian and Natural History Societies. He died on January 28, in the sixty-eighth year of his age. In him English geology and archæology have lost one of those enthusiastic and disinterested labourers, to whose exertions the progress of these sciences has in the past been so largely due.

THE AURORA [1]

I.

IT has often been remarked that the importance of Arctic exploration is not so much in the geographical discoveries which can now be made during our slow advance towards the North Pole, as in the additions which accrue to physical geography by the observer; quite a new field of observations being opened to the observer during his stay in Arctic regions. The accuracy of this remark is completely confirmed by the new and most important conclusions as to the nature of auroræ which Baron Nordenskjöld has arrived at during the wintering of the *Vega* in the neighbourhood of Behring Strait.

The auroræ observed at the winter quarters of the *Vega* were mostly very feeble and had nothing of the important character they often have in other latitudes. "There are no auroræ, at least none worthy of this name," said one of the *Vega's* crew. But precisely because of their less brilliant character, of their simplicity, so to say, and of their regularity, Nordenskjöld was enabled to arrive at

[1] A. E. Nordenskjöld, "Om norrskenen under *Vegas* öfvervintring vid Berings Sund, 1878-79," in "*Vega* Expeditionen Vetenskapliga Arbeten." The Scientific Work of the *Vega* Expedition, part 1, pp. 401-452.)

certain conclusions as to their origin, which give us quite a new conception of the whole phenomenon of auroræ.

It is well known that auroræ are of two different kinds. The most usual ones in that part of the northern hemisphere which is more or less inhabited, and therefore the best known, show us a luminous arc which consists of rays and beams of light perpendicular to its lower edge. These beams flow towards the zenith, and sometimes they meet together and accumulate in the neighbourhood of this point in the shape of a crown; sometimes they are dissolved into light and bright clouds, or in regular strata of light. The most characteristic feature of these auroræ is the restless motion of light and their continuous changes. Those observed by the Swedish Spitzbergen Expedition in 1872-73, at Mussel Bay, belong to the same kind of auroræ, but with the difference from the European ones that they appeared in the southern or south-eastern part of the sky. They usually began in the shape of an arched band of light at a small height above the southern part of the horizon; soon it rose higher, became less regular and more brilliant, and divided into bundles of light which seemed to have a tendency to meet together in the zenith of the inclination-needle. The beams of light continually changed their place, increasing in number and size, and finally there appeared the well-known beautiful "draperies" of rays.

But besides this kind of auroræ there was sometimes observed another, consisting simply of a luminous halo-like arc, not distributed into rays, and characterised by its feeble brilliancy, as well as by the remarkable quietness of the whole phenomenon. Such were, with one single exception, all the auroræ observed during the wintering of the *Vega* at Kolutchin Bay (67° 5′ N. lat., and 186° 37′ E. long.) "Only once," Nordenskjöld says, "on March 29 to 30, did we see some beams of light; but nearly always, as soon as the sky was bright and the faint light of the aurora was not dimmed by sun- or moon-light, we have seen on the north-eastern part of the horizon an arc of equally spread light, the summit of which was 5° to 12° above the horizon. Usually it reached about 10°, and then it spread with a regular curvature for about 45° on both sides of its summit, which

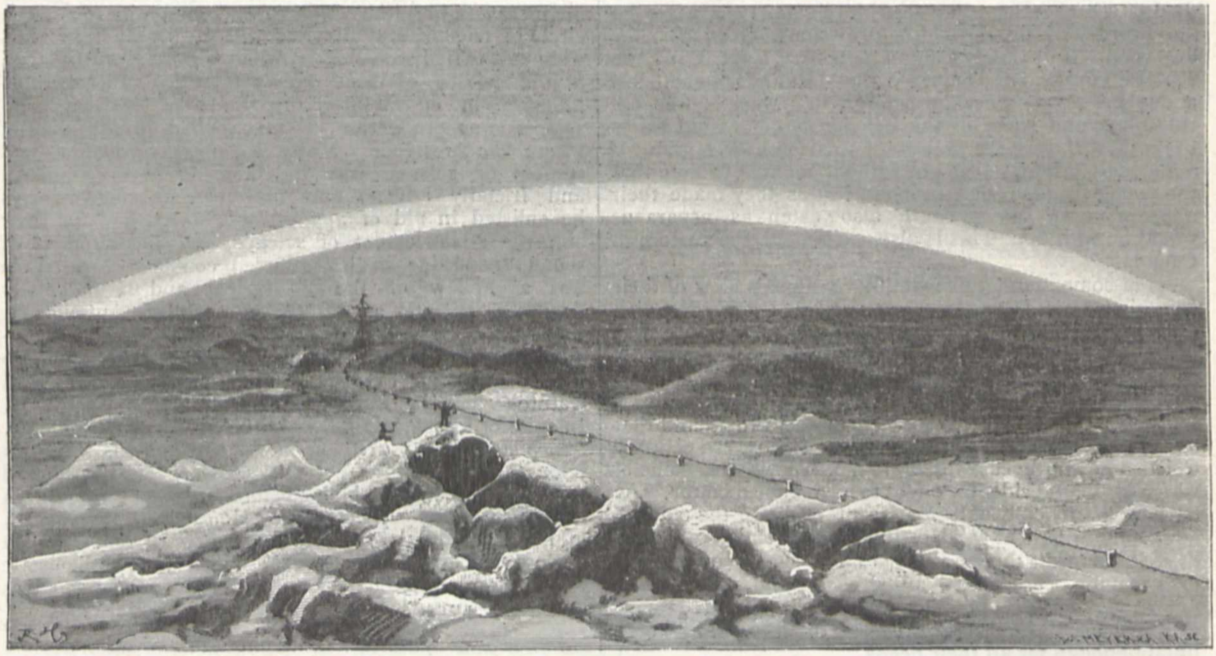


FIG. 1.—The common aurora-arc at the *Vega's* winter quarters.

was situated toward north-north-east (see Fig. 1). Hour after hour, day after day, this arc remained unchanged, varying but insignificantly as to its height, extension, and bearing. Indeed, one might ask if it could not be photographed by an 'exposure' for fifteen minutes." This arc soon received from the *Vega's* crew the name of the "common aurora-arc," which name Nordenskjöld maintains in his description. At Mussel Bay the members of the Swedish expedition also had seen such arcs with regularly spread light, and they had thought that they originated in rays being directed towards the observer. But now Nordenskjöld doubts whether on any occasion the aurora-arc could consist of rays of light. If this explanation were true the arc ought to be more brilliant than the separate rays, but the contrary is the case. Besides, the arcs observed at Mussel Bay were of a far less regular shape and more changeable as to the brilliancy of their different parts, than those observed at the *Vega's* wintering place. In these last there were sometimes observed also streams of light like pulsations which move from one part of the arc to another; and sometimes, but rarely, it happened also that rays of light were cast to a height of 20° or 30°, or even to the zenith.

The "common arc" was often accompanied by one, or several exterior arcs from which it was separated by a dark strip, sometimes crossed by rays of light flowing from one arc to the other. The exterior edge of the aurora-arc was not well defined, as its brilliancy diminished towards the upper edge, spreading a noticeable light on the sky above it. On the contrary the separation line between light and darkness was more definite on the lower edge, so as to convey the impression that the luminous arc reposed on a dark cloud-like basis—the so-called "dark segment." The true name for it would, however, be "the unlighted segment," as it remained dark whilst the sky above the arc was as if covered with a feeble luminous veil. In reality there is no "dark segment" at all. Whilst *usually* the stars were visible through the "dark segment" without any loss of brilliancy, that was not always the case. In the latter case the "dark segment" was in reality a true cloud which simply seemed to have the shape of the aurora-arc: it seems as if the aurora were cast out of its exterior edge, but in reality there is nothing but a common stratus-cloud, or a low-lying frost-mist, which extends upon a certain part of the horizon, and which has no other connection with the aurora than to diminish its brillancy, whereby the apparent horizon is a little elevated above the true one. The dark segment seemed in this case to be yet darker, and the light seemed to be cast out of the edge of the cloud. "I can maintain with full certitude," Baron Nordenskjöld says, "that the lighted segment of clouds which we saw during the winter of 1878–79 had this origin; and most probably, several luminous mists which we saw during the nights of March 18 and 20, close by our ship, *close by the ice*, were due to the same cause; but I cannot affirm that quite certainly."

The observations and measurements which were made at the *Vega* winter-quarters have led Nordenskjöld to the following conclusions as to the nature of auroræ:—

"Our globe," he says, "even during a minimum aurora year, is adorned with an almost constant crown of light, single, double, or multiple, whose inner edge was usually,

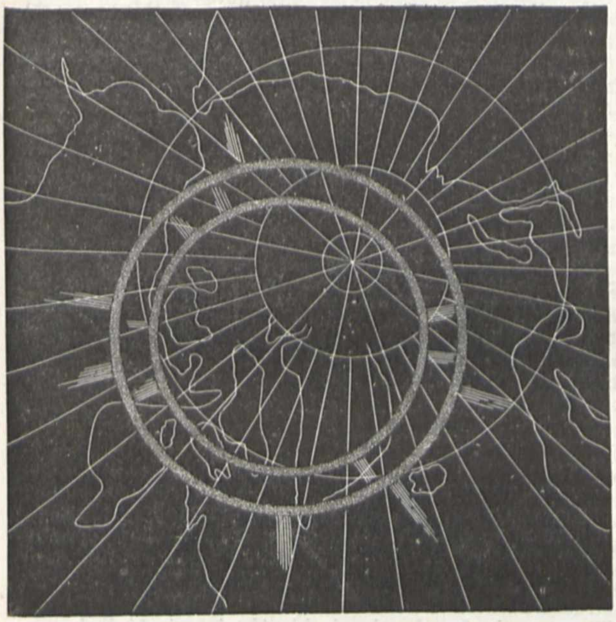


Fig. 2.—Map showing the position of the aurora-glory.

during the winter of 1878–79, at a height of about 0·03 radius of the earth above its surface, whose surface was somewhat *under* the earth's surface, a little north of the magnetic pole, and which, with a diameter of about 0·32 radius of the earth, extends in a plane perpendicular to the earth's radius which passes through the centre of this luminous ring." An idea of this double luminous crown, which Nordenskjöld has named the "aurora-glory," will be conveyed by the drawing, Fig. 2.

Of these two luminous rings of the aurora-glory, the interior, or the "common arc," is the most regular, and it is almost permanent. But it is visible only in such parts of the Arctic regions as are mostly not inhabited by people of European origin; and this circumstance, together with its feeble brilliancy, was the cause of its not having attracted till now the attention it deserves. It is known that even in Sweden the auroræ begin sometimes with the appearance of a halo-like arc, not divided into rays, and which must not be confounded with the ray-auroræ which also often take the shape of a luminous arc. But this regular arc which sometimes is seen in Sweden is not that which was observed at the *Vega's* winter-quarters: it is a second outer ring situated in the same plane as the interior one, but does not have the same regularity nor permanency. As to the ray-auroræ, visible in more southern regions, they are but a particular form of the aurora considered as a whole; they are but emissions of rays from the crowns of light, or aurora glories, which surround the Polar regions of our globe.

The true position of the permanent inner circle of the aurora glory could be easily determined if we had simultaneous measurements made at two distant points. But such observations not being made, Nordenskjöld tries to determine it from measurements made at Kolutchin Bay, admitting the following most probable suppositions:—That the glory is situated in a plane perpendicular to the earth's radius, which passes through its centre; that it is circular, and that its centre is situated somewhere in the neighbourhood of the magnetic pole. Admitting these suppositions, and with the measurements made during the wintering of the *Vega*, Nordenskjöld arrives, by means of calculations, at the conclusion that the centre of the aurora glory does not coincide with the magnetic pole, but is situated about 81° N. latitude, and 80° E. longitude, and, to avoid mistakes, he proposes to give to this pole the name of the "Auroral Pole." The summit of the common aurora arc being visible in the direction of the magnetic North when seen from places situated beyond the projection of the glory on the earth's surface, and in the magnetic South for observers situated within this projection, it is most probable that the centre of the glory is within the ellipse which circumscribes that part of the Arctic regions where the inclination is 90°. But a glance on a map representing the magnetic meridians shows that this hypothesis is far better satisfied when admitting that the aurora-pole is situated at the above-mentioned place, than if we admit that it coincides with the magnetic pole. The sections of the great circles tangential to the magnetic meridians at a distance of 20° to 30° from the magnetic pole, meet the surface of the earth about this same place. But it should be remembered that the section of the luminous crown, as also the position of its centre undergo certain changes. Under ordinary circumstance these changes are slow and within certain narrow limits; but during aurora-storms they are both rapid and wide. In these cases luminous arcs having different centres may appear at once. It is probable that it would not be difficult to determine, from observations made at two distant places, the laws of these changes; but with the measurements we have now at our disposal it is impossible. "We can," Nordenskjöld says, "only point out the main features of the phenomenon, and the above-mentioned figures are intended only to facilitate the understanding of the conception of auroræ which I try to establish." P. K.

(*To be continued.*)

THEODOR SCHWANN

THE death is announced of the distinguished physiologist whose name will be for ever associated with the history of the 'cell-theory.' He was born at Neuss near Dusseldorf in 1810, and was therefore in his seventy-second year. The most important fact in the history of his mental development, is that he came under the influence of the greatest teacher and worker in biological science whom Germany rich in such men, has ever produced, namely Johannes Müller. Schwann was by nine years the junior of his great master, who died whilst in the full tide of active work, at the comparatively early age of fifty-seven. When Schwann was twenty-three years of age, having completed his medical studies, he became Joh. Müller's assistant in the Anatomical Museum of Berlin and remained there for five years. In 1839 he was called to the chair of Anatomy in the Catholic University of Louvain, being then in his twenty-eighth year. In 1848 he migrated to the chair of Anatomy in the University of Liège, where he remained to the time of his death, having exchanged after a time, the chair of Anatomy for that of Physiology. It is noteworthy that Schwann was a Catholic, which probably had some influence in his selection by De Ram, the ecclesiastical Rector of Louvain University, for the chair which he first occupied, and he appears to have retained the confidence of the Catholic hierarchy in the later years of his life, if we may judge by the fact that an attempt was made by the clergy to procure him as an expert witness in the case of the reputed miraculous "stigmata" of Louise Latour.

Only four years ago—the professors of Liège and the scientific men of Belgium organized a festival to celebrate Schwann's fortieth year of professorship in his adopted country. From all parts of Europe addresses of congratulation flowed in, and public honours of all kinds were showered upon the head of "the founder of the Cell-theory." Schwann was naturally a man of retiring disposition, and simple habits of life. He had visited London twice within the last thirty years, and had not cared to make himself personally known to his colleagues there; he was equally unknown in the laboratories and scientific gatherings of his German fatherland. As he had published very little if anything since 1845,—though actively engaged in his professorial teaching at Liège which was very highly appreciated—Schwann had become to most biologists, one of the great names of the past —a revered historical character. To sit with him in front of a café in the pleasant streets of Louvain, and hear him discourse of the progress of histology and the germ-theory of disease some six years ago, was, for the present writer, a pleasure only less startling than that which could be conferred by one risen from the dead.

His modesty did not prevent Schwann from keenly enjoying the festival offered to him by his colleagues in 1878; and for some time after that event, he was busy in arranging the publication, for circulation among his friends, of a volume which contains an excellent photograph of himself and a complete report of the eulogistic speeches, and a reproduction of the hundred or more addresses from foreign universities and academies which the occasion of his festival called forth.

Among the many honours which Schwann received in 1878 or had previously acquired, may be mentioned the foreign memberships of the Royal Society of London, and of the Academy of Sciences of Vienna. and the Prussian cross 'pour le mérite'; whilst as early as 1845 he received from the Royal Society of London its most coveted decoration, the Copley medal.

Three important pieces of work are due to Theodor Schwann, each of which was the starting point of endless researches carried out by his successors, and to each is still directly and clearly traceable a distinct and vastly important line of investigation which, up to the present day, is being pursued with ever increasing activity. The first of these consists in his observations and reflections relative to the cell-structure of organisms; the second is his discovery of the organic nature of yeast, of the yeast plant as the cause of alcoholic fermentation, and of organisms as the cause of putrefaction in general; the third is his investigation of the laws of muscular contraction which is declared by the competent authority of Du Bois Reymond to have been "the first occasion on which an eminently vital force was examined as a physical force, and the laws of its action expressed mathematically in numbers."

Schwann's name is very generally known only in connection with his "microscopical researches into the accordance in the structure and growth of animals and plants," and as it seems to us somewhat erroneously, his merit is apt to be associated prominently or even exclusively with the history of Histology. In reality Schwann's merit as an anatomical histologist is comparatively a minor affair; the striking features in his *Microscopical Researches* are his breadth of view and the physiological generalizations which really constitute his cell-theory. Schwann started the conception of a physiology (*i.e.* a truly chemico-physical physiology) of the cell and without using the word "protoplasm" laid down in principle all that it implies. He established in so many words the difference between "crystalloids" and "colloids," and attributed the peculiar growth of cells to the capacity possessed by their substance of imbibing liquids; and further suggested that a peculiar molecular arrangement may exist in these colloid units comparable to the molecular structure of true crystals.

Both in animals and in plants "cells" had been recognized as a very general feature of their structure, previously to 1838. Comparisons had been made between the "cells" known to form plant-tissues and the "cells" seen in some animal tissues. Johannes Müller had especially compared the cells of notochordal tissue to the cells of vegetable parenchyma and had led Schwann to give attention to this matter. But as yet there had been no notion that the cells of plants were the *same* kind of things as the cells discovered in animals. Mirbel followed by Schleiden now propounded the view that *all* vegetable tissues are formed of cells more or less modified, and are produced by the developmental transformation of a primitive cellular tissue. This conception, as Schwann states, fired his imagination and the hypothesis occurred (in 1837) to him that animal and vegetable cells are of identical character, the structural and physiological units of organic nature, and that not only vegetable tissues but animal tissues also are ultimately to be traced to cells. He proceeded most laboriously to test his hypothesis by searching for cell-structure in every kind of animal tissue upon which he could bring his microscope to bear. He confirmed his hypothesis and not only that, but he made a number of important discoveries, in detail, as to the structure of animal tissues, and published his "Researches" in 1839.

The merit of transferring the botanical doctrine of cell-structure to animals and of thus raising it from special to universal application, was undeniably a great one and belongs to Schwann, as does also the merit of having securely established this doctrine by new observations—a task which speculative naturalists are often, in similar cases, disposed to leave to the care of their disciples.

But it is not this *morphological* generalization as to cell-structure which is Schwann's greatest claim to our regard. That is to be found rather in his *physiological* cell-theory, in the masterly chapter in which he lays down the view that the physiological processes occurring in these units called cells are, when summed up, that which we call "life," and *that these processes may be traced to mechanical* (that is to physico-chemical) *causes*. The later "protoplasm-theory" is scarcely an advance upon Schwann, as compared with the great gap which separates his "cellular physiology" from all that preceded it.[1]

[1] The following extracts from Schwann's last chapter of his "Researches," entitled "The Theory of Cells," cannot fail to interest and even astonish the reader when he reflects that they were written five-and-forty years ago, when the doctrine of evolution was almost if not entirely ignored by naturalists. It is also instructive to note that the man who held these views and proclaimed them was an orthodox catholic, and was not considered unfit to be called from Berlin to a Belgian university by the clergy, nor subsequently did a Liberal Ministry fear to promote him from the Chair of Louvain to that of Liège.

(A) "In physics all those suggestions which were suggested by a teleological view of nature. such as 'horror vacui," and the like, have long been discarded. But in animated nature, adaptation—individual adaptation—to a purpose, is so prominently marked, that it is difficult to reject all teleological explanations. Meanwhile it must be remembered that such explanations which explain at once all and nothing, can be but the last resource, when no other view can possibly be adopted. In the case of organised bodies there is no such necessity for admitting the teleological view. The adaptation to a purpose which is characteristic of organised bodies differs only in degree from what is apparent also in the inorganic part of nature; and the explanation that organised bodies are developed, like all the phenomena of inorganic nature, by the operation of

It is seldom given to one man to fully establish so vast an innovation in scientific doctrine as is the "cell-theory" in its complete form. Schwann had not this good fortune. His position may be indicated in his own words taken from his "Microscopical Researches" published in Berlin in 1839 immediately before his departure for the chair at Louvain. He says: "The elementary parts of all tissues are formed of cells in an analagous though very diversified manner, so that it may be asserted, *that there is one universal principle of development for the elementary parts of organisms however different, and that this principle is the formation of cells.* This is the chief result of the foregoing observations." So far Schwann has only been confirmed and established by all succeeding observers. But when he came to attempt to explain the formation of the cells themselves, Schwann signally failed. He proceeds: "A structureless substance is present in the first instance, which lies either around or in the interior of cells already existing, and cells are formed in it in accordance with certain laws."

Schwann put forward the notion that cells are produced by a sort of aggregative process in a structureless mother-substance; he did not recognize any more than his botanical contemporaries the universal origin of cells by the division of pre-existing cells, although he very fully and correctly identified the animal ovum with a single cell, its "germinal vesicle" with the cell-nucleus and the "germinal spot" with the cell-nucleouls discovered by him, The enunciation of the doctrine "omnis cellula e cellulâ" was reserved for later workers. Von Mohl in plants, and Kölliker and Remak in the cephalopods and vertebrates respectively, made observations on cell-division which have contributed more than any others to the filling out of Schwann's cell-theory by the true doctrine of cell-genesis. It may in truth be said that up to the present day a large part of the progress in both vegetable and animal histology since Schwann's time, has consisted in the demonstration in case after case of the erroneous nature of his doctrine of the free formation of cells.

It is not an easy matter to estimate Schwann's influence in the history of that exact experimental physiology, which his researches on muscular contraction inaugurated. It is sufficient to point to the enormous development of that branch of enquiry within his lifetime, and to insist upon the wide range of capacity (however much we may recognise in its activity the influence of the great Johannes Müller) which enabled one and the same man to establish the generalisation known as the cell-theory, and, at the same time, to make the first exact measurements of the operation of forces in a living body, by the methods and instruments proper to the physicist.

blind laws, coeval with the existence of matter itself, cannot be rejected as impossible. Reason certainly requires some ground for such adaptation, but for her it is sufficient to assume that matter, with the powers inherent in it, owes its existence to a rational Being. Once established and preserved in their integrity, these powers may, in accordance with their immutable laws of blind necessity, very well produce combinations, which manifest, even in a high degree, individual adaptation to a purpose. If, however, rational power interposes after creation merely to sustain, and not as an immediately active agent *then it may, so far as natural science is concerned, be entirely excluded from consideration in relation to the creation.*"

(B) The first development of the many forms of organised bodies—the progressive formation of organic nature indicated by geology—is also much more difficult to understand according to the teleological than the physical view.

(C) "An explanation of the teleological kind is only admissible where the physical can be shown to be impossible. Assuredly it conduces more directly to the object of science to at least make the effort to obtain a physical explanation. And I would repeat that when speaking of a physical explanation of organic phenomena, it is not necessary to understand an explanation by *known* physical powers, such, for instance, as that universal refuge, electricity, and the like; but an explanation by means of forces which operate *like* the physical forces, in accordance with the strict laws of blind necessity, whether they are also to be found in organic nature or not.

"We set out, therefore, with the supposition that *an organised body is not produced by a fundamental power which is guided in its operation by a definite idea*, but is developed, according to blind laws of necessity, by powers which, like those of inorganic nature, are established by the very existence of matter."

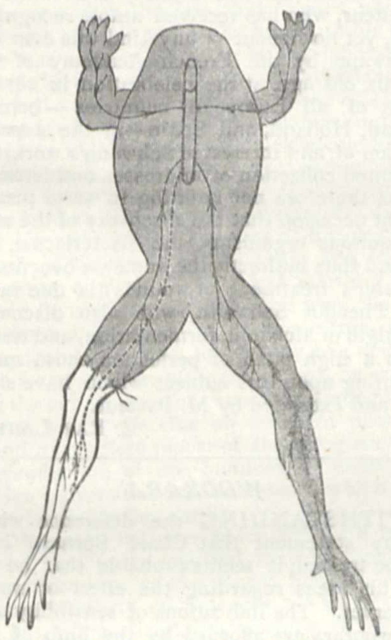
Schwann's merit in relation to the doctrine of organisms as the cause of putrefaction and of fermentation, requires to be more fully noticed since the history of recent research in these subjects has been such as to place a French chemist, M. Pasteur, before the scientific world in the position which truly belongs to Schwann. The latter appears never to have followed up the brilliant experiments by which he demonstrated that putrefactive and fermentative processes depend upon the access of organic germs to the fluids in which those processes occur. But in his "Microscopic Researches" there is an important note on "the theory of fermentation set forth by Cagniard-Latour and myself," in which the yeast-cell is described as an elementary organism, and its activities are discussed as "the simplest representation of the process which is repeated in each cell of the living body." It is a remarkable fact that although Schwann communicated his "cell-theory" to the Academy of Sciences of Paris in 1838, and although his experiments on putrefaction and fermentation form the basis of the observations which have since been conducted with so much approval by M. Pasteur, who has received ample recognition from that body, yet no honour of any kind was ever conferred upon Schwann by the French Academy of Sciences. Even in his old age, at the celebration in 1878, France stood last of all European countries — behind even Switzerland, Holland, and Spain—in the expression of appreciation of, and interest in Schwann's work, as shown by the printed collection of addresses and letters.

It seems therefore not unfitting to state precisely on the present occasion that the discovery of the relation of those ubiquitous organisms, the Bacteriaceæ, to putrefaction (and thus indirectly the immense benefits obtained by our Lister's treatment of wounds) is due in the first place to Theodor Schwann, who also discovered the organic origin of alcoholic fermentation, and devised and carried to a high pitch of perfection those methods of experimenting upon this subject which have since been amplified and extended by M. Pasteur.

E. Ray Lankester

WOORARA

NOTWITHSTANDING the deference with which every statement that Claud Bernard has made ought to be treated, it seems probable that he was mistaken in his ideas regarding the effect of woorara on sensory nerves. The indications of sensibility under the action of woorara are afforded by the limb of a frog to which the poison has not had access, so that the endings of the motor nerves in it are not paralysed. On pinching a portion of the skin anywhere in such an animal, even on the poisoned leg, it is noticed that movement takes place only on the unpoisoned one, while all the poisoned parts remain perfectly limp and motionless. But this movement, while it might indicate pain, does not necessarily do so, and may only indicate simple reflex action. The difference between these two conditions, in which the movement is alike, is that which exists between the effect of tickling the sole of the foot in man with a feather and running a pin into it. In both cases the foot would be drawn up, perhaps even more so with the feather than with the pin, but the pin would cause pain, and the feather would not. The movement of the frog's leg in woorara poisoning much resembles that caused by the feather, for it will occur as readily, or more so, if the brain has been removed. We know that in cases where the spinal cord has been broken by accident in man reflex occurs in the legs quite readily, but of this the patient himself is utterly unconscious excepting by seeing the movements in the same way as a bystander. Increased movement, therefore, in the curarised frog, instead of indicating increased sensibility to pain, may only indicate increased irritability of the spinal cord and in all probability does so. The same arguments which would prove that woorara increases the susceptibility to pain prove also that morphia does so, for in small doses morphia also increases the movement of the leg of the frog in the same way as woorara; but we know perfectly well from observation in man that morphia does not increase pain even in small doses, and that a large dose completely abolishes it. There can be little doubt that large doses of woorara also abolish sensibility as well as motion, for after the poison has acted awhile, the movements, even in the protected leg, become less and less, showing that the spinal cord has been paralysed; but before this take place, the sensory nerves themselves are paralysed by the poison, as was first shown by Schiff, the correctness of whose experiments has been since confirmed. The mode of experiment will be better understood by reference to the accompanying diagram representing a frog, in which the artery going to one leg has been tied so as to protect it from the influence of the poison. This leg has been left unshaded, but all the



poisoned parts of the body are shaded. At first, pinching in any part of the body, whether poisoned or not, will induce movement in the non-poisoned leg, but after a little they do not, while pinching of the skin of the unpoisoned leg below the point of ligature will cause movements. This is most strikingly seen when the skin is pinched, first just above the ligature, and afterwards just below it. The pinch above the ligature produces no effect; the pinch below it produces movement. In the former case the sensory nerves have been poisoned by the woorara; in the latter case they have not. This experiment shows clearly that the ends of the sensory nerves are also paralysed by woorara like the ends of the motor nerves, although they are not so quickly affected, for a reference to the diagram will show that the trunks of both motor and sensory nerves and the spinal cord have been equally exposed to the poison, and that the only difference between the skin just above the ligature and just below it is that the ends of the sensory nerves above it have been poisoned, and those below it have not been poisoned. It is therefore almost certain that woorara in large doses diminishes, and finally abolishes all susceptibility to pain, as well as all power of motion, and that it may be looked upon as an anæsthetic, although not so powerful as chloroform, ether, or morphia.

NOTES

THE American Association for the Advancement of Science will hold its thirty-first annual meeting in Montreal during the week beginning Wednesday, August 23, 1882, under the presidency of J. W. Dawson, LL.D., F.R.S. A large attendance is expected from the United States and Canada, and it is hoped that there will be a good number of visitors from the British Islands and Continental Europe. The new Redpath Museum of the University, then to be opened, will contain remarkable collections, in part gathered for the occasion, illustrating American Geology and Archæology. The Allan and Dominion lines of steamers have placed at the disposal of the Local Committee a considerable number of passages from Liverpool to Quebec and back, at much reduced rates, and arrangements will be made for entertaining private visitors. Circulars, giving full particulars, will soon be issued, but meanwhile it is requested that any persons proposing to avail themselves of the occasion will communicate as soon as possible with Dr. T. Sterry Hunt, Montreal, Canada.

A LETTER has been received by one of the local secretaries of the British Association, intimating that Prince Leopold (Duke of Albany) had consented to accept the position of President of the Local Committee for the annual meeting of the British Association to be held at Southampton in the ensuing autumn. It is understood that the Earl of Carnarvon, the Bishop of Winchester, and Lord Northbrook, have agreed to act as Vice-Presidents. Answers have not yet been received from many other noblemen and gentlemen to whom similar invitations have been given.

WHAT a treasury of information the U.S. Census is compared with our own meagre enumeration. We have received, for example, five maps, with accompanying statistics, under the title of "Forestry Bulletin," showing the pine supply of Texas, Florida, Alabama, Mississippi, and Minnesota; doubtless the series will be completed. These maps not only show the area under pines, but also the distribution of the different species of pines, while, among other useful information, the text gives the number of feet standing.

WE can only this week announce the death of Sir Robert Christison; next week we shall give some particulars of his career.

THE Royal Society of New South Wales offers a prize for the best communication, containin g the results of original research or observation, upon each of the following subjects:—Series I. (to be sent in not later than September 30, 1882). No. 1. On the Aborigines of New South Wales, 25*l.* No. 2. On the treatment of auriferous pyrites, 25*l.* No. 3. On the forage plants indigenous to New South Wales, 25*l.* No. 4. On the influence of the Australian climates and pastures upon the growth of wool, 25*l.* Series II. (to be sent in not later than August 31, 1883). No. 5. On the chemistry of the Australian gums and resins, 25*l.* No. 6. On water supply in the *interior* of New South Wales, 25*l.* No. 7. On the embryology and development of the marsupials, 25*l.* No. 8. On the Infusoria peculiar to Australia, 25*l.* The competition is in no way confined to members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the Council for the time being; neither will an award be made for a mere compilation, however meritorious in its way—the communication to be successful must be either wholly or in part the result of original observation or research on the part of the contributor. The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labour, but it is hoped that the honour will be regarded as a sufficient inducement and reward. The successful papers will be published in the Society's Annual Volume. Fifty reprint copies will be furnished to the author free of expense. It is the intention of the Society to offer additional prizes should this first attempt to encourage original scientific investigation be reasonably successful. The Society deserves the highest credit for the enterprise, and we hope they will be encouraged to continue it.

IT was lately announced that a German in Russia, Herr Dittmar, had found a way of solidifying petroleum, which would be of great commercial advantage. The method (we now learn from *Deut. Ind. Zeit.*) consists in heating petroleum in a still with 2, or at most 3, per cent. of soap. At first there is a great deal of foam; and at 100° the whole mass suddenly becomes like wax. For liquefaction afterwards vinegar is used. So far as yet apears, the invention is not applicable to raw naphtha. The distilled oils at Baku (on the Caspian) should be solidified, transported, and then submitted to further distillation. A lively discussion on the subject recently took place at the Russian Technical Society in St. Petersburg, and some objections raised by Prof. Wilchinski were not, it is said, adequately met by the inventor. It was urged, *inter alia*, that the solidifying did not wholly do away with leakage. When a piece of the solid petroleum is laid on blotting-paper, the latter absorbs some of the petroleum, and the solid piece loses weight. The same occurs with wood, and the proposed wooden cases, saturated during transport, might give off vapours which, mixing with air, would form explosive mixtures. If cases impermeable by petroleum were used instead, the advantage of the cheaper chests would fall away. Further, the consumption of soap (not a very cheap material) is considerable; thus 100,000 cwt. of petroleum would take 2000 cwt. of soap. The fatty matter need not indeed be lost, but it would be lost for the naphtha district, as the carriage back would not pay. Further, the solid petroleum could not be brought into the houses, but would require large central liquefying works, whence the liquid would be carried in vessels. Herr Ditmar's figures, showing a great advantage in the cost of transport of solid petroleum, were vigorously debated, and it was pointed out that the unloading of the chests was disadvantageous compared with the simple pumping from tanks.

DOES the resistance of a gas to the motion of a solid body in it vary with the temperature when the density of the gas is kept perfectly constant? To this a negative answer has been given lately by M. Hirn, as the result of some ingenious experiments; and the deduction follows that the ideas at the base of the kinetic theory of gases must be given up, for according to that theory (Clausius) the resistance must vary, other things equal, in the direct ratio of the square root of the absolute temperature. M. Hirn, indeed, affirms "that the pressure and temperature of gases are not constituted by movements, of whatever kind, of material atoms." His experiments were made with a pendulum arrangement in a large globular vessel of glass, the pendulum consisting of a rectangular glass plate suspended by a steel wire, which passed up through a stopper of vulcanised caoutchouc. The temperature was varied between 11° and 50° C. In their reports on the memoir to the Belgian Academy, MM. Folie, Van der Mensbrugghe, and Melsens, while recognising the high merit of M. Hirn's researches, are still not prepared to accept his results. It is pointed out, *inter alia*, that the range of temperature is too limited. In M. Clausius' hypothesis, moreover, the law of resistance relates to *rectilinear* motion of a disc in an *indefinite* fluid, whereas the author experiments with *alternating* motion within a vessel *hermetically closed*. One of the reporters thinks the vessel should have been carefully weighed before and after the experiments. Once more the experiments of Meyer, Stefan, &c., on internal friction of gases have proved an incontestable influence of temperature. M. Hirn, in his memoir, indicates the far-reaching nature of his results, and their bearings on metaphysical questions. A *résumé* of this part of his argument is given by M. Melsens in his report (*Bull. Belg. Ac.*, Nos. 9 and 10).

IT is just fifty years since the first number of *Chambers's Journal* was published, and its founder, Dr. Wm. Chambers, gives in the number for January some interesting reminiscences of its and his own long career. He has reason to be proud of both; his journal has done much to spread sound and healthy knowledge, and all along in its pages science has had its place. The house of which Dr. Chambers is the venerable head has through its many publications, a large proportion of which are scientific, had no inconsiderable share in fostering and promoting the now widespread desire for thorough popular education.

IT is interesting to observe that the nobles of Japan, whom superficial writers are accustomed to regard as an effete and useless class, are taking up with much vigour the question of education in Western knowledge among members of their own body. A few years ago a school for the sons of *Kwasoku* (the old *daimiô* class) was opened in Tokio. All the funds necessary for a large and handsome building were contributed by the nobles themselves, and education in Western methods by trained native and foreign teachers was commenced. A recent decree of the Mikado has ordered the establishment of a Senate and House of Representatives, and it is believed that the hereditary nobility, or a certain number of them will have seats in the upper house. In order to render them fit for these new duties, it has now been decided that all pupils graduating in the nobles' school above mentioned shall be sent abroad to study in Europe or America. It may be added that the great majority of the Japanese students in this and other foreign countries are now studying wholly at their own expense. This interesting fact would go to show that the thirst for Western knowledge in Japan is widespread; otherwise the relations of these young men would not spend the comparatively large sums required for their maintenance abroad.

THE latest information from the East shows the existence of wide-spread seismic disturbance of an unusual kind. Details of a destructive earthquake in the Chinese province of Kansuh have been received. At one place (Kanchou) 42 persons were killed and 27 injured. One hundred houses also were destroyed, and 120 animals killed. At Chiebichou the damage was mnch greater, 347 persons were either killed or injured, and 300 animals killed. As frequently occurs on these occasions, the disturbance was followed by an inundation which caused such destruction that the Emperor has been petitioned to remit all taxes and dispense charity. From the Philippine islands we receive news of a violent eruption of the volcano of Mayon, which has ruined many cocoa-nut plantations and caused much alarm. The whole island of Ceylon has also been visited by an earthquake, which, however, did little damage.

WE are glad to observe that the King of Siam is vigorously extending education throughout his territory. He has recently erected two new schools in Bankok. At one of these, where English is taught, a number of his Majesty's sons and brothers are among the pupils. At the other school only the vernacular is taught.

As we anticipated in NATURE a short time ago, the Chinese telegraph lines have been thrown open to the public, but no one could have been prepared for the manner in which this was done. The authorities have taken into consideration the fact that telegraphic communication is new in China, and that its advantages will make their way slowly among the people at first unless some vigorous steps were taken to make them known. They have accordingly decided to give the public free use of the lines for one month. This bold and wise measure will, we doubt not, be fully justified by the result.

A ROUMANIAN engineer, M. Theodorescu, has invented a submarine ship, before which all similar inventions are said to pale. This ship, according to the statement of the inventor, can be guided for twelve hours completely under water, the depth of immersion varying between 100 and 300 feet at the option of the commander. Upon the surface the ship can be managed like any other vessel, its rate of speed, however, being less than that of ordinary steamers. The diving is done by means of screws, vertically, and can be accomplished suddenly or gradually. In the same manner the ship can be made to emerge from the water. When the vessel is under water, enough light is supplied to enable those on board to see any obstacle 130 feet ahead, and to regulate the ship's motion accordingly. The air supplied to the vessel is said to suffice for the whole crew for about twelve to fourteen hours. In case of need the air reservoir can be filled again, even under water, by means of telescopic tubes sent up to the surface. The progress of the vessel, as well as the diving, are said to be absolutely noiseless. We give all these details from the inventor's statement with due reserve, but should they prove true, the invention would be likely to prove a highly valuable one even for peaceable objects, apart from its great utility in naval warfare.

IT is announced that, at the instance of the Marquis of Lorne, the initiatory steps have been taken for the establishment of an academy of eminent literary and scientific men in Canada, after the plan of the Assembly of the Immortals in France. The proposed body is to be composed of six sections, representing English and French letters, history and archæology, and the mathematical, physical, geological, and biological sciences. It is probable that there will be ten or twelve members in each section. Dr. Dawson is spoken of as the first president.

THE Boston Society of Natural History have published in a separate form various papers on the Palæolithic implements of the valley of the Delaware.

PROF. KIRCHHOFF, of Hallé-a-S., announced at the last meeting of the Saxo-Thuringian "Verein für Erdkunde" that the second German Geographical Congress will take place at Halle during the current year. A committee has been formed.

ON the day following his resignation as Minister M. Paul Bert was nominated president of the Société de Biology, filling the room which had been vacated by the death of Claude Bernard.

A SLIGHT shock of earthquake was noticed at Agram on January 9 at 2.29 a.m.

WITH regard to the *Jeannette* expedition the latest news received at St. Petersburg, January 28, from Irkutsk, states that Mr. Melville has started for the mouth of the River Lena to resume the search for Lieut. De Long. The search will be carried on with the utmost vigour with the aid of the natives. The supply of provisions is plentiful, so that if necessary the search may be prolonged until far into the summer. Mr. Melville will be accompanied on his expedition by the captain of the steamer *Lena*.

AT the meeting of the Geographical Society on February 13 Sir Richard Temple, Bart., G.C.S.I., formerly Governor of Bombay, will deliver a lecture on the Geography of the Birthplace and Cradle of the Mahratta power in Western India. The lecture will be illustrated by the author's own sketches, which have been enlarged for the occasion by his brother, Lieut G. T. Temple, R.N.

FROM the *Compte Rendu des Séances*, just issued by the French Geographical Society, we learn that at their next meeting on February 3, some interesting letters will be read, including one from Dr. Crevaux, who is about to explore the sources of the Pilcomayo in the Bolivian Andes, and afterwards descend the river to its mouth. A paper will also be read by Col. Veniukoff on the unexplored parts of Asia.

THE Moscow Society of Naturalists have appointed a special Commission to inquire into the influence of the decrease of forests on rivers and streams. This Society intend to celebrate, on May 14 next, the fiftieth anniversary of the doctorate of their vice-president, M. Charles Renard, who has for forty-two years rendered eminent service to the Society as well as to science.

AN important meeting of the Executive Committee of the Parkes Museum was held on Friday, Prof. Berkeley Hill in the chair. The Curator, Mr. Mark H. Judge, as Secretary of the recent International Medical and Sanitary Exhibition, presented the final report of the Exhibition Committee, which, after giving a detailed account of the origin and success of the undertaking, concluded as follows:—"The work for which the Exhibition Committee were appointed having now come to an end, they have the satisfaction of handing over to the Executive Committee of the Museum the sum of 933*l*. 11*s*., together with furniture and fittings to the value of 100*l*., while contributions to the Guarantee Fund to the amount of 86*l*. 19*s*. have been transferred to the Parkes Museum Building Fund, making the financial result of their labours a profit to the Parkes Museum of 1,120*l*." The Honorary Secretary, Dr. G. V. Poore, read a communication from the Council of University College, in which that body agreed, with some modifications, to proposals which had been made in behalf of the Museum to the Council of the College in reference to the erection of a building for the Museum. After a long discussion the modifications suggested by the Council of University College were accepted, and it was resolved that steps should be taken to obtain the funds necessary for carrying out the scheme, which embraces (1) the building of an addition to the north wing of the College for the purposes of the Museum; (2) an endowment for the maintenance and management of the Museum; (3) the Museum to be opened free to the public and to be placed on a somewhat similar footing to the North London Hospital, *i.e.* to be autonomous, with due representation of the Council of University College on the Executive Committee of the Museum. It is estimated that 30,000*l*. is the sum that will be required thus permanently to establish the Museum as a national institution. Towards this Mr. Thomas Twining of Twickenham, had written to say that he would subscribe the sum of 100*l*. if one hundred promises of a similar amount were obtained. Promises of subscriptions may be sent to the Curator at the Parkes Museum, University College, Gower Street. Subscriptions may be paid to the account of the Parkes Museum at the Union Bank, Argyl Place, Regent Street.

THE additions to the Zoological Society's Gardens during the past week include a Toque Monkey (*Macacus pileatus* ♂) from Ceylon, presented by Mrs. Evans; an Azara's Fox (*Canis azaræ*) from South America, presented by Mr. Owen E. Grant; an Indian Vulture (*Gyps, bengalensis*) from India, presented by Capt. Th. Leportier; a Chimpanzee (*Anthropopithecus troglodytes* ♀) from West Africa, deposited.

OUR ASTRONOMICAL COLUMN

THE OBSERVATORY OF HARVARD COLLEGE, U.S.—The Annual Report of the proceedings of this Observatory, presented to the visiting Committee in November last by the present zealous director, Prof. Pickering, has been issued. Aided by the subscription raised in 1878 for the support of the Observatory for five years, the director has been enabled to keep the establishment in great activity, and his Report will be a gratifying proof that the funds placed so liberally by subscribers at his disposal are being dispensed in a manner that must prove of great advantage to the progress of astronomical research. Three instruments the equatorial of 15-inches aperture, the meridian circle, and the meridian photometer, have been kept in active work. With the former, sixty-four eclipses of Jupiter's satellites were observed photometrically, an improvement having been introduced by which the number of settings is largely increased. A single observer, it was found, could make but three settings in a minute, or one in twenty seconds. With an assistant to record, the time is reduced to about nine seconds, while by the employment of two assistants, one of whom reads the photometer circle, while the other records and observes the time by the chronometer, the time is reduced to five seconds. It is probable that, as the observer does not remove his eye from the eyepiece, the accuracy of the observations is increased, and the satellite followed nearer to the point of disappearance. The search for objects having singular spectra, which only admits of being carried on in perfectly clear, moonless nights, had been much interrupted by other current work. The most notable result was the discovery of the peculiar spectrum of the star Lalande 13412, a seventh magnitude; two of the lines appear to be coincident with two in the spectrum of the great comet of 1881, as described by Dr. Konkoly; "accordingly, while other comets have a spectrum identical with that of the stars of Secchi's fourth type, this comet contains a substance as yet unknown, which one star only is as yet known to contain." The star L^2 Puppis was found to have a banded spectrum; its declination is more than forty-four degrees south of the equator, and at the time of Prof. Pickering's examination it was less than two degrees above the horizon. Its variability was pointed out by Dr. Gould (*Uranometria Argentina*, p. 279); he inferred a period of about 135 days; maxima occurred in 1874 on Feb. 8 and June 25; the star is stated to be red in all its stages and remarkably so about minimum, limits of variation 3·6 and 6·3. The position for 1875·0 is in R.A. 7h. 9m. 43s., N.P.D. 134° 26′. 2. The spectra of all the stars north of − 40°, marked as red or coloured in Dr. Gould's work have been examined at Harvard College, no peculiarity of spectrum being detected in the majority. Algol and the star D.M. 81°, 25 were assiduously studied photometrically. The meridian-circle had been in use on 250 days. The work originally proposed for the meridian-photometer, viz., the measuring on three nights the light of each of the naked eye stars visible in the latitude of the Observatory, was essentially completed on August 25, 1881, but it is intended to continue the observations for another year, as the necessary delay in reduction and publication will not be greatly increased thereby. With the view to a more complete comparison of the photometric observations with those made by the naked eye, which the *Uranometria Argentina* affords the means of doing as far as 10° north, all the stars in the *Atlas Cœlestis Novus* of Heis north of the equator and brighter than the sixth magnitude, are being measured by the eye, aided by an opera-glass when necessary. It is intended that each star shall be measured by three observers, who are to compare it with two stars in the vicinity of the pole, one a little brighter, the other a little fainter; the interval between the two stars is supposed to be divided into ten parts, and the brightness of the star under comparison is estimated on terms of this interval. Prof. Pickering mentions that out of about nine thousand comparisons required for this work, nearly a quarter have been already made.

Vol. xiii. of the "Annals" now in process of publication will contain results of work with the large equatorial, under the direction of the late Prof. Winlock, and micrometrical measures up to the present time. These include measurements of double stars, observations of nebulæ and their spectra, satellites of Saturn, Uranus, and Neptune, satellites of Mars during the oppositions of 1877 and 1879, &c. Vol xiv. will contain the measures made with the meridian-photometer.

An important and much-wanted bibliographical work has been undertaken by Mr. Chandler, viz., the collecting of references to observations of stars of known or suspected variability, those of each star being brought together; on the completion of this work it is intended to measure the comparison-stars photometrically, and to effect a reduction on a uniform system of all the observations of the variable-stars of long period.

The staff of computers employed upon the ordinary reductions of observations with all three instruments includes several ladies. We suspect that those who are competent and have had opportunity of judging of the work of the lady-computer (who is to be found elsewhere than at Harvard Observatory) will be of opinion that she is well able to hold her own against even the practised computer of the other sex. If proper opportunities and encouragement were afforded, we might hear of Madame Lepautes in our own day.

BIOLOGICAL NOTES

Delicate Test for Oxygen.—T. W. Engelmann proposes, in the *Botanische Zeitung*, a new test, of an extremely delicate nature, for determining the presence of very minute quantities of oxygen, namely, its power of exciting the motility of bacteria. If any of the smaller species, especially *Bacterium termo*, are brought to rest, and then introduced into a fluid in which there is the minutest trace of free oxygen, they will immediately begin to move about freely; and if the oxygen is gradually introduced, their motion will be set up only in those parts of the drop which the oxygen reaches. In this way Engelmann was able to determine the evolution of oxygen by *Euglena* and by chlorophyll-granules.

Prothallium and Embryo of Azolla.—The development of the prothallium and embryo of Azolla, hitherto but imperfectly known, have been followed out by Prof. Berggren (*Lunds Univ. Arsskrift*) in the case of *A. caroliniana*, and found closely to follow the phenomena in Salvinia. The endospore splits, on germination, along its three edges; and the prothallium, on escaping, has the form of a slightly convex disk, consisting in the middle of several layers of cells, at the margin of only one, and separated below by a thin hyaline membrane from the large protoplasmic spore-cavity. Shortly afterwards an archegonium is formed, consisting of four cells inclosing the oospore, and of four neck-cells. When quite mature, the part of the prothallium which projects outside the spore is nearly hemispherical, and three obscure wings are produced by three longitudinal furrows. After fertilisation the oospore is divided by the first oblique division-wall into a smaller upper cell facing the neck of the archegonium, and a somewhat larger lower cell filled with coarse-grained protoplasm. By successive walls vertical to one another and to the first division-wall, and parallel to its longitudinal axis, the embryo is then divided into octants. In each octant a wall next appears parallel to the first division-wall, and the entire embryo then consists of sixteen cells arranged in four parallel rows. After fertilisation the embryo breaks through the prothallium near the archegonium, and the prothallium then surrounds the foot of the embryo like a cup, carrying the withered archegonium on its dorsal side behind the scutellum. To prepare for fertilisation the massulæ of the macrosporangia, with their anchor-shaped glochidia, fix themselves in large numbers to the epispore of the macrospores which are floating on the surface of the water. The central fibrous portion of the floating apparatus is perforated by a narrow canal, through which the antherozoids probably reach the archegonium. By their subsequent growth the prothallium, and later also the embryo, force themselves into this canal and increase its size. By this means the three floating bodies are displaced from their original position, and finally stand at a right angle from the macrospore. The indusium which covers the floating apparatus in the form of a brown cap is at the same time pushed upwards, and finally forced against the embryo. The hood-like fibrous layer which is closely applied to the floating apparatus is turned over, and surrounds the foot of the embryo like a collar. Shortly afterwards the embryo detaches itself from the macrospore, the margins of the scutellum become broader, and then lie on the surface of the water in the form of cups or scales.

Phyllomic Nectar Glands in Poplars.—In a very interesting memoir on this subject, Mr. Wm. Trelease calls attention to the fact that these glands have been very generally overlooked, and that they have been considered of little value by the systematic botanist. He accounts for this by their being occasionally suppressed, and of their limitation to the earlier-formed leaves. Still most of the American botanists refer to them, and Michaux figures them in his monograph of the genus. In May, 1880, Mr. Trelease's attention was drawn to examine the leaves of a small aspen by the action of some bees. The tree was covered with its newly expanded foliage, and the bees were flying from leaf to leaf; they were seen to be collecting nectar which was poured out from a double gland at the base of each leaf. These glands were placed on the upper surface of the petiole at its union with the blade. On section and microscopical examination they showed the usual structure. They were found not to occur on all leaves, but as a rule only on the first half dozen or less which appear on each branch in the early spring; and later on in the season, when these have fallen off, one may sometimes examine all the leaves without detecting a single glanduliferous one, and this on a species which produced them in abundance earlier in the year. From an examination of the American species it would seem that the greater number possess two or more distinct or confluent glands situated where the blade and petiole join, and in these few species where none were discovered, it is quite possible that a closer examination in the spring time may show that they exist. Thus on *P. tremula*, the weeping variety, a careful examination in early May failed to show a single gland; but a week or two later, after several days' rain, the young branches grew very rapidly for a short time, unfolding many new leaves, and the first three or four of these on each branch bore large and active glands. The nectar is greedily gathered by insects, chiefly Hymenoptera and Diptera. The most numerous were the ants, who, as is usual in such cases, would fight rather than give up a good position near a nectar-secreting gland. The author regards these glands as protective. (The *Botanical Gazette*, Crawfordsville, November, 1881.)

FAUNA AND FLORA OF THE WHITE SEA.—At a meeting of the Natural History Society of St. Petersburg (April 23, 1881) Dr. Chr. Gobi gave a sketch of Prof. Cienkowski's report on his expedition to the White Sea, which appears in the *Proceedings* of the Society, in the Russian tongue, and is illustrated with three coloured plates. The bathymetrical distribution of the algæ seems to show a connection between the marine flora of the Solowezk Islands and that of the Scandinavian and Arctic coasts. In the White Sea there is a distinct though fully developed littoral zone, chiefly marked by the presence of Fucoids, with a few Chlorophyceæ and Florideæ. As new to the White Sea flora may be mentioned *Bulbocaulon piliferum*, Pringsh., and *Gloeothamnin palmelloides*, Cnk. The sea was by no means rich in microscopical organisms, but still a few new and interesting forms were found, and are described and figured, such as *Wagneria mereschkowskii*, a new genus and species of Protista, somewhat between Haeckeliana and Clathrulina; several new Flagellata, *Multicilia marina*, new genus and species having a protoplasmic body of protean form without nucleus or contractile vesicle, but having several cilia; *Exuviaella marina* also new, with an ovum-like body, flattened horizontally at the top, with two cilia and one or two round marks (*Schildchen*); *Daphnidium boreale* n.g. and sp., with a spherical body, prolonged into a curved beak, giving origin to one long cilium. In the dead cells of Pylaicella and other Phæospores there was found a colourless form of a Labyrinthula which had previously been found thriving in the cells of a Lemna; Finally, a new Moner, *Gobiella borealis*, which shows a great resemblance to Vampyrella, but the green contents seem never to extend into the pseudopodia (*Botanische Zeitung*, January 13, 1882.)

THE GROWTH OF PALMS.—In a paper (Russian) recently read before the Botanical Section of the St. Petersburg Natural History Society, Mr. K. Friderich describes in detail the anatomical structures to be met with in the ærial roots of *Acanthorhiza aculeata*, these roots presenting a remarkable example of roots being metamorphosed into spines. Supplementing this, E. Regel made the following remarks:—Palm trees, grown from seed, thicken their stems for a succession of years, like bulbs, only at the base. Many palms continue this primary growth (*i.e.* the growth they first started with) for fifty to sixty years before they form their trunk. During this time new roots are always being developed at the base of the stem, in whorls, and these always above the old roots. This even takes place in old specimens, especially in those planted in the open ground which have already formed a trunk. In such cases the cortex layer, where the roots break through, is sprung off. In conservatories, under the influence of the damp air, this root-formation, on which indeed the further normal growth of the palm depends, takes place without any special assistance. When the palm is grown in a sitting-room, one must surround the base of the trunk with moss, which is to be kept damp, in order to favour the development of the roots. When the base of the palm-trunk has almost reached its normal thickness, then begins the upward development of the trunk which takes place more slowly in those species whose leaves grow close together than in those whose leaves are further apart. In specimens of many species of Cocos and Syagrus, whose leaves are particularly far apart, the stems grow so quickly when planted in the open ground that they increase by five to six feet in height per annum. The stem of those palms which develop a terminal inflorescence have ended their apical growth by doing so, and wither gradually. In addition to this (withering) in the case *e.g.* of *Arenga saccharifera*, new inflorescences are developed from the original axils (*Blattachseln*) from above downwards, so that one sees at last the already leafless trunk still developing inflorescences in the direction towards the base of the trunk. Almost all palms with this latter kind of growth develop off-shoots in their youth at the base of their trunks which shoot up again into trunks after the death of the primary trunk, if they are not taken off before. As to the structure of the palm-trunks out of unconnected wood-bundles, the assertion has been made that the palm-stem does not grow thicker in the course of time, and that this is the explanation of the columnar almost evenly thick trunk. But careful measurements that were made for years have led Regel to the conclusion that a thickening of the trunk actually takes place, which probably amounts to an increase of about a third over the original circumference of the trunk.

ACTION OF GASES AND LIQUIDS ON THE VITALITY OF SEEDS

MY experiments extend over a period of nearly three years. They were made principally with the seeds of *Medicago sativa*, these seeds resisting in a remarkable manner the action of chemical agents. The observations were very numerous and frequent; but in the present abstract those results alone are given in which the action of the gases and liquids lasted longest.

I. *Action of Gases.*—The chief difficulty in these experiments is an easy method of keeping many samples of seeds in the several gases the action of which is to be tested. I devised the following simple plan:—A thick glass tubing was heated in the middle and blown into a bulb of sufficient size to contain a certain quantity of seeds and a relatively large volume of gas; after introducing the seeds into the bulb, the two extremities of the tube were heated, and drawn out, so as to form, on each side of the bulb, a nearly capillary neck; one end was left free, while the other was connected, by means of an india-rubber tube, with the generator of the gas that was to fill the bulb. The air was completely displaced in the latter by allowing the gas to pass for some time through the apparatus; after which, without previously interrupting the passage of the gas, the bulb was sealed by fusing at the blowpipe the two capillary necks.

I prepared a large number of bulbs with seeds and with different gases; the greater number of bulbs contained air-dry seeds, while some contained seeds that had been moistened and swollen with water. On opening the bulbs the seeds were sown, and their vitality measured by the percentage of those that germinated on moist quartz sand.

Experiments with air-dry seeds of *Medicago sativa* in dry gases:—

Gas.	Number of days in which the seeds remained in the gas.	Percentage of seeds that retained the germinating power.
Air (not in bulbs) ...	More than two years	... 83
Air (not in bulbs—another sample) ...	More than three years	... 50
Nitrogen	789 ...	... 93
Oxygen	758 ...	... 59
Hydrogen	1005 ...	... 63
Carbon monoxide ...	803 ...	... 93
Carbon dioxide ...	1035 ...	... 24
,, ,, ...	408 ...	... 73
Marsh-gas	550 ...	... 58
Nitrogen protoxide ...	214 ...	... 70
,, dioxide ...	776 ...	... 48
Ammonia	832 ...	... 0·5
,, ...	398 ...	... 1·2
Sulphur dioxide ...	838 ...	... 4·5
,, ,, ...	405 ...	... 10·6
Sulphuretted hydrogen.	976 ...	... 58
Arseniuretted ,,	802 ...	... 87

Chlorine and hydrochloric acid gas rapidly disorganise the seeds, and destroy their vitality. It is remarkable how air-dry seeds can resist for so long a time the action of nitric oxide, of sulphuretted hydrogen, and of sulphur dioxide, and how some can even survive the action of dry ammonia-gas. The percentages that represent the vitality of the seeds that have been under the action of the different gases cannot be compared, for the experiments were not all begun at the same time, nor extended over the same period, nor was the same sample of seeds used in all the experiments.

Whenever seeds moistened with water are kept in the above-named gases, their germinating power is very rapidly destroyed.

It is also a well-ascertained fact that moist heat acts much more powerfully on seeds than dry heat. We may safely conclude therefore that when the physical and chemical conditions of the medium in which a seed is placed are unfavourable to its germination, water is the most powerful agent in rapidly destroying its vitality. My experiments on the action of liquids on seeds confirm this conclusion.

Moist seeds kept in oxygen and in nitrogen protoxide do not germinate. In some few cases I observed the commencement of sprouting in seeds kept in oxygen. My observations confirm those of Cossa, and are contrary to those of Borscow and Rischawi, who asserted that nitrogen protoxide can cause moistened seeds to germinate.

II. *Action of Liquids.*—The air-dry seeds were kept in the different liquids in well-stoppered bottles. In some liquids several kinds of seeds were put. The following are some of the results of experiments with the seeds of Lucerne or *Medicago sativa* :—

Liquids used.	Number of days in which the seeds remained in the liquid.	Percentage of seeds that retained the germinating power.
Methyl alcohol...	841	19
Ethyl ,, (absolute)	834	78
Amyl ,,	841	19
Ethyl ether	484	29
,, ,,	908	1·3
Chloroform	484	29·6
,,	841	6
,,	924	0
Carbon tetrachloride	350	57·4
,, disulphide	405	63·2
,, ,,	802	58·4
Ethyl iodide	350	65·4
,, ,,	792	52·5
Glycerine	157	24·2
,,	484	5·2
Benzol	397	20
,,	841	8·6
Nitrobenzol	397	17·4
,,	841	6·0
Aniline	397	20·1
,,	841	4·2
,, and alcohol (93°)	709	37

In the experiments with methyl alcohol and with glycerine the presence of small quantities of water must have contributed not a little in augmenting the action of the liquid on the vitality of the seeds.

Experiments were made to see the action of ethyl-alcohol when at different degrees of dilution. It was observed that, when the solution contained less than 50 per cent. of alcohol, the seeds easily got swollen, and were rapidly killed. The following are the results of experiments where Lucerne seeds, from the same sample, were kept for 834 days in different mixtures of alcohol and water :—

Degree of the alcoholic solution, Gay-Lussac's scale, per cent. in volume.	Percentage of seeds that retained the germinating power.
60	0
70	0
80	23
90	62
100	63
100 *bis*	78

Absolute or nearly absolute, alcohol rapidly destroys the germinating power of some kinds of seeds, such as wheat, flax, &c.

In some cases seeds resist the action even of boiling liquids, when the temperature of the boiling point is not too high. Thus, of Lucerne seeds that had been for 160 hours in boiling ether (boiling point 36°) 31 per cent. were still capable of germinating. Seeds of the same plant were kept for 81 hours in boiling carbon disulphide (boiling point 43°): 75 per cent. of the seeds sprouted when sown in moist sand. After five hours boiling in absolute alcohol (boiling point 78°) only 9½ per cent. of the Lucerne seeds did germinate.

In all the experiments where seeds, previously swollen in water, were brought in contact with other liquids, such as absolute alcohol, ether, carbon disulphide, the germinative power was quickly destroyed.

The last series of experiments was made with solutions of solids and gases in liquids different from water. Great care had to be taken in washing the seeds, the germinative power of which had to be tested on the moist sand well with alcohol, and then with water; the presence, even of traces, of the solution in which the seeds had been immersed was sufficient, in some cases, to entirely prevent germination. The following are experiments made with Lucerne seeds :—

Solutions used.	Number of days in which the seeds remained in the solution.	Percentage of seeds that retained the germinating power.
Alcoholic solution of iodine	382	1·5
,, ,, potassium bromide	757	68·4
,, ,, zinc chloride	757	34·6
,, ,, ,, ,,	376	83·6
,, ,, mercuric chloride.	756	68·4
Glycerine ,, copper sulphate	757	23·1
,, ,, ,, ,,	375	67·1
,, ,, arsenic trioxide	758	1·3
,, ,, ,, ,,	322	70·2
Alcoholic ,, potassium sulphide	223	8·2
,, ,, ammonium ,,	223	0
Glycerine ,, potassium cyanide	757	80
,, ,, ,, ,,	376	95·3
Alcoholic ,, camphor	757	70·4
,, ,, phenol	757	65
Ether ,, ,,	598	69·4

All these solutions easily destroyed the germinating power of wheat.

The following results show the action of saturated alcoholic solutions of gases on Lucerne seeds :—

Solution (alcohol at 97° Gay-Lussac).	Number of days in which the seeds remained in the solution.	Percentage of seeds that retained the germinating power.
Alcoholic solution of sulphuretted hydrogen	587	27
,, ,, sulphur dioxide	587	3
,, ,, nitric oxide	587	20

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Dr. Acland, Dr. Burdon Sanderson, and Mr. W. W. Fisher, having been appointed examiners for the Radcliffe Travelling Fellowship, give notice that an examination will be held for the purpose of electing a Travelling Fellow on Tuesday, February 14. Candidates are to send their names to Mr. Fisher before February 8.

There will be an examination at Christ Church on February 22 for at least one Junior Studentship in Natural Science; papers will be set in Chemistry, Biology, and Physics; but no candidate will be allowed to offer himself for examination in more than two of these subjects.

Candidates for the Natural Science Studentships who make Physics their principal subject are recommended to offer themselves for examination in Mathematics, at least in Algebra, Plane Trigonometry, and Pure Geometry, as great weight will be attached in their case to a knowledge of these subjects.

Candidates for the Natural Science Studentships will also have to show that they possess such a knowledge of Classics as will enable them to pass Responsions.

On February 7 Convocation will be asked to pass a decree authorising the Curators of the University Chest to pay to the Delegates of the Museum a sum not exceeding 250*l.*, for the purpose of providing the Linacre Professor of Physiology with additional microscopes, diagrams, and drawings for the use of students in the Physiological Laboratory, as well as with additional cupboards for containing diagrams and drawings.

CAMBRIDGE.—The following elementary lectures on chemistry are being given :—Prof. Liveing's and Mr. Main's (St. John's College) General Courses; Mr. Pattison Muir (Caius), Non-Metallic Elements; Mr. Lewis (Downing), Catechetical Lectures; Mr. Walker (Sidney), Organic Chemistry; Mr. Garnett is lecturing on Heat at St. John's; Mr. Glazebrook (Trinity), also on Heat; and Mr. Shaw (Emmanuel), on Conservation of Energy.

The followin g are advanced lectures:—Organic Chemistry, Prof. Dewar; Physical Optics, Mr. Trotter (Trinity); Electricity and Magnetism, Mr. Garnett (St. John's).

Practical Chemistry at the University, St. John's, Caius, and Sidney Laboratories. Practical Physics at the Cavendish Laboratory; also advanced demonstrations by Messrs. Shaw and Glazebrook.

In geology Prof. Hughes is lecturing on Stratigraphical Geology; Mr. Tawney, on Fossil Echinoderms and Crustaceans, and on Petrology. Dr. Roberts (Clare College) is also taking a class in Petrology; and Prof. Hughes makes periodical field excursions.

Dr. Vines (Christ's) lectures on the Anatomy of Plants, with practical work; Mr. Hicks (Sidney), on Elementary Botany, chiefly Morphology; Mr. Saunders (Downing), on Elementary Botany; and Mr. Hillhouse, on the Anatomy and Physiology of Plants, at the Museums.

Prof. Newton takes Vertebrata this term (lectures on Geographical Distribution once a week). Mr. Balfour gives elementary and advanced lectures on Morphology, with practical work, as usual. Dr. Foster's elementary course of Physiology is continued; and the advanced lectures are Dr. Gaskell's, on Respiration; Mr. Langley's, on the Digestive System; and Mr. Hill's, on the Central Nervous System.

Prof, Humphry lectures on the nervous system and the Organs of Special Sense, and takes a class for Tripos and 2nd M.B. work in Anatomy and Physiology. Dr. Creighton has a class for Osteology, and Practical Human Anatomy commenced on January 20.

Prof. Stuart is lecturing on the Theory of Strictures. The Demonstrator of Mechanism will form classes in elementary and advanced mathematics applicable to engineering.

The last Senior Wrangler under the old regulations is Mr. R. A. Herman, of Trinity College, educated at King Edward's School, Bath; his private tutor was Mr. Routh. The second wrangler is Mr. J. S. Yeo, of St. John's College, educated at Blundell's School, Tiverton; his private tutor was Mr. R. R. Webb, of St. John's. The third wrangler is Mr. S. S. Loney, of Sidney College, educated at Maidstone Grammar School and Tonbridge School: private tutor, Mr. Routh. St. John's has four wranglers of the first eight; Trinity has only one wrangler besides the Senior.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 8, 1881.—"On the Development of the Skull in *Lepidosteus osseous*," by W. K. Parker, F.R.S.

The materials for the present paper were kindly sent to me by Prof. A. Agassiz; they were for the use of Mr. Balfour and myself, and consisted of fifty-four small bottles of eggs and embryos in various stages. These very valuable materials were obtained from Black Lake by Mr. S. W. Garman and Prof. Agassiz, and many of the embryos were described and figured by the latter in the *Proceedings* of the American Academy of Arts and Sciences, October 8, 1878.

We have had additional materials from Prof. Burt G. Wilder; Mr. Balfour has obtained from Prof. Agassiz several adult fishes in spirit; and I am indebted to Prof. Flower for an adult in the dry state.

Mr. Balfour's part of the work has been done with the assistance of my son, Mr. W. N. Parker, and their joint labour will include the anatomy of various organs of the adult fish.

My observations on the skull and visceral arches have been made on embryos and young, varying from one-third of an inch to 4½ inches in length; I have (artificially) divided these into six stages. Cartilage was being formed in the smallest examined by me, but in my second stage, embryos five-twelfths of an inch long, this tissue was quite consistent, and I succeeded in dissecting out all the parts. The large notochord at this stage bends downwards under the swelling hind-brain, and turning up a little at its free end, and passing into the lower part of the fissure between the mid- and hind-brain, it reaches beyond the middle of the cranium, and just touches the infundibulum and *distinct* pituitary body. Between the trabeculæ, in front, there is a small wedge of younger cartilage, the rudiment of the "intertrabecula."

As in the Batrachia, the fore part of the palato-quadrate cartilage is continuous with the trabeculæ in front; but the pedicle is free behind. The free articulo-Meckelian rod is quite in front of the eye-balls, and is nearly as long as the hind suspensorium, or proper quadrate region; this forward position of the hinge of the mandible is not temporary, as in the frog, but permanent. The uppermost element of the hyoid arch is an anvil-shaped cartilage from the first, and ossifies afterwards, as the hyo-mandibular and symplectic bones. As pointed out to me by Mr. Balfour, its dorsal end is continuous, *as cartilage*, with the auditory capsule above. The basi-hyal is not yet ossified, but distinct inter-, cerato-, and hypo-hyal segments are already marked out. Four larger and one small rod of cartilage are seen on each side, articulating with a median band; these are the branchial arches, which chondrify before they undergo segmentation. In this stage there are no osseous laminæ as yet formed.

Here, in this stage, in connection with a large pre-nasal suctorial disk, we have three important generalised characters, namely, the continuity of the distal end of the mandibular pier and of the proximal end of the hyoid pier with the skull, and the forward position of the hinge of the jaw coupled with the horizontal direction of the suspensorium. The hyoid arch has its segments formed much earlier than in the Teleostei, and the "pharyngo-branchials" are not independent cartilages, as in the *Skate*.

The third stage—embryos two-thirds of an inch long—show a considerable advance in the development of the skull; the cartilage, generally, is more solid and more extensive, and new tracts have appeared. The apex of the notochord is now in the middle of the basis cranii, for the pro-chordal tracts have grown faster than the para-chordals. The trabeculæ swell out where they are confluent, and then are narrower in front again. At their fore end each band passes insensibly into the corresponding palato-quadrate bar outside, whilst inside they are separated by a large pyriform wedge of cartilage, the intertrabecula. The thick, rounded, free fore end of this median cartilage is the rudiment of the great "nasal rostrum," and the rounded fore ends of the trabeculæ are the rudiments of their "cornua."

There is only a floor in the occipital region, but the wall-plate of the chondrocranium has begun as a styloid cartilage running forward from the fore end of each auditory capsule into the superorbital region. The palato-pterygoid bar—continuous in front with the trabeculæ—is now longer than the proximal part of the suspensorium, the spatulate quadrate region whose dorsal end is the free pedicle. The wide proximal part of each trabecula is now already forming an oblong facet, the basipterygoid, for articulation with the facet of the pedicle.

In this stage the skull is a curious compromise between that of a salmon at the same stage and that of a tadpole just beginning its transformation. The hind-skull is quite like that of a young salmon, the fore-skull, with its non-segmented palatoquadrate, and its forwardly placed quadrate condyles and horizontal suspensorium, is very much like what is seen in the suctorial skull of the Anurous larva. A splint bone, the parasphenoid, as in the tadpole, has now made its appearance.

The largest embryos reared by Messrs. Agassiz and Gorman, which are about one inch in length, form my *fourth* stage; these are rapidly acquiring the character of the adult.

This is the stage in which the chondrocranium of this Holostean type corresponds most closely with that of the Chondrostean sturgeon, whose adult skull is similar to that of garpike just as the latter begins to show its own special characters. This important difference is already evident, namely, that whilst in *Acipenser* the olfactory capsules remain in the *antorbital* position, those of *Lepidosteus* are already carried forwards by the growing intertrabecula, and are even now in front of the relatively huge cornua trabeculæ. Thus these regions are now well grown in front of the ethmoidal territory, which, instead of being, as in the last stage, in the front margin of the skull, is now fairly in its middle, and this change has taken place whilst the embryo has only become one-half larger—from two-thirds of an inch to an inch in length. It is the hypertrophy of cartilage in the three trabecular tracts that makes the rostrum of the sturgeon so massive, even whilst only a few inches in length, and this state of things exists temporarily in the garpike.

Above, the sphenotic, epiotic, and opisthotic projections of the auditory capsule are more evident, but are not ossified. Some slight bony deposit has appeared in the pro-otic regions. The "cephalostyle" is the first *endo*-cranial bone, and the parasphenoid the first *ecto*-cranial centre; but the exoccipitals are just appearing also.

The superficial bones can now be seen as fine films in the transverse sections, and the parosteal palatine and pterygoid are large leaves of bone applied to the pterygopalatine bar; the mesopterygoid is only half as large as them, but is relatively much larger than in the adult.

While doubling its length, the young *Lepidosteus* gains a cranium much more like that of the adult; this is my *fifth* stage. The general form is now intensely modified by the foregrowth of the rostrum, which is two-thirds the length of the entire skull. The cornua trabeculæ now reach only two-fifths of the distance to the end of the beak, and the pterygopalatine arcade reaches but little further forwards. The bony matter of the "cephalostyle" is now aggregated towards the hinder half of the notochord; it is now the basi-occipital bone. The exoccipitals and pro-otics are growing larger, and there are both sphenotics and alisphenoids. Also, below, the quadrate, metapterygoid, and articular centres have appeared; and behind the jaw there are the hyomandibular, symplectic, epihyal, ceratohyal, and hypo-hyal centres; and the epi-, cerato-, and hypobranchials have acquired a bony sheath.

In a young *Lepidosteus* 4½ inches long (nearly), the approach to the adult state of the skull has been very great; the supercial bones can all be determined. The most remarkable of these are the small distal nasals and premaxillaries: the long *maxillary chain*, ending in an os mystaceum and jugal; the extremely long and slender "ethmo-nasals" and vomers; the small preopercular; and the huge angulated inter-opercular, which carries the large opercular and the sub-opercular. The five mandibular splints are all present (as in most Sauropsida), the branchiostegals are only three in number, as in the Carp tribe.

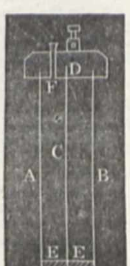
The intertrabecula, which was at first merely a small tract of cells binding the trabeculæ together in front, is now three-fourths the length of the entire skull; to it is due the length of the beak. The cornua trabeculæ are now merely short lanceolate leafy growths on the sides of the rostrum at its hind part. In the last stage there was a fine bridge of cells running across behind the pituitary body; it is now a small cartilaginous post-clinoid bar. The opisthotic and epiotic form now a scarcely divided tract of bone, all the other centres are developing, and a pair of additional bones have appeared in the funnel-shaped fore-end of the chondrocranium; these are the "lateral ethmoids." The bony matter of the basi-occipital has now retired to the hinder third of the notochord, which is much shrunken.

There are now two centres (as in *Amia calva*) in the articular region of the mandible; the quadrate and metapterygoid centres are much larger; the hyo-mandibular and symplectic are together only half the size of the mandibular suspensorium; the basi-hyal is very large, is composed of two parallel pieces, and is very *Myxinoid*.

No clear understanding of the morphology of this type of skull can be had unless it be seen in the light derived from that of the Elasmobranchs, the Sturgeon, and the Anurous larva on one hand, and that of *Amia calva* and the Teleostei on the other.

Royal Society, January 12.—"On a New Electrical Storage Battery (Supplementary Note)." By Henry Sutton. Communicated by the President.

The new cell consists of a flat copper case, same shape as a Grove's cell; it has a lid of paraffined wood, from which hangs a plate of lead amalgamated with mercury, the lower part of lead plate being held in a groove in a slip of paraffined wood resting on bottom of copper case; through the lid a hole is bored for introduction of solution, which consists of a solution of cupric sulphate, to which is added one-twelfth of hydric sulphate; the presence of this free sulphuric acid improves the cell at once.



The sectional sketch shows the arrangement.

A B. The outer flat copper case.

C. Plate of amalgamated lead held in grooves in cap D and slip E.

F shows the hole in cap through which the solution is introduced, and by the introduction of a glass tube through this hole the state of the charge is seen by observing the colour; the interior surface of the case forms the negative electrode, and the amalgamated lead the positive.

Linnean Society, January 19.—Sir John Lubbock, Bart., F.R.S., President in the chair. Mr. R. Kippist's death was officially notified, and a valuable donation of books from the late treasurer (Mr. Currey) announced. There were exhibited, for Mr. Thomas Bruges Flower, three rare British plants, viz.: *Potentilla rupestris*, L., from Montgomeryshire, *Polygonum maritimum*, L., and *Senecio squalidus*, L., from North Devon; and, for Mr. W. Bancroft Espeut, an albino specimen of Bat., (*Molossus obscurus*, Geoff.) from Jamaica; albinism in the cheiroptera being said to be extremely rare. Dr. T. Spencer Cobbold called attention to living examples of *Leptodera* under the microscope. Mr. G. Maw read a communication on the Life History of a Crocus and classification and distribution of the genus. He says the corm tunic is the only permanent record of perennial existence, and even this in the living state lasts but a year. Minute papillæ stud the surface of the corm, these increase as bud-growth and ultimately secure the life cycle; the new corm is implanted on and finally absorbs the parent. The tunics are homologous with leaves, and their fibrous net-like structure has so many ornamental patterns that by a fragment a species can be determined. Certain *Croci* are constant in colour, others are exceedingly variable, and still others change in tint as found from east to west: *C. cancellatus* being purple in Asia Minor, lilac in Greece, and white in the Ionian Islands. The stigmata are so variable that Mr. Maw thinks that Mr. Baker's threefold classification, based thereon, fails. Grouping of the genus is necessarily to be founded on a combination of characters, for the overlapping and interlacing of single ones militate against the natural sequence of species. A modification of Dean Herbert's classification is, by the author, preferred to those of Haworth and Baker. The crocuses are geographically confined to the Old World and Northern Hemisphere, their chief area of distribution being around the Mediterranean and Black Sea. Mr. Maw divides their region of occupation into nine sub-districts. *C. biflorus* has the widest range of longitude, and extends from Italy into Georgia, and *C. sativus* follows, ranging from Italy to Kurdistan. Certain Mediterranean islands, on the other hand, present curious examples of quite a local distribution. The author expresses doubts of the existence of wild hybrids; and he points out the great tendency to morphosis of nearly every part of the plant.—Mr. W. Percy Sladen read a paper "On the Asteroidea of the 'Challenger' Expedition." The family Pterasteridæ, he remarks, has been heretofore but feebly represented in living forms; 8 species only being on record as belonging to the genera *Pteraster* and *Retaster*, and a 9th solitary representative to *Hymenaster*. From the *Challenger* collection 34 species of Pterasteridæ have been obtained, 2 only known previously. Of the 32 new species, 3 belong to *Pteraster*, 4 to *Retaster*, and 20 to *Hymenaster*—a genus now found to be world-wide in deep waters. The remaining 5 species are the representatives of 3 new genera, viz.: *Marsipaster* 2, *Benthaster* 2, and *Calyptraster* 1 species.—The Rev. G. Henslow read a note "On the Occurrence of a Staminiferous Corolla in the Foxglove and in the Potato"; staminody in these plants seldom having been recorded and figured.

Chemical Society, January 19.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the chemistry of Bast fibres by C. F. Cross and E. J. Bevan (we give a report of this elsewhere).—Dr. Carnelley then read a paper on the action of heat on mercuric chloride. About twelve months ago the author exhibited to the Society some experiments on the action of heat on ice and mercuric chloride under low pressures, and subsequently read a paper on the subject before the Royal Society. Two propositions were advanced—(1) that when the superincumbent pressure is maintained below a certain point called "the critical pressure," it is impossible to *melt* ice, mercuric chloride, and probably other substances, no matter how great the heat applied; (2) that under these circumstances ice and mercuric chloride attain temperatures considerably above their natural melting-points without melting. Subsequent observers have confirmed the first proposition, but have been unable to verify the second. The author has therefore repeated his previous experiments with mercuric chloride, and in addition has made determinations of the temperature of mercuric chloride, heated in a vacuum, by dropping the heated solid into a calorimeter containing turpentine, benzine, and petroleum. Some unexpected results were obtained. When the salt is pressed as a compact powder round the bulb of the thermometer, and heated in a vacuum, the thermometer rises 21° to 50° above the melting-point of the mercuric chloride, though still surrounded by the solid salt. When the salt is in the form of a solidified cylinder, the temperature rises 15° above the melting-point. When a turpentine calorimeter is used, the temperature of the mercuric chloride came out 100° above the ordinary melting-point; but with petroleum or benzine, temperatures above the ordinary melting-point could not be obtained. The author therefore withdraws his previous statement, and concludes that although mercuric chloride does not fuse when heated under diminished pressure, yet its temperature never rises appreciably above its ordinary melting-point. The high temperatures indicated by the thermometer being due to the diffusion of the superheated vapours of the mercuric chloride through the pores of the solid salt. The author also concludes that turpentine cannot be used in a calorimeter for the determination of the specific heat of bodies soluble in water, since some substances such as mercuric chloride, zinc chloride, &c., when heated, cause an evolution of heat, due probably to the polymerisation of the turpentine. Hence many of Regnault's specific heat determinations, in which turpentine was employed, are probably too high; they are, it may be remarked, in almost all cases higher than Kopp's numbers, that observer having used coal-tar naphtha. The specific heat of mercuric chloride is 0·06425, and of zinc chloride 0·14301, neither value being altered by a rise of temperature.—Contributions to the history of cerium compounds, including the analysis of Rhabdophane, a new British mineral containing Cerium, Lanthanum, Didymium, Yttrium, by W. N. Hartley.—On the reaction of chromic anhydride with sulphuric acid, by C. F. Cross and A. Higgin.—On dibenzoybanilin and its isomerides, by A. Higgin.

Entomological Society, January 18.—Annual Meeting.—An address was delivered by the president, H. T. Stainton, F.R.S., and the following gentlemen were elected to serve on the Council for 1882:—President, H. T. Stainton, F.R.S. Treasurer, E. Saunders, F.L.S. Librarian, F. Grut, F.L.S. Secretaries: E. A. Fitch, F.L.S., and W. F. Kirby. Other Members of Council: W. Cole, F. Du Cane Godman, F.L.S., F. P. Pascoe, F.L.S., O. Salvin, F.R.S., W. A. Forbes, B.A., F.L.S., F.G.S., Rev. H. S. Gorham, Lord Walsingham, M.A., F.Z.S., and C. O. Waterhouse.

Paris

Academy of Sciences, January 23.—M. Jamin in the chair.—The following papers were read:—On the explosive wave, by M. Berthelot. It is not a sound-wave travelling with a velocity depending on the physical constitution of the medium, but a change of chemical constitution propagated. M. Berthelot recapitulates its properties. As to dependence of the velocity on the diameter, this becomes less and less as the increase of the diameter allows more freedom of motion to the molecules and diminishes friction. The total energy of the gas, at the moment of explosion, depends on its initial temperature and the heat liberated during combination. These two data determine the absolute temperature of the system, which, moreover, is proportional to the kinetic energy ($\frac{1}{2}mv^2$) of translation of the molecules. It follows that the velocity of translation is proportional to the square root of the ratio between the absolute temperature and the density of the gas referred to air. The result of experiments agrees closely with this.—*Résumé* of meteorological observations made during 1881 at four points of Haut-Rhin and the Vosges, by M. Hirn. The stations are—Thann (alt. 350 m.), Munster (alt. 388 m.), Col de la Schlucht (alt. 1154 m.), and Colmar (alt. 195 m.). *Inter alia*, the maximum difference between a black-bulb thermometer and an ordinary one at the same height in shade at Colmar was 27·6 (in January). The most violent winds at Colmar never exceeded 18 to 20 metres per second. The rainfall at Schlucht was 1310·8 mm., at Munster 664 mm., at Colmar 521 mm.—Spectroscopic observations with monochromatic light, by M. Zenger. Seeking combinations which should give strong dispersion with perfect transparency and total reflection of red or violet, he finds that benzine and benzylene, combined with quartz, eliminate the extreme red of an angle of about 75°, while pure anethol, at the same angle, eliminates the extreme violet. A parallelepiped thus formed is the best means of observing the solar protuberances or spots, or the reversed colours of the chromosphere. He commends it to the Transit of Venus Commisston. Irradiation is abolished or greatly reduced. Larger magnifying power may be used. The confusion arising from interference-bands at the edge of Venus' disc is obviated. And better photographs may be had.—Remarks on a note of MM. Mignon and Rouart, on processes of coppering, by M. Weil. He denies that he uses organic acid merely as an accessory.—On the spherical representation of surfaces, by M. Darboux.—On some transcendent equations, by M Laguerre.—On Fuchsian functions, by M. Poincaré.—On a means of extending the theory of imaginaries, without making use of imaginaries, by M. Saltel.—New manner of employing the principle of least action, in questions of dynamics, by M. Brassinne.—Determination, by means of the microphone, of the nodes and ventral segments in vibrating columns of air, by M. Serro-Carpi. A small graphite microphone is applied to an elastic membrane on a ring, and this is brought into the sounding-pipe. The presence of a node is indicated by a roll (*roulement*) in the telephone, like that which the instrument gives with induced currents. In the ventral segments the sounds are more apart and rare. One does not hear the musical sound of the pipe.—On spermatogenesis in Annelids and Vertebrates, by M. Sabatier. In Annelids he has observed two generations of spermatoblasts formed on the inner surface of the spermatic pouches. The second, springing from the first, are transformed into spermatozoids (the nuclei forming the heads). M. Sabatier considers that spermatogenesis in Vertebrates may be similarly explained.—On the *rôle* of the amnios in the production of anomalies, by M. Daresti. In an anomalous fœtus of sheep he finds confirmation of his view that deviations, and especially congenital club-foot in man, are the consequence of compression of the body of the embryo by the amnios arrested in its development.—On the vegetation of aquatic plants in air, by M. Mer. He concludes, that if certain aquatic plants cannot form branches in free air, it is simply because their tissues are unable to resist active transpiration, and not, as in the case of aerial plants immersed, because they are incapable of development and nutrition in air. They can live in air, provided this is moist, and can produce starch in it sometimes more easily than in water. But there are very few in which the same leaf will act in both media.—On the concentric bands of felspars, by M. Lévy.—On the barometric height of January 17, 1882, by M. Renou. This on the parc de Saint Maur (alt. 49·30 m.) at 10 a.m. was 782·13 mm.; reduced to sea-level, 786·92 mm. During nearly a century, there has only been one height slightly exceeding this, at Paris Observatory. On February 6, 1821, at 9 a.m., the height was 780·90 mm., at sea-level, 787·52 mm. It would appear that at Paris during two centuries, with exception of the figures in 1821 and 1882, the barometer has never exceeded 778·5 mm. M. Renan gave an explanation of the recent high pressure. M. Faye attributed to the pressure a remarkable depression of the sea-level observed at Antibes (in the south of France), about which M. Naudin had written him. It lasted a fortnight.

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