THURSDAY, JANUARY 16, 1873

THE INTERNATIONAL METRIC COMMISSION

THE methodical statement of the resolutions passed by the International Metric Commission at their meeting in Paris last October, has already been given in NATURE, vol. vi. p. 544. From this statement, a general idea may be formed of the extent and importance of the operations to be carried out under the superintendence and direction of so many eminent men of science, for the construction and verification of new international standards of metric weight and measure. We may thus hope eventually to see a real and practical uniformity established in the weights and measures regulating all transactions of trade and commerce between the several countries of the world, as well as in those used for all constructive works and technical instruments of various descriptions, and in scientific investigations and researches. Such a result of the labours of the Commission will be one of the greatest triumphs of modern civilisation. We may better estimate its value and importance, if we consider that it will create a universal language, so far as regards expressing any required quantity of material things capable of being measured or weighed, and this in terms at once intelligible to every one; and it must afford the means of immensely extending and diffusing useful knowledge, and facilitating its acquirement.

The statement before referred to contains the text of the formal decisions of the Commission upon the several points involved in the immediate duties which have been entrusted to them; that is to say, the construction of the new international metric standards, and the establishment of their identity or their equation by the most perfect instruments and from the most accurate comparisons. In the accomplishment of these objects, all the best appliances of modern science will be employed. It will be seen, also, that the Commission further propose to adopt the most effectual means for maintaining inviolate the uniformity of the new standards of weights and measures, through the agency of an International Metric Institution to be permanently established at Paris. This institution is to be placed under the direction of a permanent committee, which has been already chosen by the Commission from among their own body. Among the members so elected are the chief officers of weights and measures in the principal countries of Europe, and in the United States of North America. To this International Metric Institution it is proposed to entrust the custody of the new prototypes of metric weight and measure, and to furnish to its officers the means, and impose upon them the duty, of making all such further comparisons of the several international standards with the prototypes and with each other as may be required. Regulations are also to be laid down by the Commission for guaranteeing continued uniformity and invariability of these international standards.

But probably many persons in this country will say—Of what use to us will be the making of all these new metric standards, and the creation of this new International Metric Institution? We have our own Imperial system of weights and measures, as well as national standards, and are quite satisfied with them; why should we want any metric weights and measures? Now, in the first place, without discussing the disputed question of the introduction of the metric system, with its uniform decimal scale, into this country, it may be pointed out that any notion of forcing the extensive adoption of the metric system upon the English people in opposition to public opinion, has been altogether disclaimed by the authorities. In the late annual address to the Royal Society by its president, the Astronomer Royal, printed in the Society's Proceedings on Nov. 30, 1872, he said, with reference to the International Commission for the establishment of new and uniform *Standards* of the Metric System:—"I think it imperative on me to state that the British Government gave their assent only on the express understanding that they could take no part in the Commission if it displayed any propagandist intention. Speaking as the representative of the body who had best considered this subject, namely, the Standards Commission now dormant, I can say as their unanimous opinion that they deprecate the slightest interference with national usages; but they recognise the great importance of an accurate international system which, like the Latin of the Middle Ages, enables men of science to speak the same language: and for this international character they think the metric system singularly well adapted." But, in point of fact, whether we adopt the metric system to a greater or less extent, and sooner or later, in this country, or not, it is quite evident that as it has been adopted by almost every country on the Continent of Europe, and that all the necessary steps have been taken for its adoption in the United States of North America, in Canada, and in British India, thus establishing its international character, it must be of the greatest advantage to us in all commercial transactions with countries abroad, including the computation of Customs duties, to be able to deal with their commodities when weighed or measured, everywhere by one uniform standard. This advantage must, at any rate, be allowed, even if we continue to stick to our imperial weights and measures. In dealing also with technical and scientific instruments, and with computations of quantities in technical and scientific investigations, it must be of great importance to us here in England to find quantities of measure or weight everywhere else expressed in the same terms. These considerations tend to show, even to the upholders of our imperial system of weights and measures, the great benefits that must result to this country from the adoption everywhere abroad of uniform weights and measures; based on standards the identity of which, and its maintenance, will be guaranteed by the International Metric Commission and their permanent institution. They also show how impossible it must be for this great commercial country to remain in a position of isolation with regard to this large international question, and the necessity of our adopting this uniform system of weights and measures, at least for all purposes of an international character.

There are other important advantages proposed to be obtained by establishing the new International Metric Institution, the benefits of which will extend to this country as well as to other countries. Many scientific

questions connected with the accurate comparisons of Standard weights and measures now require an authoritative decision, with a view to their general adoption. These constitute the data upon which the requisite corrections of the actual results of the several comparisons must be computed, before an accurate determination can be arrived at, with reference to the circumstances under which the comparisons are made. Amongst these questions may be instanced: The determination of the true weight of a given unit of measure of dry atmospheric air; the true weight of a given unit of measure of pure water; the condition of pure water employed in Standard operations, as to its being more or less deprived of or saturated with air; the rate of expansion of air; the rate of expansion of water and of its maximum density; the amount of aqueous moisture in atmospheric air and its influence on the weighing and measuring of Standards; the relative rates of expansion generally of solid, liquid, and aëriform bodies, and the limits of temperature within which this rate is to be determined; more particularly, of the relative expansion of the quicksilver and glass of thermometers, and the constancy of the determined rates of expansion; the constancy of the determined length of Standard measuring bars, and of their coefficients of dilatation; the adoption of a uniform average rate of expansion, within determinate limits of temperature, of metallic and other bodies used in Standard operations; and of average conditions of temperature of these bodies and of the medium in which they are placed; the employment of an air thermometer, &c. &c. At the present time, different solutions of these questions are adopted in the several countries, the results being that not only is any uniform agreement in the results of comparisons rendered absolutely impossible, but doubts exist as to the accuracy of the determinations of these questions which have hitherto been made. It is evident that in order to obtain any satisfactory solution, long and varied observations and comparisons will have to be made, and such labours are proposed to form an important part of the future work of the International Metric Institution. It is only by such an authoritative determination made by the combined efforts of men of science in the different countries, under whose direction the Institution is to be placed, that the urgent need of uniform and accurate data for obtaining trustworthy results in all comparisons of Standards can be expected to be supplied.

It ought, however, to be distinctly understood that not only the more immediate operations of the International Metric Commission, but also the proposed future operations of the International Metric Bureau, under the directions of their permanent committee, are wholly and exclusively of a scientific character. The objects of the Commission are to furnish and to afford the means of maintaining uniform standards for all countries which have already adopted, or which may hereafter adopt, the metric system, as either a national or international system of weights and measures. The true sphere of the Commission is thus limited to the investigation and accomplishment of all the best means, either in a scientific or a technical point of view, by which these objects may be attained. Whether the adoption of the metric system of weights and measures by this or any other country be advantageous to it or not is a question to be determined by each country upon its own merits, but it is one with which the International Metric Commission is no way called upon or entitled to interfere.

An incident which occurred at the late meeting of the Commission may be noticed as showing how strictly their objects were considered by them to be confined to purposes of science. The question of the mode of voting having been raised, it was referred to a committee to report upon. The Committee recommended, and the proposition was unanimously agreed to by the Commission, that on ordinary occasions each member present should vote personally; but upon the demand of five members, the votes should be taken by countries represented, each country having one, two, or three votes, according to the population. Amongst others, one vote was assigned to the Papal See, represented by Padre Secchi, who had originally been appointed delegate of the Papal States. Unfortunately a report of these proceedings appeared in the *Journal Officiel*, though not in the official portion, and attracted the notice of the Italian Parliament then sitting, when the Italian Government was instructed to insist on the cancelling of the vote for a nation given to the representative of the Papal See, the Pope being no longer a territorial Sovereign. A diplomatic communication was accordingly made to the French Government, who declined to interfere in a matter within the power of the International Commission, and which had reference merely to the proceedings of a scientific body. The Italian Government then directed their representatives to take no further part in the Commission, so long as Padre Secchi continued to be the delegate of the Papal See, and Marquis Ricci and Prof. Govi were reluctantly compelled formally to announce this to the Commission. But the Commission felt that they could only deal with this communication as an accomplished fact, and they expressed their great regret at this secession, in consequence of imperative orders, of two of their most eminent colleagues, which they trusted would be only temporary. They at the same time expressed their astonishment at so unlooked-for an interference with their proceedings which were of so entirely a scientific character.

The extent of the preliminary work hitherto accomplished by the Commission may be estimated from the fact of their Minutes of Proceedings during the last four years filling 580 closely printed 12mo. pages. On the occasion of their recent meeting, when the Commission was found to comprehend 50 members, representing 29 of the principal countries of the civilised world, the subjects of the formal resolutions passed by them had been previously arranged for their discussion and deliberation, and were referred by them to eleven different Committees. The Reports of these Committees, which are printed at length in the *Procès-Verbaux* of the Commission, contain the form of the Resolutions under each subject which was proposed for adoption; and, generally speaking, they were unanimously passed by the Commission, with but slight amendments. The grounds of the conclusions arrived at by the several Committees are stated at length in their Reports, and in a future article some of the more important of them of the highest scientific interest will be specified.

H. W. C.

MINERAL PHOSPHATES

Mineral Phosphates and Pure Fertilisers. By Campbell Morfit, M.D., F.C.S. (London: Trübner and Co.)

THE date of the patent taken out by Mr. Lawes, in 1842, for treating mineral phosphates with sulphuric acid, has proved the date of the commencement of a new industry which has now attained to vast proportions. At present the manufacture of superphosphates in Great Britain can hardly be short of 400,000 tons per annum, and the market value of the same cannot be under 2,400,000*l.* Competition naturally tends to develop improvements, and of late years several novel processes have been suggested for the better treatment of mineral phosphates. Dr. Morfit's book is mainly devoted to a description of these new methods, and more especially to a detailed account of the practical working of his own inventions. The object of all these processes is the preparation of "Pure Fertilisers." The mineral phosphates at the disposal of the manufacturer contain 50-80 per cent. of tricalcic phosphate, the poorer minerals preponderating. In making ordinary superphosphate the whole mineral is treated with sulphuric acid, and the resulting superphosphate is of course rich or poor according to the quality of the mineral taken. But in making a "Pure Fertiliser" the aim is to separate the calcium phosphate from the original mineral and offer it for sale in a nearly pure state. The production of a pure phosphate is of course a more costly operation than the simple treatment of the powdered mineral with sulphuric acid, and we believe that these pure fertilisers will consequently not be able to compete with ordinary superphosphate, except in cases where, as in America, the manure has to be transported over great distances, and small bulk is therefore a desideratum. Their advantage over the comparatively poor superphosphate is much lessened by the fact, that the non-phosphatic matter in superphosphate is principally gypsum, which is itself a valuable manure. There is one class of mineral phosphates, however, which is wholly unsuited for the manufacture of superphosphate—we allude to the native phosphates of aluminium; the processes patented by Mr. P. Spence and Mr. J. Townsend for the extraction of the phosphoric acid are in this case most valuable.

Dr. Morfit's plan is to roast the powdered crude calcium phosphate, then dissolve it in strong hydrochloric acid, and precipitate the solution by ammonia gas, by lime, by whiting, or by the addition of a previously precipitated mixture of the oxides and phosphates of iron and aluminium. When the solution is left acid by an insufficient use of lime, or when the last two precipitants are employed, the precipitate obtained consists chiefly of dicalcic phosphate. The resulting calcium phosphate is either sold as such, or else converted into a superphosphate. The acid mother liquors are precipitated with lime, which throws down the iron, aluminium, and remaining phosphoric acid; the purified calcium chloride is then boiled down and brought into a solid state for sale. There is thus a constant production of two bye-products. The author regards them as valuable materials; the calcium chloride is to be used for making Ransome's artificial stone, and the ferruginous phosphates for the clarification of sewage. This scheme looks promising on paper, but must require special local circumstances for its fulfilment.

The reader will find in this book a full account of the patents of Way, Spence, Townsend and others, who have worked on the subject, together with much practical information as to the construction of apparatus and the performance of manufacturing operations; the subject is, in short, fully treated. The book contains, however, some very unpractical schemes, as when the author proposes the universal adoption of earth closets, with the recovery of the nitrogen by combustion with soda-lime, and the production of phosphoric acid by lixiviation of the residue. Now as fully saturated closet earth contains, according to Voelcker, but ·33 per cent. of nitrogen, and ·55 per cent. of phosphoric acid more than the loam originally taken, the notion seems to us somewhat impracticable. The book also contains, we are sorry to say, examples of doubtful chemistry.

We refer in conclusion to some statements which we consider to be errors in the volume.

Dr. Morfit gives proportions for the preparation of manures for all the ordinary crops; these proportions are professedly based on the composition of the crops themselves. All these mixtures contain large amounts of potash, and the manures for wheat, clover, and turnips all contain the same amount of nitrogen. Having said this, we have made it plain to every scientific agriculturist that the author's notions are quite unpractical; he has, in fact, fallen into the common mistake of chemists who know little of agriculture. If manures are to be constructed on the basis of returning to the land what has been taken from it, we have then to look at the composition of the materials sold off the farm, and not at the composition of the crops grown, as these are in great part consumed on the farm itself. But even this is not the practical aspect of the case. Each crop has, in fact, a characteristic capacity for self-supply; it obtains with ease some portions of its food, and others with difficulty; the aim of economic manuring should therefore be to supplement the plant's weakness. Thus, wheat supplies itself with difficulty with nitrogen, while clover has a wonderful power of self-supply in this particular. The scientific farmer therefore manures wheat liberally with nitrogen, and gives little or none to clover. The mere chemist would do just the reverse, as clover contains much more nitrogen than wheat. Manuring, on the principles of the author, is simply impossible; the manures would often cost more than the increase of crop obtained.

Dr. Morfit again finds fault with the ordinary commercial analyses of phosphatic materials, and devotes a whole chapter to directions for the analysis of mineral and other phosphates. We strongly recommend the reader not to follow Dr. Morfit's guidance. It is quite impossible to enter here into details of the doubtful chemistry that occurs throughout the chapter, but we may refer to one point which governs many of the author's conclusions. He professes to ascertain the "individual combinations of the phosphoric acid present," a task which other chemists would probably express their inability to do. He accomplishes this by assuming that the phosphoric acid which is precipitated as ferric phosphate in his analysis, existed in the same state in the original mineral. By this means, and by assuming in the same way that other precipitates

truly represent the original compounds, the task becomes quite easy. It follows naturally from these assumptions that the acids determined in the mineral are found insufficient for the lime present; the existence of organic acids is therefore next assumed, and "organate of lime" appears in the author's analyses as an ingredient of mineral phosphates!

R. W.

LIGHT SCIENCE

Anecdotal and Descriptive Natural History. By A. Romer.—*The Ivy.* A Monograph. By Shirley Hibberd.—*Buds and Blossoms.* Stories for Children.—*Fairy Mary's Dream.* By A. F. L. (Groombridge and Sons.)

IT is very gratifying to see works of the above class brought out,—books which it is supposed, are calculated to amuse as well as instruct. Ten years ago they would have been a dead loss to the publisher, and their publication now is one of the surest proofs that science is permeating all classes and is appreciated by persons of all ages.

Mr. Romer's beautiful book explains in the introductory chapter in a clear and simple manner the classes and orders of the Animal Kingdom, and then goes on to describe the haunts and habits of the best known frequenters of the jungle and prairies, such as the lion, cheetah, and rhinoceros, giving particular attention to the monkey tribe and bears. The book is enlivened by numerous anecdotes and contains coloured plates and wood engravings.

"The Ivy" is a monograph comprising the history, uses, characteristics, and affinities of the plant, and a descriptive list of the garden ivies in cultivation. The book is most luxurious and tasteful, both in binding and letterpress. The plates, coloured with great delicacy, represent the various kinds of ivy, and so natural are the leaves, that one is almost tempted to take one up. A coloured sketch of the Entrance Gate of Conway Castle, surrounded by specimens of ivy, forms the title-page; the letterpress is thickly interspersed with sketches of "ivied castles, and churches, and quotations from Virgil, Euripides, Harleian Manuscripts, Shakespeare, Wordsworth, and the modern poets." An interesting part of the work is the author's historical and literary memoranda from the times when the ivy was called "the plant of Osiris" by the Egyptians down to the time when its praises were sung in that famous song, by Charles Dickens, "The Ivy Green."

"Buds and Blossoms," a book containing ten stories, will be a welcome addition to a child's library; the last, called the "Fir-tree's Story," being particularly pretty. This little volume contains several coloured plates and woodcuts, and the title-page is gracefully illuminated.

"Fairy Mary's Dream," another charming book for children, is in the form of a poem. The illustrations are well done. The colouring of the peacock's feathers on the title-page and in the plate "Till on a green fern's nodding crest" is exquisite; and besides the plates there are many engravings descriptive of the butterfly's journey.

W. L.

OUR BOOK SHELF

Pathologische Histologie der Luftwege und der Lunge. Von Dr. Albert Thierfelder. Atlas of six plates (Leipzig, 1872).

ALTHOUGH death and disease are as much a part of Nature as life and health, yet it is found convenient to separate the study of living structures under morbid conditions from the rest of biology, so that a work like the present must in these pages be more briefly noticed than its importance would deserve.

It is more than fifteen years since the publication of the late Prof. Förster's Atlas of Morbid Histology; and when we consider all that has been done in that time, represented in such volumes as those of Virchow, of Förster himself, of Rindfleisch, of Cornil and Ranvier, we see ample reason for the issue of a new series of plates illustrating the subject. The present *Heft* is the first instalment of the complete work, which is to consist of ten such, each complete in itself. The drawings are admirably executed both by Dr. Thierfelder and by the engraver. The text is strictly limited to explaining them, and is therefore much shorter than in Eiker's physiological atlas, for instance; but in the present state of pathology we regard this as a merit. The selection of subjects for illustration is always difficult: it might be objected that some of these drawings (*e.g.* fig. 2 of Pl. I.) represent little but normal tissues; but, on the whole, practical pathologists will not have room to complain on this score. Some patriotic anatomists will be glad to see "die von den Engländern supponirte Basementmembrane" taking its place without question here. The price of these beautiful plates is very moderate, and we heartily wish Dr. Thierfelder success in completing his work.

Coalfields, Western Port. Report of the Board to the Colonial Government, Victoria.

THE Government of Victoria are determined to find a workable coal-field in that colony, and, apparently not satisfied with the examination of the mesozoic rocks made by the extinct Geological Survey, have had the same strata re-examined by a mining engineer acting under the direction of a Board. The results of these further investigations are embodied in this final Report, but they add little or nothing to our previous knowledge. Indeed the Report seems to be for the most part a work of supererogation. The geological age of the coal-bearing strata had already been definitely ascertained by Mr. Selwyn and his staff, yet the Report goes into this question at considerable length as if it was quite a novelty. Then, as regards the extent of the actually proved coal-seams, Mr. Selwyn, as is well known, expressed an unfavourable opinion. Upon his geological map of Cape Patterson the coal-seams exposed upon the coast are protracted inland so as to show the approximate area over which they extend, and this is only some 106 acres. So experienced a geologist as Mr. Selwyn was not likely to misread the evidence which is so clearly and abundantly developed along the coast. But the Board believe that "any calculations based on the bearings of the strike of seams in this locality are unreliable." There does not appear, however, to be anything specially mysterious and abnormal about the coal-bearing strata of Cape Patterson, nor is there any reason why they should not "behave" like similar deposits elsewhere. The Geological Survey's map shows a very small area of workable coal, and perhaps this is why the strike and dip on the well-exposed coast at Cape Patterson are considered unreliable—the wish in this case being father to the thought. Mr. Selwyn and Professor M'Coy both believed it possible that at some considerable depth below the coal-seams of Cape Patterson a better coal-field might be got. The Board, however, does not think this likely. Here, again, we should be inclined to pay more deference to the opinion

of highly trained and experienced geologists than to that of gentlemen, who, whatever their attainments may be, certainly do not in this Report evince much acquaintance with geology. J. G.

Reports of the Mining Surveyors and Registrars for Quarter ending March 31, 1872. Victoria.

THERE is nothing in these Reports calling for special notice. The total quantity of gold got respectively from alluvia (or, as the Reports have it, *alluviums*) and quartz reefs during the quarter were as follows:—Alluvial, 171,851 oz. 10 dwt.; quartz, 164,670 oz. 8 dwt.; total, 336,521 oz. 18 dwt. The quantity of gold, the produce of the colony, exported during the same period was 398,131 oz. 10 dwt.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Aurora Spectrum

IN connection with my letter in last number of NATURE, I have in a diagram approximately placed the aurora lines side by side with the spectrum of hydrogen and of some of the principal air lines (as given in Dr. Watt's index) and with the following results:—

Line No. 1. Close upon, if not identical with, an air-line marked by Huggins N O, and Plücher O.

No. 2.—Not apparently coincident with any prominent air-line. The coincidence with a line of oxygen noted by so careful an observer as Mr. Proctor is puzzling; and if the instrumental power used was sufficient to ensure absolute identity, seems to indicate a second or unusual spectrum of that gas.

No. 3 is not near any principal air-line.

No. 4 is nearly coincident with a faint line of oxygen (confirmatory of Mr. Proctor's observations).

No. 5 corresponds to a rather strong N line.

No. 6 does not coincide with any principal air-line, very faint lines of O and N being the nearest.

No. 7. Upon close examination the positions of this line as respectively fixed by Mr. Proctor and Lord Lindsay are not inconsistent, and the line closely corresponds with a strong line of oxygen situate on the less refrangible side of solar G.

Nos. 1, 4, 6, and 7 fairly correspond in intensity with their representative air-lines. None of the lines are identified with H α, H β, or H γ, and it would appear that the aurora, if a spectra of atmospheric gases, mainly selects oxygen and ignores H α and the stronger N lines. The modification of compound spectra by conditions of temperature and pressure, is however only a partially explored subject, and we have moreover no certain data of conditions in the case of the aurora, which will assist us in bringing it to bear.

I accidentally omitted from the names of some observers of the zodiacal light that of Prof. Piazzi Smyth, whose observations in the south may be said to have conclusively demolished the supposed identity of the light, and the aurora (at least so far as bright lines are concerned) made it extremely improbable that anything beyond a continuous spectrum will ever be seen in the pure zodiacal light, though a further search should be by no means neglected. J. RAND CAPRON

Guildford, Jan. 10, 1873

Polarisation of the Zodiacal Light and of the Aurora

IN the interesting article by Mr. Rand Capron in the last number of NATURE—after collating the various results of the spectroscopic examinations of the aurora and zodiacal light which have appeared at different times in your pages, together with those which have been collected by Dr. Schellen—he terminates his analysis of the general results by remarking that he is "not aware whether the zodiacal light and the aurora have been examined with the polariscope," and suggests that the "light, though faint, might be tested with a Nicol's prism and Savart's bands."

I would refer him to a paper in the March number of the "Monthly Notices of the Astronomical Society" for 1871, in which an observation by Mr. Burton (late assistant to the Earl of Rosse) on the polarisation of the zodiacal light is described.

Mr. Burton was one of the eclipse party stationed at Agosta, in Sicily. He made use of a Savart's polariscope, set so as to give a black centre where the bands were parallel to the plane of polarisation. On looking to the brightest parts of the zodiacal light Mr. Burton believed that he could detect faint traces of polarisation, sufficiently strong to enable him just to recognise that the bands were black centred when their direction coincided with the axis of the cone of light, that is, when the direction passed through the position of the sun.

To make sure that he was not examining the remains of air polarisation given by the slight remaining twilight, he examined the light of other parts of the heavens, but was unable anywhere else to detect any trace of bands. In contradistinction, however, to this must be set an observation of my own, yielding a negative result, though made on the same evening and with a similar instrument, as well as with the same Savart used by Mr. Burton. I was, however, unable to detect any trace of bands either upon the cones of zodiacal brightness or upon the adjacent parts of the sky; but it is very possible that Mr. Burton's eye may be more sensitive to faint lights than my own.

In February last I also met with a negative result in examining a faint trace of the zodiacal light visible in England. I then used a double-image prism as well as a Savart, thinking that its two oppositely polarised fields in juxtaposition might afford a more delicate test for so faint an object.

Capt. Tupman while cruising in the Mediterranean has also, I believe, repeatedly obtained negative results when making use of a Savart on the zodiacal light.

And I understand that Mr. Lockyer, together with the other observers of the Indian Eclipse of December 1871, totally failed to detect any traces of polarisation in the brilliant displays of the zodiacal light which they observed while crossing the Indian Ocean.

I am therefore disposed to conclude that any traces of polarisation must be very slight, if indeed any polarisation at all is to be attributed to the zodiacal light itself and not to the veil of atmospheric impurities lying between us and objects near to the horizon. Certainly we may conclude that there is no such polarisation as is found in the light of the solar corona or—as we might expect—if the zodiacal light were caused by a great cloud of cosmical dust made up of particles smaller in diameter than the wave-length.

Indeed there cannot be as great a percentage of polarisation, or, to speak more exactly, as great a difference between the component radial to the sun's place and the component at right angles, as in the case of a sunbeam dispersed by the dust in our own atmosphere. For if any one will examine the track of a sunbeam passing through a room with a Savart, he will not fail to be struck with the distinctness of the bands. We seem therefore justified in concluding, that if the zodiacal light is composed of cosmical dust, such dust particles must be considerably coarser than those which float in our own atmosphere.

As to the polarisation of the light of the aurora, I examined, both with a double-image prism and Savart, a faint auroral display on November 10, 1871; as also the light of the great aurora of Sunday, Feb. 4, 1872, but in neither instance was able to detect any traces of polarisation.

A. COWPER RANYARD

The Diathermacy of Flame

THERE are some statements in Capt. Ericsson's reply to my letter (NATURE, vol. vii. p. 149) which demand discussion. In the first place he calculates the supply of gas in *his* pipe and applies it to *my* burners. As his pipe did not supply my flames, but his own, which were at least fifteen times larger than mine, the applicability of his figures is rather obscure.

Capt. Ericsson says, "The apparatus contrived by Mr. Williams for determining the diathermancy of flame, as described by himself, is exceedingly faulty, *the temperature it records being that produced by heat derived from several sources. The radiant heat transmitted to the bulb of the thermometer by the flames, acting conjointly with the unknown degree of heat imparted by the surrounding medium*, it will be evident that Mr. Williams' device is worthless as an indicator of radiant intensity." Does Capt. Ericsson really mean that the maximum temperature indicated by a thermometer exposed to several varying sources of heat is not determined by the maximum radiators or convections

of the body capable of communicating the highest temperature, but by this, plus the minor radiators or convections of the cooler bodies? The words I have put in italics distinctly imply such an assumption.

He seems to forget that I did, in the first place, observe and record the temperature of the surrounding medium. It was the 19° C. which served as my starting-point. As no additional radiations were introduced beyond those of the flames to be experimented upon, and the blackened bulb of my thermometer was surrounded by polished reflecting metal surfaces on all sides, except that exposed to the flames, all the subsequent increments of heat were unquestionably due to the radiators from those flames, whether they came directly from the flames themselves or were received and reflected from the back and sides of the polished chamber. Fully admitting the desirability of a continuous record of the heat thus communicated to the surroundings of the thermometer during the experiments, I nevertheless firmly maintain that, rude as it was, my apparatus (I refer, not to the thermometer, but to its adjuncts) was far superior to Capt. Ericsson's. Mine was liable to a small source of error from a possible accidental irregularity of radiation by the thermometer bulb, but his was specially devised to ensure a large amount of such irregularity, continually increasing with the progress of the experiments. It is not a little surprising that so careful and luxurious an experimentalist as Capt. Ericsson should have overlooked the fact, that the very precautions which he so elaborately introduced to secure equal radiation from his bulb are precisely adapted to produce the contrary result.

The arrangements by which his thermometer is "enclosed in an exterior vessel charged with water kept at a constant temperature" of 60° by communication with a capacious cistern, directly violate the conditions demanded by the Newtonian law of radiation, of which Capt. Ericsson is so able a champion; for as the experiment proceeds with an increasing number of flames, and consequent rising of the thermometer, this constant temperature of the water jacket goes on steadily augmenting the difference between the temperature of the bulb and that of its surroundings, and consequently secures just what it is intended to prevent, viz. a variable radiation. What is required to secure a constant degree of radiation from the bulb is not the constant temperature of the surroundings, but a temperature steadily increasing at the same rate as that of the bulb, in order that the *differential* and not the *absolute* temperature of the surrounding medium, &c., should remain constant. This was rudely obtained in my simple apparatus, as both the thermometer and its surroundings were simultaneously influenced by the same radiations.

Capt. Ericsson takes great pains to controvert my "assumption that the intensity of a gas flame is proportional to the gas consumed." This is unnecessary, inasmuch as I never made any such assumption, but have, on the contrary, endeavoured to prove that such cannot possibly be the case, by showing what becomes of the radiations from the interior of a large solid flame. If he will read chaps. 7 and 8 of "The Fuel of the Sun," he will see how and why this has been done, and learn the true bearings of the experiments under discussion upon this subject.

W. MATTIEU WILLIAMS

P.S.—The present is a suitable opportunity for asking a question which doubtless the philological readers of NATURE can easily answer. Many writers use the words "diathermancy," "diathermanous," "athermanous," &c., rather than "diathermacy," diathermous," &c. Why is this? We do not say "thermanal" or "thermanometer," &c. Why, then, should we depart from the analogy of ancient usage in constructing the more modern compounds of the same root?

Pollen-eaters

MR. HART'S note in NATURE, vol. vii. p. 161, is interesting to those who have paid attention to the subject of fertilisation by insect agency, and would be still more so if he could furnish the names of the species of both plants and *Syrphidæ* that have come under his observation.

May I take this opportunity of calling the attention of the readers of NATURE to a suggestion which I made some months since in the *Journal of Botany*, and which has at present met with no response? I believe no greater service could be rendered to this department of physiological botany than a series of observations on the species of insects which frequent and assist in the fertilisation of our wild flowers. I know of no such list even with respect to our commonest flowers. Here is a wide field for observation during the next season.

London, Jan. 7 ALFRED W. BENNETT

P.S.—At the time of writing the above, I had not seen Dr. Buchanan White's article in the January number of the "Journal of Botany," on "The Influence of Insect-agency in the Distribution of Plants," an admirable introduction to the series of papers I had in my mind.

Welwitschia

IF you will kindly permit me, I wish to make an addition to your notice of my paper on "Welwitschia," read at the Linnean Society on the 19th ult. That paper was completed and put in Dr. Hooker's hands about three months ago; and the reading of it was delayed until I had seen Strasburger's recently published memoir on Coniferæ and Gnetaceæ. After perusing that valuable work, I added a small appendix to my paper, and it is to the omission of the remarks contained therein that I wish to direct attention.

In the description of the male flower, Strasburger and I almost completely agree. It possesses two outer parts of the perianth, two inner parts, six stamens, which I believe to arise by branching from two primordial stamens, although Strasburger does not agree with me in this, and two carpels. The formula of the flower may be expressed thus:—

$$Ca_2\ Co_2\ An_2^3\ Gn_2$$

In the female flower I had very great difficulty in coming to a conclusion as to the value of the two outer parts, but the inner I concluded was a covering of the nucleus, an ovular integument, and not carpellary. There were only two ways of deciding what was the morphological significance of the two outer parts, either by comparison with the male flower, or by comparing them with the parts in the flowers of *Ephedra* and *Gnetum*. I applied to Dr. Hooker for specimens of these genera, and he has kindly promised to procure them for me. As Strasburger's material for the examination of Ephedra and Gnetum was imperfect, it is still of importance to examine both in detail. Being, therefore, obliged to fall back on comparison with the male flower (the study of the development alone not being sufficient for the purpose), I described the two outer parts as forming a perianth, although I could not feel certain that I was correct in so doing, and could not explain the occurrence of the short stalk under them, no such stalk existing in the male. On looking at Strasburger's figures of Ephedra, I at once saw that I had been in error in describing the outer parts as forming a perianth, and in the appendix stated that they were *carpellary*.

The formula would therefore be:—

$$Ca_0\ Co_0\ An_0\ Gn_2$$

The carpels, therefore, exist in both flowers; but whereas in the male they are anterior and posterior, in the female they are lateral. Kindly make this correction, because I do not think that after Strasburger's magnificent work, the Gymnospermous theory is for a moment tenable.

Should any correspondent be able to obtain specimens of Ephedra and Gnetum for me, I would be greatly obliged, as I am desirous of completing my paper on "Welwitschia" by a description of its embryogeny, as well as that of the other two genera. Specimens which have been put in absolute alcohol are by far the best for examination, but that, I fear, could only be obtained abroad with great difficulty.

W. R. MCNAB

Dublin, Dec. 27, 1872

Gauges for Ocean Rainfall

IN reply to Mr. Miller's letter on ocean rainfall, in NATURE, vol. vii. p. 123, I beg to acquaint your correspondent that I have endeavoured to meet the difficulties he mentions, by designing two forms of rain-gauge for use on board ship. One is of a cylindrical form, and composed of a collector and receiver, detachable from each other, and is suspended on gimbals in a frame or vexa. The rainfall may be estimated either by a glass scale at the sides, or by emptying the contents into a graduated glass measure.

A description of this instrument as above designed appeared in the Journal of the Scottish Meteorological Society for January 1870, and was illustrated by diagrams.

The other form consists of the cylinder as above, divided into col-

lector and receiver, detachable from each other, but it is poised on a pivot projecting from the floor below, into a conical cavity in the bottom of the receiver. It is also enclosed in a square box, from which, in each case, the cylinder is removeable entire for emptying the contents, and the rainfall admits of being estimated in the same way by scales or glass vessels.

A full-sized model of this instrument has been made, and was exhibited at the annual meeting of the Scottish Meteorological Society in July last, and a notice of it appeared in the account of the proceedings of the meeting in the Edinburgh papers of July 4, 1872. It has likewise been exhibited at the Meteorological Office, Victoria Street, London, and its construction has been approved of by several naval officers, and others specially interested in rainfall.

I may add that some gauges are being constructed, with the view of being used on board such steamers as would permit of their being placed under the superintendence of interested and scientific officers.

I hope by-and-by to be enabled to present to the readers of NATURE some results of the observations made by these gauges, which may lead to an introduction of such instruments as part of a ship's equipment, and so to put them in possession of some trustworthy observations of the rainfall at sea.

W. J. BLACK

Star Shower in 1838

I AM not sure that the following extract from my note-book may not have been printed by the British Association; but even in that case it may be thought suitable for reproduction at the present juncture.

"1838. Dec. 7.—A great number of falling stars were observed between 6^h and 7^h. In about half-an-hour 40 were counted, sometimes by one, sometimes two, sometimes three observers—two at a medium. They were of all magnitudes up to the first: the larger dissolved into a train of light, but left no train behind them: the S. and W. quarters were chiefly observed, but their prevalence seemed to be universal: they all fell in nearly a vertical direction, but those in the N.W. and S.E. quarters inclined towards the S.W. The colour of the more conspicuous ones seemed to verge towards orange. Their courses were of no great length. There was at the same time a pale auroral light along the N. horizon from N.W. to N.E., apparently equally extended on each side of the true meridian. The Meteors were not watched after 7^h, but about 11^h upon looking out again I saw one, the only one in several minutes, in the S.W.; but it had no longer a vertical direction, its course pointing now to the N.W.

"For account of this phenomenon as observed by Mr. Maverly at Gosport, see 'Proceedings of the Meteorological Society during the session 1838-1839,' p. 9."

T. W. WEBB

Salmonidæ of Great Britain

IN reply to the Rev. W. S. Symonds's questions (NATURE, Vol. vii. p. 162) regarding the occurrence of certain salmonoids in Welsh and non-glacial lakes, I beg to draw his attention to the sixth volume of the "Catalogue of Fishes," published by the trustees of the British Museum, which, I believe, contains the information for which he asks. I would with pleasure extract this information for him if I were not ignorant as regards the glacial or non glacial character of some of the lakes. The geographical distribution of the various kinds of Charr is given in detail on pp. 125–154, and that of the *Coregoni* on pp. 172–199. The group of Charr and that of *Coregoni* are by no means limited to lakes, many true charr, like *Salmo, fluviatilis, fontinalis*, &c., being more or less exclusively river-fish; and *Coregonus oxyrhynchus* being common in salt water on the coasts of Holland at certain seasons of the year. In addition to Sir Philip Egerton's observation that he has taken *Salmo ferox* in Lake Bala, I may mention that the British Museum possesses an example from the Lake of Llanberis, presented by S. P. W. Ellis, Esq. (Catal. Fish, p. 93.)

ALBERT GÜNTHER

British Museum, Jan. 6

M. Figuier and the Origin of American Indians

ON page 484 of Figuier's work, "The Human Race," the author speaks of the Mohawk Indians of the Rio Colorado, and on the opposite page reproduces M. Mollhausen's drawing of two Mojave Indians, as described in vol. iii. of Pacific R. R. Reports, by Messrs. Whipple, Ewbank, and Turner. As the Mohawk Indians of New York and the North-west are so totally distinct from the Colorado Mojaves, I thought it desirable to call attention to the error.

M. Figuier, I notice, in other portions of his work, finds the origin of the original peoples of America a difficult problem to solve, and I think contradicts himself. He states, on page 16, that, "unless we regard men as a solitary exception among all living beings, unless we withdraw them from the operation of the universal laws of nature, we must come to the conclusion that they do but form a certain number of races of one and the same species, and all descend from one primitive unique species." I do grant that it must have been a very unique species, whose descendants could have varied to the extent that man has. But it is not the question of variation of species that I wish to allude to, but the geography of the question. In speaking of what M. Figuier calls "the red race," pp. 404–406, he states—"The Indians cannot be accurately brought into connection with either the white, yellow, or brown race;" and again, "Probably the population which existed in the new world before the arrival of the Europeans was made up of several types different from those that are extant at present in the other regions of the globes, types having a great tendency to modify themselves, and which were obliterated whenever they came in contact with the races of Europe. But to re-ascend back to this primordial population would now be impossible." There is here a plain acknowledgment of a strictly autochthonic American people, modified since by contact with European races. This latter contact we believe, of course, to be purely imaginative; but if there was an autochthonous people in America, as the "primordial population" of Figuier is supposed to be, how then can "all (men) descend from one primitive unique species?" M. Figuier does not believe in the evolution of man from some pithecoid creature; he claims to have "shown . . . . that man is not derived . . . . from any animal." How this stand can be taken, and still the unity of the race asserted to be true, we cannot understand: for surely it cannot be denied now, that man was once lower than the lowest savage, although different from modern savages; and, as in America, there have been found traces of man's presence, as old geologically as those found in Europe; as fossil men have been found in California; and drift implements in the river gravels of the Delaware Valley, on the opposite side of the Continent; and as these implements, in part, show that their fashioners were little, if any, in advance of the beings first worthy to be called men, how could they have descended from a stock in common with the European and Asiatic races? It must have been, indeed, a unique species, whose nearest relations spread over the whole continent of North America; or starting somewhere on the Pacific coast, finally reached the Atlantic, yet made no advance—learned nothing in a slow overland journey of three thousand miles. The "primordial population," of which M. Figuier speaks, we doubt not originated in America; its pithecoid ancestry may have been European or Asiatic, but if so, the "old world" monkey was somewhat Americanised before it evolved that peculiar red-race which we call the Indians. If there ever was land communication between South America and the "old world" tropics, this pithecoid man may have reached the shores of the Southern Continent, and lost the ape-like characters after his arrival. Either evolved thus, or created *de novo*, as M. Figuier claims, the American savage is purely an American institution, and upsets that unity which M. Figuier claims for every race, tongue and condition, savage and civilised, throughout the world.

CHARLES C. ABBOTT, M.D.

Trenton, New Jersey, U.S.A., Dec. 23, 1872

THE ZODIACAL LIGHT

FOR several nights lately the zodiacal light has been exceedingly bright and well-defined, and more particularly on the nights of November 24 and 27; on the evening of the 24th I found an explanation of what had often perplexed me before, viz. the existence of a faint,

isolated, band of light across the zenith, but as soon as it was dark that evening, the zodiacal light was distinctly seen to stretch across the whole sky, forming that faint band of light previously observed; I then began to note its position, but the best observations were made on the night of the 27th, when it was most distinct.

On that night it passed centrally over the planet Venus, and then over the stars δ Capricorni, γ Aquarii, ο Piscium, and reached a point between the Pleiades and the Hyades, so that the central portion of the light traced out the course of the Ecliptic with wonderful precision; it was brightest in the central part of the band, and gradually faded off towards the edges; its illumination about Venus was somewhat greater than that of the Milky Way, but became fainter and fainter as the light proceeded along the Ecliptic; it was impossible to trace it beyond the Hyades, where it seemed absolutely to terminate; at midnight, however, a feeble glow could be seen above the eastern horizon in Leo and Cancer, but nothing was certain about this branch.

Returning to the western and brighter branch, at Venus its breadth was about 40°, and as the longitude of the planet was 280° while that of the sun was 246°, its breadth was 40° at a distance of 34° from the sun; at δ Capricorni its breadth was 20°, at γ Aquarii 16°, and at ο Piscium 10°, so that we get the following results :—

Distance from sun	Breadth
34°	40°
66	20
93	16
139	10

and its extreme distance from the sun was about 177°, where it was too faint to note anything but its existence. The light seemed perfectly fixed in the heavens, and there was no sign of any displacement such as might be caused by parallax combined with the earth's rotation; and when the brighter part had set and was far below the horizon, the band across the zenith was quite as distinct as before.

Now these few facts go a long way towards explaining the nature of the zodiacal light, and a few more observations at different times of the year may be all that are necessary to do so satisfactorily; but as the light was so vivid here, it must have been seen in other parts of the world, and a comparison of the different accounts may bring about the desired result; hence these notes, and the following rough explanation.

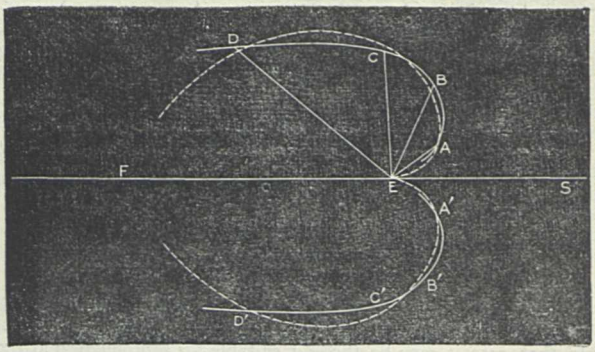
The zodiacal light has generally been supposed to be a luminous ring, surrounding the Sun, and situated between the orbits of Venus and Mars; the fact that the light has often been seen in both the east and west at the same place and time does not affect the probability of this explanation, as we have only to suppose the earth to be just within the ring; but there are many difficulties to encounter, and the explanation never seemed satisfactory. The instant, however, that I saw the prolonged ray, I felt sure that the zodiacal light was similar in its nature to the rays issued from a comet towards the sun, which, drifting over the nucleus, are then forced backwards and form the tail; and that in the case of the earth, the light is generated in those regions to which the sun is vertical, and passing round the earth, the light is swept back in a direct line from the sun, thus forming a train which always tends towards a point in the heavens 180° from the sun, and which is therefore stationary with regard to the earth's axial rotation.

It is not easy, however, to test the truth of these ideas by means of the notes above, but the following attempt may not prove uninteresting.

If the zodiacal light were a ring, and the earth within it, we could compare the distances of the different parts of the ring by means of their apparent angular breadths, supposing the actual breadth of the ring to be uniform; in order to see whether that prolonged ray was part of a ring or not, let E S be the line joining the earth and the sun, the plane of the paper coinciding with the Ecliptic; and at an angle of 34° (θ_1) measure off any length E A (r_1), in which direction the breadth of the light was 40° (ϕ_1); now, the distance r_2 of any point where the angular breadth is ϕ_2, will be determined by the equation—

$$r_2 = r_1 \tan \frac{\phi_1}{2} \cot \frac{\phi_2}{2}$$

so that we can draw E B, E C, and E D, corresponding to the second, third, and fourth observations; but the



curve drawn through these points is by no means an arc of a circle, and very fairly represents what we have expressed in words above, so that the rays issuing from E towards S are swept to the right hand and to the left, and passing by the earth they form a train of light stretching out into space.

But to what an astonishing distance must this train proceed, in order to acquire an angular distance of 177° from the sun! It is, however, quite possible that the two branches close together near the point F, following the dotted curves; these curves are the positive and negative branches of the spiral of Archimedes, and fairly represent our curves for an angular distance of 90° from the sun.

MAXWELL HALL

Jamaica

THE LATE PROFESSOR W. J. MACQUORN RANKINE

THE death of Prof. Macquorn Rankine, which we announced a fortnight ago, will excite a pang in the hearts of many persons who had enjoyed actual intercourse with the genial spirit whose early loss we now mourn, and of a still greater number who were only acquainted with him through his published works. He died at his residence in Glasgow, on Christmas Eve, in his fifty-third year, the date of his birth being July 5, 1820. For several months he had been labouring under a serious derangement of his eyesight, coupled with heart disease; but it was confidently hoped for a time that his valuable life might be preserved for the benefit of science, provided that he rested himself from all his ordinary labours. Latterly he did take that rest which seemed to be so imperatively demanded by his physical nature, the chief portion of his ordinary work, namely, that of conducting his class in the University of Glasgow, being handed over to Mr. Bamber, C.E., who formerly distinguished himself as a student under the deceased professor; but the bodily system had evidently little power of resisting the ravages of the insidious disease under which it laboured; paralysis set in on Sunday, the 22nd ult., and in forty-eight hours Macquorn Rankine was dead.

The amount of space at our disposal is quite insufficient for the simple mention of the many important facts that

are intimately bound up with the professional and scientific career of Professor Rankine, and therefore our sketch, at the best, can only be of the most cursory sort. In due time, doubtless, a suitable tribute will be paid to his memory and his scientific genius by the hand of one of his literary executors.

Professor Rankine was born in Edinburgh, and received most of his ordinary school education in the Burgh Academy of the town of Ayr, and in the High School of Glasgow; but he received the most valuable part of his education, doubtless, from his father, who was a retired lieutenant of the Rifle Brigade, during the residence of the family at Edinburgh. At a very early age young Rankine entered himself as a student in the University of Edinburgh, where he enjoyed the invaluable benefit of instruction in chemistry from Dr. D. B. Reid; in natural history (including zoology, geology, and mineralogy) from Prof. Jameson, a man of European reputation as a naturalist; in botany from Prof. Graham; and in natural philosophy from Prof. James D. Forbes. The extraordinary genius which he displayed in after life in pure and applied mathematics seems to have owed little or nothing to any external or adventitious aid in the shape of professional instruction: he was a born mathematician.

The bent of his mind began very early to show itself, for before he was out of his "teens" he had written two essays on purely physical subjects—"The Undulatory Theory of Light," and "Methods of Physical Investigation." When he was about eighteen years of age he betook himself to the profession of civil engineering, and served as a pupil under an eminent master, Sir John Macneil, for three or four years, a large portion of which was spent on engineering works in Ireland. He was afterwards employed for several years on railway and other engineering works in Scotland, and in 1850 or 1851 he settled down in Glasgow to pursue his profession in partnership with Mr. John Thomson, C.E.

Meanwhile, Mr. Rankine had been prosecuting inquiry in reference to several purely scientific subjects, as well as those that more immediately pertained to his profession as a civil engineer; and he did not fail to put on record the results of his investigations, almost all of which he gave to the world through the medium of one of the learned societies. He was elected a Fellow of the Royal Scottish Society of Arts in 1842, an Associate of the Institution of Civil Engineers in 1843, a Fellow of the Royal Society of Edinburgh in 1849, a Member of the Philosophical Society of Glasgow in 1853, and a Fellow of the Royal Society of London in the same year. In the year 1850 he first cast in his lot with the British Association, and at the meeting held in Edinburgh that year he was the Secretary of the Physical and Mathematical Section. He afterwards occupied still more prominent positions both in Section A and Section G, and many of his admirers looked forward with pleasure to an early meeting of the Association being held in Glasgow, when they hoped to see him filling the presidential chair.

In the year 1855 he was appointed by the Crown to the Regius Professorship of Civil Engineering and Mechanics in the University of Glasgow, in succession to Prof. Lewis Gordon, and in that highly honourable position he laboured with unexampled distinction for seventeen years. The spirit in which he conducted his class may be judged of by the following extract from the introductory lecture which he delivered on the occasion of taking possession of his chair; the subject of the lecture was, "The Harmony of Theory and Practice in Mechanics," in the course of which he said: "The objects of instruction in purely scientific mechanics and physics are, first, to produce in the student that improvement of the understanding which results from the cultivation of natural knowledge, and that elevation of mind which flows from the contemplation of the order of the universe; and, secondly, if possible, to qualify him to become a scientific discoverer. In this branch of study exactness is an essential feature, and mathematical difficulties must not be shrunk from when the nature of the subject leads to them. The ascertainment and illustration of truth are the objects; and structures and machines are looked upon merely as natural bodies are, namely, as furnishing experimental data for the ascertaining of principles and examples for their illustration."

When the British Association meeting was held in Dublin in 1857 Prof. Rankine had the honorary degree of LL.D. conferred upon him as a mark of the eminence which he had then attained as a physical investigator, although only thirty-seven years of age; and in the same year he was chosen as the first president of the Institution of Engineers in Scotland, an organisation which he materially helped to bring into existence. In November 1861 he also became President of the Philosophical Society of Glasgow, and during his term of office he conducted the business of the society with great tact and superlative ability; he delivered two addresses from the presidential chair and contributed several other papers, all of which were valuable contributions to science. We would only mention his first presidential address, the subject of which was "On the Use of Mechanical Hypotheses in Science, especially in the Theory of Heat." In it he gave a short account of the results which had been derived from that hypothesis which ascribes the mechanical action of heat to the centrifugal force of certain supposed molecular motions, a hypothesis which, like the wave theory of light, the hypothesis of atoms in chemistry, and all other physical hypotheses whatsoever, substitutes a supposed for a real phenomenon, namely, invisible motion for tangible heat; the object being to deduce the laws of the real phenomenon from those of the supposed one. Another of the most remarkable of his Philosophical Society papers was one which he read in January 1867, the subject being "On the Phrase 'Potential Energy,' and on the Definitions of Physical Quantities." This was suggested by a paper, entitled "On the Origin of Force," which Sir John Herschel contributed to the *Fortnightly Review*, and in which he expressed the opinion that the phrase in question was unfortunate, inasmuch as it went to substitute a truism for the announcement of a great dynamical fact.

Prof. Rankine did not content himself with being a "star of the first magnitude" in respect of the science of thermodynamics; he also plunged into, and won distinction in, the science of naval architecture, being impelled in that direction, doubtless, through the intimate friendly intercourse which he had with Mr. James R. Napier, F.R.S., one of the most original-minded naval architects and marine engineers that the Clyde has yet produced.

The deceased professor's writings are exceedingly numerous. He wrote and published, up to and including the year 1863, no fewer than eighty papers which were found to be worthy of mention in the Royal Society's catalogue; and between that and his death he had probably written as many more, in addition to the various treatises which he wrote upon "Civil Engineering," "Applied Mechanics," &c., all of which are of the very highest scientific and practical value. Whatever he wrote he executed with almost matchless perfection, whether we regard the elegance of his diction, the scientific order of his exposition, or the lucid methods of illustration which he adopted. His mind was of the very first order, and his death creates such a profound void in pure physics and scientific engineering that we could easily have afforded to give half-a-dozen of our most eminent practical engineers, civil or mechanical, that he might have been retained among us to pursue his original investigations and mould the minds of the engineers of the future.

JOHN MAYER

THE BIRTH OF CHEMISTRY

VI.

Latin and English MSS. on Alchemy.—Sources from which the earlier Alchemists acquired knowledge.—Arabic learning during the Middle Ages.—Geber.

IN the last article we discussed the Greek MSS. on Alchemy, and endeavoured to show that, owing to the uncertainty of their age and the obscurity of their authorship, they are less important components of the early history of chemistry than some writers have laboured to prove them.

There exist also many MSS. in Arabic and Persian on alchemy, but in all probability few of them are earlier than the 8th century. The Library of El Escorial is undoubtedly more rich in such MSS. than any existing library; but from the imperfect manner in which its treasures are catalogued, we are unable even to give a list of the more important of these treatises. The British Museum contains several Arabic MSS. on alchemy, written about the 12th century. Such of these as we have seen are devoid of drawings, and apparently also of symbols.

Early MSS. on alchemy in Latin exist in all large libraries. They contain various recipes for making the philosophers' stone, "secrets of art," copies of the inscription of the Smaragdine table, with the interpretation thereof, and an infinite amount of unintelligible nonsense. They differ in no respect from the later printed treatises on alchemy, which we shall presently discuss in detail. The matter of most of the MSS. is to be found in printed works compiled by alchemists of the 15th and 16th centuries.

One of the oldest alchemical MSS. in the British Museum is a transcript of the *Speculum Secretorum* of Roger Bacon, who died in 1284. It is in the Sloane Collection, and was written towards the end of the 13th century, say between 1290 and 1300. There is no autograph MS. of Roger Bacon either in the British Museum or in the Record Office; the MS. in question was copied by an unknown man. The following woodcut represents a few lines of the commencement of the MS.

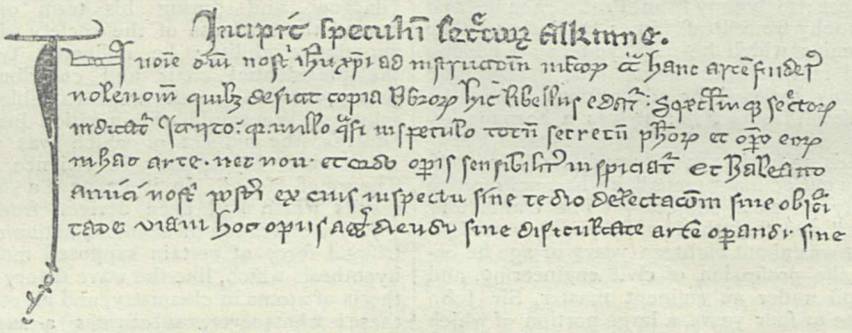


FIG. 8.—Alchemical MS. of the thirteenth century.—British Museum.

The above reads as follows:—"Incipit speculum secretorum alkimiæ. In nomine Domini Nostri Jesu Christi ad instructionem multorum circa hanc artem studere volentium, quibus deficit copia librorum, hic libellus edatur, speculumque secretorum indicatur, idcirco quia in illo, quasi in speculo, totum secretum philosophorum et operatio eorum in hac arte, nec non et ordo operis, sensibiliter inspiciatur. Et habeant amici nostri posteri ex ejus inspectu sine tedio delectationem, sine obscuritate viam hoc opus aggrediendi, sine difficultate artem operandi." The translation is as follows:—"In the name of our Lord Jesus Christ, for the information of the many who wish to devote themselves to the study of this art, and who lack a supply of books, this small manual is published, and is entitled the 'Mirror of Secrets,' seeing that in it, as in a mirror, the whole secret of philosophers and their working in this art—nay more, the process of their work—may be visibly discerned. And may our friendly descendants obtain from the perusal of it unwearied delight, a clear path for taking this work in hand, and a mode of operation unhampered by obstacles."

Among the earlier English MSS. on Alchemy in the British Museum is one which, the Preface informs us, was done "at the instance and prayer of a poure creature, and to the helping of man, I, Malmedis, being at greete uneased in prisone, have thees forseide bokes hidre to itake a hand, and so I shal fynnysshe hit, to God be the laude and preisyng."

The following woodcut (Fig. 9) represents a portion of this MS. relating to mercury*:—

It will be noted that mercury, together with sulphur, and the "rede stoone," is designated the producer of all metals; we also observe an allusion to the Aristotelian theory of the elements (of which an account has been given in the second of these articles) in the assertion that mercury is "hotte and moyste." This MS. is in the Sloane collection, and is well preserved, and written on vellum.

Let us now turn our attention to the dogmas of the alchemists and early chemists, as set forth in the numberless printed books on the subject.

We must bear in mind at the outset that chemistry and alchemy—understanding by the former legitimate inquiry into the nature of different kinds of matter, and by the latter the futile attempts to make gold—existed side by side in the same age, often in the same person. We cannot agree with M. Hoefer when he says, "La chimie du moyen âge, c'est l'alchimie," because some of the early chemists were not alchemists, and the crude processes of the one often led to the exact processes of the other. Lord Bacon in the "De Augmentis Scientiarum," has some very pertinent remarks regarding alchemy:—"Credulity in arts and opinions," he remarks, "is likewise of two kinds, viz., when men give too much belief to arts themselves, or to certain authors in any art. The sciences that sway the imagination more than the reason are principally three, viz., Astrology, Natural magic, and Alchemy. . . . Alchemy may be compared to the man who told his sons that he had left them gold, buried somewhere in his vineyard; where they by digging found no gold, but by turning up the mould about the roots of the vines, procured a plentiful vintage. So the search and endeavours to make gold have brought many useful inventions and instructive experiments to light."

The heritage which the alchemists and early chemists received from the ancients was by no means insignificant; for they possessed all the experience accumulated by the ancients in the various arts and processes which we have before described; and of theoretical matter they possessed, adopted, and prized, the theory of the transmutation of the elements proposed by Aristotle. Of works bearing upon the history of matter they had the writings of Aristotle, Dioscorides, Lucretius, Archimedes, Hero, Vitruvius, and Pliny. Few books are quoted more often in alchemic treatises than the "Natural History" of Pliny; and we sometimes find an almost verbatim transcript of certain portions of this work. The alchemists can therefore scarcely be said to have created a science, for the science of their day is linked with that of the ancients.

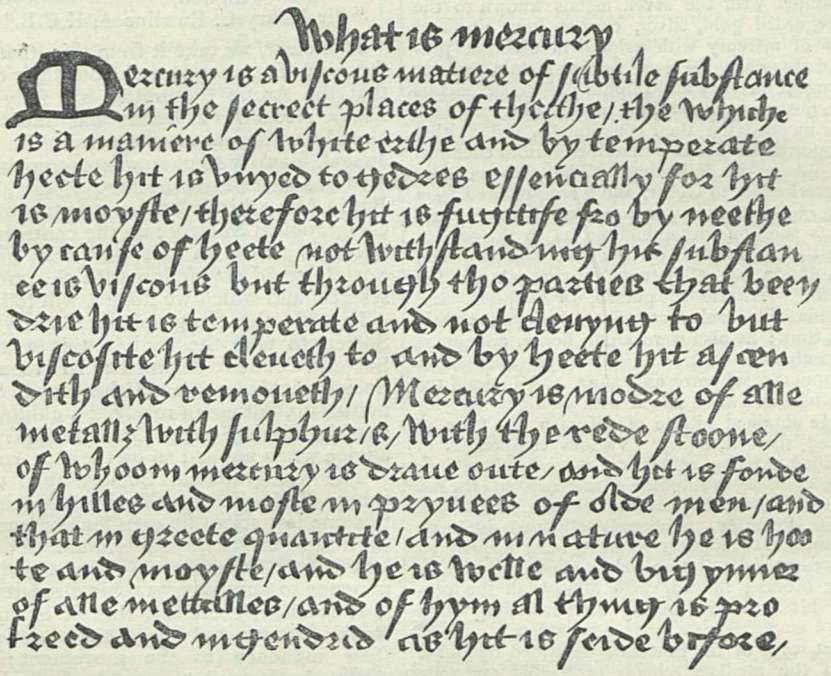
When ancient learning had almost died out, and Europe was, intellectually, in a state of complete darkness, the Arabians were the most cultivated people in the world. It is to Arabia that we must look for the origin of several sciences which we are wont to attribute to other nations. The Arabians instituted universities, observatories, public libraries, and museums; they collected together all the remains of ancient learning, and through their medium the greater number of Greek and Latin authors which were read during the Middle Ages were known to Europe.

In the eighth century the Arabs had full possession of Spain,

* We must express our great indebtedness to Mr. Maunde Thompson, of he British Museum, for allowing us ready access to the MSS. department.

and at a somewhat later date this country possessed the most famous universities in Europe. The Arabs, in propagating their new religion, propagated also the remains of ancient culture, which had already been introduced into Persia and Syria by the Nestorians, who had founded a school of great reputation at Odessa. Again, when Justinian closed the schools of Athens and Alexandria, many of the professors fled to Persia and Arabia, and formed new centres of learning. The works of many authors, including Aristotle, Dioscorides, and Pliny, were soon translated into Arabic and Persian, and became widely diffused. "Ce fut," remarks M. Figuier, "ainsi que de l'Inde jusqu'à l'Espagne, des rivages du Tigre jusqu'à ceux du Guadalquivir, les livres de science se propagèrent parmi des peuples qui avait déjà une littérature, une philosophie religieuse, et qui n'étaient point dépourvus d'imagination."

In the eighth century the University of Bagdad was founded


What is mercury

Mercury is a viscous matiere of subtile substance in the secret places of the erthe, the which is a maniere of white erthe and by temperate heete hit is dryed to thedres essencially for hit is moyste, therefore hit is fuyttife fro by meethe by cause of heete notwithstandyng hit substance is viscous but through the partes that beey drye hit is temperate and not denyed to but viscosite hit eleueth to and by heete hit ascendith and remoueth. Mercury is moore of alle metalle with sulphur & with the rede stoone, of whoom mercury is draue oute, and hit is fonde in hilles and moste in pryueez of olde men, and that in greete quantite, and in nature he is hoote and moyste, and he is wette and bryynge of alle metalles, and of hym al thyng is procreed and engendred as hit is sede before,

Fig. 9.—English MS. on Alchemy.—Fifteenth century.

by the Caliph Al-Mansor, and in the following century it attained a pre-eminent position. A large medical school was connected with it, also hospitals and laboratories. The Caliph Al-Mamoum erected an observatory in Bagdad, and an attempt was made to measure an arc of the meridian. It is said that at one time the University of Bagdad possessed more than six thousand students. In it the sciences found a home, and every scrap of ancient learning was eagerly collected and often extended. When the Arabic empire was broken up by internal dissensions into a number of small states, the University of Bagdad, losing the powerful patronage of the Caliphs, fell into decay, and soon ceased to be known. A somewhat celebrated school arose in Cairo in the tenth century, but we possess but few particulars concerning it.

We soon hear of Spain as a focus of learning. In the tenth century this was the most flourishing country in Europe, both intellectually and otherwise. The University of Cordova possessed great celebrity, and students flocked to it from all parts of the world. It contained a library of between 200,000 and 300,000 volumes, an unusually large collection of books prior to the invention of printing. The Arabians were great mathematicians and astronomers. Lalande places Mohammed-ben-Giaber (better known as Albategnius) among the twenty greatest astronomers who have ever lived. Again, Alhazen wrote a treatise on optics in the eleventh century, and there were many treatises on botany and medicine. The Arabs made but little advance in anatomy however, because they were forbidden by the Koran to mutilate the human body.

After the above remarks it is almost needless to say that we must look to Arabia for the earliest treatises on alchemy and chemistry. Indeed the Arabians cultivated the latter science with success, and the first work on the subject with which we are acquainted was written by Yeber-Abou-Moussah-Djafer-al-Sofi, whom we call Geber, an Arab of the eighth century. There had, no doubt, been writers on chemistry before his time, but probably not long before. We have endeavoured to prove in the preceding article that the Greek MSS. on the "sacred art" are not trustworthy evidences of the early origin of the science; and we cannot tell from what source Geber acquired any of his knowledge. He alludes to no one by name, but we know that

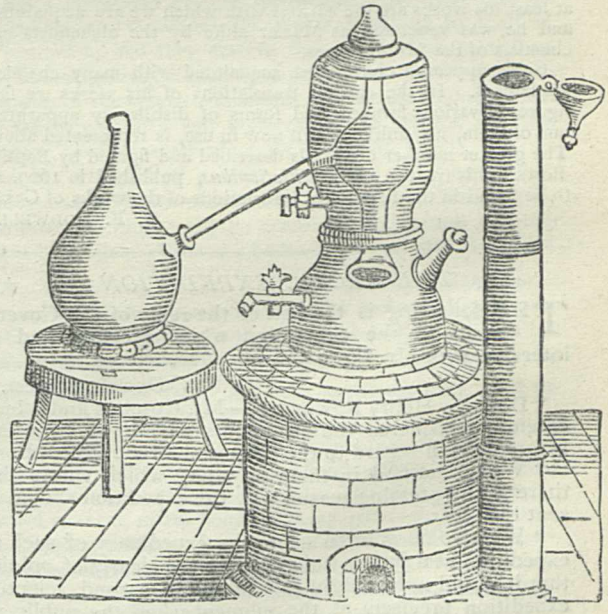


Fig. 10

the Arabians collected knowledge from every source—Egyptian, Indian, Persian, Greek, and Roman. It is thought by some

that Geber acquired some of his notions of chemistry from Egypt.

Several MSS., purporting to contain the writings of Geber, exist in various libraries in Europe; these were translated into Latin as early as the year 1529, and into English in 1678. We have reason to believe that the Latin translation was faithfully done, if the Arabic text be not corrupt. The work consists of four treatises:—(α) Of the search for Perfection, (β) Of the Sum of Perfection, (γ) Of the Invention of Verity, and (δ) Of Furnaces.

Geber was acquainted with the seven metals known to the ancients, and he regarded gold, silver, copper, iron, tin, and lead, as compounds of mercury with sulphur in different proportions. Gold and silver are the most perfect metals, and are composed of the purest mercury and sulphur; the other metals consist of less pure mercury and sulphur, but may be converted into gold and silver by purifying their constituents, and uniting them in different proportions. He also describes various chemical substances, among others the following. The carbonates of potash and soda were known to Geber, and were procured from the ashes of plants. Caustic soda was procured from the carbonate by heating its solution with quicklime, as in the present day. Common salt was purified by ignition, solution, and filtration, and the solution was afterwards evaporated, and the salt crystallised out. Nitrate of potash, or saltpetre, and chloride of ammonium, or sal ammoniac, were apparently common in Geber's time; as also were alum, borax, and green copperas, or protosulphate of iron. Geber procured nitric acid by distilling copperas, saltpetre, and alum, and he used the acid for dissolving silver, and when mixed with sal ammoniac for dissolving gold. He obtained nitrate of silver in the form of crystals, and noticed their fusibility. Various compounds of mercury are described, among others corrosive sublimate or chloride of mercury, cinnabar or sulphide of mercury, and the red oxide of mercury, in which, nearly ten centuries later, oxygen gas was discovered by Dr. Priestley. Geber also obtained sulphuric acid by distilling alum. He appears to have been acquainted with the various processes of distillation, sublimation, calcination, filtration, and many others; indeed, with almost all the processes practised by his successors during the succeeding eight or nine centuries.

It is probable that some of the processes described by Geber were worked out in the medical schools of Arabia, and were known shortly before his time; yet he was himself a patient worker, and often intersperses his descriptions of substances and processes with remarks on the method of experimenting, and the mode of thought most suitable for the studies which he describes. He has often been called the "Founder of Chemistry;" at least his works are the earliest with which we are acquainted, and he was venerated as Master alike by the alchemists and chemists of the Middle Ages.

Geber appears to have been acquainted with many chemical appliances. In the earliest translations of his works we find figures of various furnaces and forms of distillatory apparatus; one of them, not unlike a still now in use, is represented above. The greater number of vessels described and figured by Baptiste Porta in his treatise *De Distillationibus*, published in 1609, are to be found in the first Latin translations of the works of Geber.

G. F. RODWELL

THE ARCTIC EXPEDITION

THE following is the text of the reply of the Government to the deputation which recently had an interview with Mr. Lowe and Mr. Goschen:—

"11, Downing Street.

"Dear Sir Henry Rawlinson,—Mr. Goschen and I have carefully considered the documents which you have laid before us with regard to the proposed Arctic Expedition.

"We do not find in them anything which shows that there is any pressing reason why the expedition should be sent this year.

"We give no opinion as to the expediency of such an expedition at a future time, but we are clearly of opinion that it would not be right to send out a second scientific expedition precisely at the moment when the public revenue has to bear the main burden of the expenses of the operations intrusted to the Challenger.

"I believe it has been erroneously stated that the Challenger Expedition involves very little expense. That is not so. The cost has already been considerable, and nothing has been spared to insure success; there will further be an additional annual outlay for three years.

"Under these circumstances, we regret that we cannot recommend the sending an exploring party to the Arctic Ocean as a Government enterprise this year.

"Believe me, yours very truly,

"(Signed) "ROBERT LOWE.

"Sir Henry C. Rawlinson, K.C.B."

It is clear, we take it from this, that it only remains for the men of science to make out their case, and we believe that the Arctic Committee are fully alive to this. The *Daily News* in a leader has indicated what we had already ventured to suggest as the weak point of the appeal, namely that it was incomplete, and that many men of science knew nothing of the proposed expedition. But in doing this we had no intention to cast a slur upon the Geographical Society; on the contrary we think that that Society's action in this matter is one which the Royal Society could now follow with the greatest advantage to science, and which we hope it will follow.

In 1865 the Geographical Society begged the Royal Society to take the lead in this matter, but the Royal Society Council declined. In 1872 the Geographical Society again entreated the Royal Society to take the matter up, but again received a chilling reply to the effect that the Royal Society Council would be prepared to give advice when applied to by the Government.

The Geographical Society then did the next best thing. It applied to other leading scientific societies, and to some few scientific men for statements of results to be derived from Arctic exploration. These it received and laid before Government, without giving any undue prominence to purely geographical results.

It is clear, therefore, that it is now the duty of the Royal Society and the other societies at once to add their influence to the movement; let a joint committee be formed to report, if need be, to the various councils. In this way the knowledge posessed by all specialists ought to be made available for the common good, so that a complete statement may be forwarded to the Government in the summer to enable the officers of the expedition to be appointed in time to avail themselves of special training.

NOTES

THE recent fusion of the Ethnological and Anthropological Societies under the designation of "the Anthropological Institute of Great Britain and Ireland," not only did good service to science but has financially proved thus far so successful that the Report of the Council for 1872, to be presented to the members next Tuesday evening at the annual meeting, announces a handsome surplus income applicable to the reduction of liabilities incurred in former years. In this promising condition of financial prosperity it is all the more to be deplored that a serious dissension has arisen in the Council in reference to the nomination of a successor to Sir John Lubbock, who, to the universal regret of the members, vacates the presidential chair, under the pressure of parliamentary and other engagements. Touching this matter we have received a copy of a printed statement signed by Mr. Harris and seven other members of Council, which alleges that at a Council Meeting, held on the 17th of last month, Dr. Charnock was placed on the House List for 1873, but that at a succeeding Council Meeting of January 7, this nomination was rescinded and the House List recast with the substitution of Professor Busk as President in the place of Dr. Charnock. This recasting of the List is made a matter of protest, and the members of the Institute, with whom the final decision rests, are appealed to. We need hardly remark that

this appeal is wholly *ex parte*. We understand that the explanation given by the majority of the Council is that the vote of January 7 was a surprise, and as such justified its re-consideration. Now of all our public associations which have for their aim the advancement of scientific truth, the Anthropological can least afford to suffer by internal dissension, and it is earnestly to be hoped that this difference of opinion on the subject of a successor to Sir John Lubbock will be amicably arranged at the forthcoming meeting. The more so as it bears so clearly on the face of it that the interests of science are not in question.

A SCHEME is on foot for the establishment of a County College at Cambridge, and it seems likely to be successful. An address on the subject, with many influential signatures from among the masters, professors, and tutors of the University, has been presented to the Chancellor, the Duke of Devonshire. The County College is intended to combine and assist the efforts that are being made in the various counties of England to extend and raise the standard of middle-class education. The County College students would, as unattached students, be members of the University, but would be generally younger than the present undergraduates, and more strictly looked after. One qualification for admission would be a previous residence of two years in one or more schools accepted by the University, and the having passed the Junior Local Examination. The special branch of the college function would be to prepare teachers for the secondary schools throughout the country. The utmost expense for each student is estimated at 80*l.* per annum, with forty weeks' residence. The cost of the buildings is estimated at 20,000*l.*, which it is proposed to raise by a joint-stock company. Besides other necessary accommodation, the building will contain separate bedrooms for 300 students.

THE annual *conversazione* of the Midland Institute, which has now become one of considerable importance in Birmingham, was held on Tuesday and yesterday, and will be continued this evening, when all the exhibited objects will be thrown open to the students of the Industrial Department. The success of these meetings has considerably affected the prosperity of the Institute, which now adds the *prestige* of fashion to the more solid attractions of its educational usefulness.

WE would draw attention to the further communications on the recent star-shower which we print this week. At the moment of going to press we have received another account of the display as it was seen at Mauritius, which we hope to print next week.

PROF. HUMPHRY commenced his Lectures on Practical Anatomy, on Tuesday, January 14, at 9 A.M., and will continue them daily at the same hour till the 27th, after which they will be continued on alternate days. The course of Lectures on Anatomy and Physiology will be continued on Tuesday, January 28, at 1 P.M., and on Tuesdays, Thursdays, and Saturdays, at the same hour.

THE study of Physiological Botany receives so little attention in this country compared with what it does in France and Germany, that we are very glad to see that the editorial staff of the *Quarterly Journal of Microscopical Science* has been strengthened by the addition of the name of Prof. Thiselton Dyer to those of Mr. J. F. Payne and Mr. E. R. Lankester; an earnest, we trust, that vegetable histology will assume the place it deserves in the programme of the magazine for the future. As a commencement, Prof. McNab of Dublin contributed to the January number an article on "Haustein's Researches on the Development of the Embryo in Monocotyledons and Dicotyledons," which will, we hope, stimulate our young botanists to further research in this little-worked field.

THE Professor of Experimental Physics at Cambridge will lecture on Electrostatics and Electrokinematics during the Lent Term, in the Botanical Lecture-Room New Museum on Tuesdays, Thursdays, and Saturdays, at 12 A.M., beginning Feb. 1.

WE are indebted to the Scientific Editor of *Harper's Weekly* for the following:—Prof. Marsh and party returned on December 7 from the Rocky Mountains and Western Kansas, where they had spent the preceding two months in geological researches. They bring back a large number of vertebrate fossils from the cretaceous and tertiary formations of the West, including many new and interesting mammals, birds, and reptiles. Among the treasures secured during the present trip was a nearly entire skeleton of *Hesperornis regalis* (the gigantic diving bird of the cretaceous), numerous remains of pterodactyls, and a second species of the peculiar genus of cretaceous birds with biconcave vertebræ (*Ichthyornis*). The remains indicate a bird rather larger than *Ichthyornis dispar*, Marsh, but of more slender proportions. It may readily be distinguished from that species by the sacrum, which is proportionally more elongated, and has the cup of the posterior vertebral face more deeply concave. This species Prof. Marsh called *Ichthyornis celer*, and the group of birds now represented by the two species constitute the family of *Ichthyornidæ*.

THE work of Dr. Cowes, just published, upon the birds of the United States, includes a synopsis of the fossil forms supplied by Professor O. C. Marsh, who has made this branch of palæontology a special study. He enumerates no less than 29 species, to which number must be added several others discovered by Professor Marsh in his late trip to the Rocky Mountains. A single kind belongs to the woodpecker tribe, while two are raptorial and three gallinaceous, namely, three kinds of turkeys. Twelve are waders and eleven are swimmers.

WE are very glad to see from a report in *Les Mondes* for January 2, and from a letter sent us by the Abbé Moigno, that his most praiseworthy scheme of popular scientific lectures, instead of being likely to come to an end for want of funds, has taken a new lease of life, and that the *Salles* are now in a fair way to become a permanent Parisian institution. The Abbé and his friends have most disinterestedly spent a large sum to establish the institution, and they deserve the very highest credit and every encouragement in their attempt to provide for the Parisians the means of the best scientific and literary education; for not only are there lectures and *conversazioni* on science, art, and literature provided every night for grown-up people, but the Abbé has inaugurated a series of classes on a comprehensive plan for the higher education of the young. We sincerely hope this wide scheme will be completely successful, and that by-and-by its good effects will be markedly perceptible.

DR. T. ARCHER HIRST, V.P.R.S., F.R.A.S., President of the London Mathematical Society, and Assistant-Registrar in the University of London, is to be appointed Director of Studies in the Royal Naval College now being instituted at Greenwich.

MR. W. SAVILLE KENT has been appointed Curator of the Brighton Aquarium.

THE Octopus in the Brighton Aquarium met with a sad fate on Jan. 7. Finding himself uncomfortable in a tank where he had been newly placed by the curator, he came out, in an unguarded moment, of the house of living oysters he had collected as a shelter round him. In this tank were several large specimens of spotted dog-fish. One of these fish, with the true 'cuteness of a sea-dog, immediately pounced upon the unsuspecting octopus, and swallowed him.—Another novelty has been introduced into the Brighton Aquarium, viz., the apparatus for carrying on salmon and trout hatching. The trout from the Trent are thriving splendidly.

APROPOS of the preceding, MR. J. G. George, of Nassau, Bahamas, describes in the *American Naturalist* for December 1872, a gigantic Octopus, measuring 10 ft. long, and each arm 5 ft., the weight being estimated at between 200 and 300 pounds. The monster was found dead upon the beach and bore marks of injury. Mr. George adds that this is the first specimen he has seen during 27 years' residence in Bahamas, although they are traditionally of immense size.

M. E. REVERCHON, naturalist, of Briançon, Hautes Alpes, France, offers to supply or to complete collections of the plants of Dauphiny and the south of France.

THE first ordinary meeting of the new Medical Microscopical Society will take place at the Westminster Ophthalmic Hospital on the 17th inst., at 8 o'clock, when the President, Mr. Jabez Hogg, will give an introductory address.

THERE has just died at Paris M. Olivier Charles Camille Emmanuel, Vicomte de Rougé, Professor of Archæology in the Collége de France, and keeper of the Egyptian Museum in the Louvre, aged upwards of 61 years. He was the most eminent of French Egyptologists.

MR. F. J. WILLIAMSON has received a commission to execute a statue of Dr. Priestley, to be erected in Birmingham. It will be 8 ft. high, and in white marble.

A COMPANY has been recently started in Glasgow for the manufacture of asbestos into steam packing, for which purpose it has been found to exceed in durability and general usefulness every other material hitherto employed. The company, we believe, intend to put this hitherto unworkable material to a variety of other uses, it having been found, the *Glasgow Herald* says, perfectly practicable to manufacture asbestos boats, tubs, boxes, waggon bodies, and even railway carriages.

MR. EDWARD THOMAS, F.R.S., late of the East India Company's Bengal Civil Service, has been elected corresponding member of the French Academy, for his contributions to Oriental numismatic archæology.

DR. G. ISCHERMAK, Director of the Imperial museum of Mineralogy of Vienna, has published a catalogue of the meteorites in the museum up to October 1, 1872. The collection is arranged according to the system of MM. G. Rose and Rammelsberg.

WE learn from the *Athenæum* that Prof. A. C. Ramsay, of the Geological Survey of the United Kingdom, has been elected Associate of the Royal Academy of Science, Belgium.

THE Institution of Civil Engineers has now been in existence fifty-five years, having been established on January 2, 1818. It was incorporated by Royal Charter on June 3, 1828, and the numbers of the several classes constituting the corporation on the 1st inst., were 16 Honorary Members, 759 Members, and 1,151 Associates, with a class of Students attached of 267, together 2,193. Ten years ago there were on the books 20 Honorary Members, 413 Members, 574 Associates, and 10 Graduates, together 1,017 of all grades. The class of Graduates was abolished in the year 1867, when the class of Students was instituted.

THE Government have agreed to the request of the *Daily Telegraph* to grant Mr. George Smith leave of absence for the purpose of proceeding to the East in order to make further discoveries among the Assyrian ruins. The sum placed at Mr. Smith's disposal in the meantime by the proprietors of the *Telegraph* is 1,000 guineas, and they anticipate that within six months he will be able to accomplish much. Whatever relics may be the result of the excavations, will be presented to the British Museum.

AN unusually large number of Journals connected more or less intimately with science, have been started this new year. One of them is the *Irish Hospital Gazette*, intended to fill up the place left vacant by the *Dublin Hospital Gazette*, and to be especially a medium for the investigations of the physicians and surgeons of Ireland. The first number is a good one, and we hope the journal will meet with encouraging support.

ACCORDING to the correspondent of the *New York Herald*, an ingenious plan has been adopted by Prof. Agassiz's expedition for determining how far the submarine regions are pervious to light. A plate prepared for photographic purposes is enclosed in a case so contrived as to be covered by a revolving lid in the space of forty minutes. The apparatus is sunk to the required depth, and at the expiration of the period stated is drawn up and developed in the ordinary way. It is said that evidence has thus been obtained of the operation of the actinic rays at much greater depths than hitherto supposed possible.

The number for January 4 of the *Revue Scientifique* contains the translation of a long and remarkably clever paper by E. von Hartmann, the purpose of which is to show that the differences between the animal and vegetable kingdoms are very much fewer than is dreamt of in the most generally accepted philosophy, that these kingdoms ought not to be classed as subordinates, but as co-ordinates, and that there is great likelihood that plants are capable in some degree of sensation and perception.

DR. EUGENE ROBERT, in *Les Mondes* for January 9, ascribes the disappearance of the fallen leaves of autumn to multitudes of earth-worms, which drag them into their underground galleries by means of the crooked hairy appendages with which their foremost rings are provided.

THE two principal articles in the *Revue Scientifique* for January 11, are a translation of part of Prof. Tyndall's recent work on "Glaciers and the Transformations of Water," and of Mr. J. Evans' paper on "The Alphabet and its Origin."

THE two principal papers in the *Moniteur Scientifique Quesneville* are "On the Respiration and the Nutrition of Vegetables," by M. Ch. Blondeau, in continuation of three previous ones, and the eighth and conclusive paper by M. Emile, "On Anthracite and its Derivatives." M. Blondeau concludes from his inquiries that vital force is essentially the same, and manifests itself in similar effects, whether it animates vegetables or animals, and regards as a popular delusion the belief that plants decompose and restore purified to the atmosphere the carbonic acid which results from animal respiration.

THE first annual report of the Society of Telegraph Engineers shows that it is prosperous, and is doing good work.

WE have received a second edition of "A Catalogue of the Birds of Kansas," contributed to the Kansas Academy of Science, by Mr. F. H. Snow, Professor of Natural History and Meteorology, in the University of Kansas. It contains 282 entries and seems carefully compiled.

THE *Memorie della Società degli Spettroscopisti Italiani* for September contains Father Secchi's paper on the Variations of the Solar Diameter, illustrated by a carefully drawn diagram. A translation of this paper is the first article in *Der Naturforscher* for December, most of the other articles being translations from the *Comptes Rendus*, *Poggendorf's Annalen*, the *American Journal of Science*, and the published proceedings of foreign societies.

FURTHER DETAILS OF THE RECENT METEORIC SHOWER

WE have received the following further communications having reference to the recent meteoric shower. The first is an extract from a letter by Prof. Herschel :—

"Some light on the real extent and form of the radiant region will, I feel sure, be thrown as time brings fresh additions to the already great stock of information about its apparent place and features from so many observers, and from such widely distant quarters; and the knowledge so gained would be of inestimable value in clearing up the difficulties that surround the general question of the *unsettled radiation* of many meteor showers; from knowing the origin of this stream we might learn how far sporadic shooting stars may be derived from special showers of well-determined radiant points and of regularly foreseen returns. I have just received from Professors Newton and Heis in America and Germany long printed reports on their observations, which contain, I have no doubt, interesting details and speculations; but I have not yet perused them sufficiently to gather any particular idea of their contents. Capt. Tupman also wrote to me to-day, pointing out what had struck me, that the comet found by Mr. Pogson does not agree well with the contemporaneous place of the meteor-cloud through which the earth is supposed to have passed, unless its considerable distance from that place is really a proof of the extraordinary deflection of its path by the earth in its passage near it, which will make it most interesting to inquire what will become of the *new* comet in future. Two observations, which seem to be all that Mr. Pogson could obtain, are unfortunately not enough to determine its new orbit, and its 'periodic time' will therefore give us no hint as to its probable return. Capt. Tupman even suggests (to account for its '*unconformable motion*' between the first and second observation), that perhaps comet I. of the pair was seen by Mr. Pogson in his first, and comet II. of the belated Biela's couple in his second night's observations. The comet, if it is really Biela's, was, in that case at least, two months behind its time, or as Capt. Tupman says, *twelve weeks*, and it must have been 'loitering' somewhere on its path. Prof. Grant, who wrote to me to-day, says that he will send me in a few days the list of tracks of the meteors which he mapped during the shower at Glasgow, and I have no doubt that this contribution will be a very valuable addition to my 'working charts' of these strange legions.

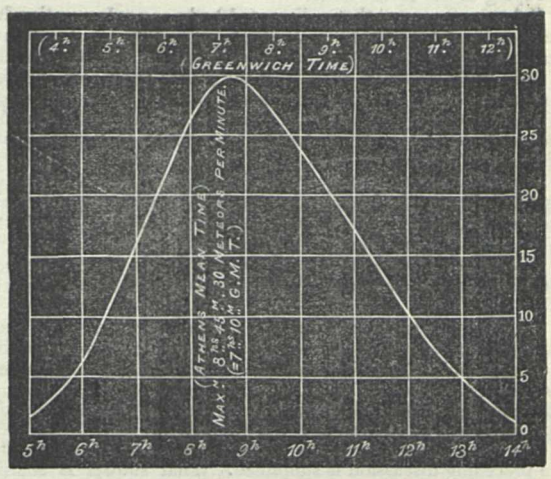
"I see that I have made a mistake in my list of 'radiant-points,' (No. 30 reading thus — 'A.D.P., Newcastle-on-Tyne,' &c. 'close to if not coincident with Mirach (γ Andromedæ).' This is a mistake, as Mirach is not γ, but β Andromedæ, and this radiant-point is therefore altogether misplaced in the list. I should like A.D.P.'s observations to be left out altogether and the observation of Mr. Van de Stadt substituted for it, thus—

No.	Observer	Place	h. m.	R.A. N.D.	Position
30	H. van de Stadt	Arnhem (Holland)	6.30 to 8.45	29 —41°	Andromeda

"The numbers in M. Denza's observations (immediately preceding it) should be changed to R. A. 29°, Decl. 41°; the R. A. and declination of the star γ Andromedæ, which I have only just now ascertained exactly.

"Prof. Heis publishes (in the Münster *Wochenschrift für Astronomie*, &c., of December 11, 18, and 25) twelve descriptions of the shower by observers at Göttingen, Dantzig, Lichtenberg, Cornorn (Hungary), Athens, &c. Those at Göttingen by Mr. Heidorn and Prof. Klinkerfues and at Athens by Dr. Schmidt are the most interesting. Prof. Klinkerfues relates that after determining the place of the radiant-point with the greatest precision at R.A. 26°, N. Decl. 37° from the projected courses of 80 meteors carefully mapped, and calculating from them the *parabolic* elements of the meteor-stream (which he gives with the radiant-point), in the usual way, he then *only accidentally* recognised its resemblance to, and evident identity with Biela while telegraphing a short note and transmitting a full account of the Göttingen observations to Dr. Heis. No wonder that at such an unexpected discovery he should have been immediately prompted to send to some observer of the southern hemisphere his famous telegram, '*Biela touched earth*, &c., look for it near θ Centauri!'

"Schmidt, at Athens, watched the shower for 9 hours uninterruptedly, from 5h. 30m. to 14h. 30m., and gives a complete curve of frequency for the whole time (in numbers for the 'four practised and two unpractised observers,' who undertook the counting) reduced to hourly numbers for a position of the radiant-point in the zenith at intervals of successive hours. On this figure I have merely altered the scale so as to exhibit his



Curve of average frequency of Shooting Stars per minute seen by four practised observers at Athens, Nov. 27, 1872. J. F. SCHMIDT

[In Athens mean time, 1h. 35m. fast on G.M.T.]

result in numbers per minute, instead of numbers per hour during the whole time. His more complete account of the shower was sent to the *Astronomische Nachrichten*, and he fixed the place of the radiant-point at R. A. 22°·5, N. Decl. 42°·5."

The following has been forwarded to us by Prof. H. A. Newton :—

"Dr. Weiss, of Vienna, who first pointed out in 1868* the probable connection between Biela's comet and the meteors seen December 6, 1798, by Brandes, and December 6, 1838, by Mr. Herrick, gives the radiant for meteors following the path of that comet as R.A. 23·4°, N. Decl. 43·0°. I assigned a point 3° from γ Andromedæ as the centre of the radiant of the meteors, or about R.A. 25·3°, N. Decl. 43·3°. The longitude of the node of Biela's comet was in 1852, according to Hubbard, 245° 51′, and the comet would pass about a million of miles from the earth's orbit, between it and the sun. We passed that place of the node early Wednesday evening, November 27. There can hardly be a doubt, therefore, that these meteors were once fragments, or companions, of that comet.

"Any theory that shall explain the formation of the present grouping of meteoroids must account for the magnitude and shape of the radiant areas. If the members of a group have nearly the same orbit, the radiant should be a point. But the area of the radiant, November 24–27, was at least 8° long. This implies that the orbits differ considerably, either—(*a*) in their inclinations to the ecliptic; (*b*) in their major axes; (*c*) in the longitude of perihelion; or, in two or three of these elements combined.

"The shower ended abruptly on Wednesday evening, and in the clear evenings that followed nothing special was to be seen. Similarly marked limits are not uncommon in other showers. The orbits must then either be approximately in a plane or there must be a common node in the ecliptic, where the earth meets them. Such a node would point unequivocally to the earth as the body that originally scattered the comet.

"If, as seems more probable, the orbits, however, lie nearly in one plane, either the major axes, or the longitudes of the perihelia, must differ widely. Neither of these conditions could be

* Sitzungsberichte, vol. lvii.

satisfied, so far as I can see, by a group formed from the dispersion of a comet by Jupiter, or other large planet. If the fragments of the comet leave the neighbourhood of Jupiter, they should after each revolution return nearly to the same point in space. But a radiant area 8° or 10° long. on the night of November 27, implies a distribution of the aphelia over 10° or 12° of longitude, or a similarly large difference of major axes. Such orbits can hardly have a common point at a great distance from the sun. Moreover, a scattering accomplished in a short time upon a body moving in an orbit inclined several degrees to the ecliptic should, it would seem, be incompatible with a grouping at the earth's node.

"Again, suppose that a disrupted body or agglomeration has been once changed into a stream by the differential action of gravitation in the manner shown so beautifully by Schiaparelli. If the perturbing forces exerted by any planet or planets, whether temporary or long continued, should produce such differences of major axes, or longitudes of perihelia, by differential action, the total action would, undoubtedly, entirely scatter the group at the earth's nodes.

"In fact, instead of regarding the meteors as a stream, we ought rather to look upon the group as coming together near the perihelion—or near the node—and then scattering widely, to reassemble, perhaps, after a complete revolution in the orbit.

"A resisting medium cannot account for the observed effect, for this does not change the longitude of the perihelion of the orbit.

"It seems to me, therefore, that the periodic meteors cannot have been brought into the solar system as a stream, but that the forces which have scattered the comets are those acting near the perihelia of their orbits. As a probable corollary, we may infer that whatever force divided Biela's comet into its two principal parts was one acting near the perihelion.

"If we consider the orbits of the meteors of November 14, the preceding discussion is simplified. That shower is sharply limited, being in its greatest intensity only one or two hours long. Its recurrence at regular intervals of one third of a century, for nearly a thousand years, precludes great differences of the major axes of the individual orbits, and the secular procession of the node of the group, *as a group*, equally forbids great differences of inclinations of the orbits.

"The size of the radiant is therefore due almost exclusively to the difference of the longitude of the perihelia. This difference for that group cannot be less than 15°.

"In conclusion I would say that we have no evidence, as yet, that any radiant of meteors is so small as is apparently required by the supposition of the distinguished Italian astronomer, that the meteors were drawn as a stream into the solar system from the stellar spaces. With Prof. Weiss and others, I am inclined to consider them all to have been once connected with periodic comets. The scattering took place apparently at or near the perihelion."

THE NATIONAL HERBARIA

THE following memorial has been transmitted to the First Lord of the Treasury on the above subject :—

"*To the Right Hon. W. E. Gladstone, First Lord of the Treasury.*

"SIR,—The undersigned persons engaged in the pursuit of botany, or in instruction therein, desire to call your serious attention to a subject that deeply concerns the progress of Natural Science, and that of those branches of agriculture, horticulture, forestry, and manufactures that largely depend on botanical research.

"The First Commissioner of Works, in a Memorandum presented to Parliament before the close of last session, clearly raised the question whether it is desirable to transfer to the branch of the British Museum about to be constructed at South Kensington the Scientific Collections and Library now existing at Kew, and further stated that, pending the decision on that subject, he considers it his duty to take care that no new expense shall be incurred at Kew which will embarrass the Ministers of the Crown or the House of Commons in arriving at a decision.

"The Lords of the Treasury, in their Minute of the 24th July, decline to refer to that portion of the above-mentioned Memorandum, and no statement on that subject has since been made by any Minister of the Crown which shows whether it has received the attention of the Government.

"Being strongly of opinion that the proposed measure would be highly detrimental to the progress of science, and injurious to all those interests that depend upon it, we beg to urge upon you that the subject is not one merely of departmental interest, and that it would not be unfitting your position, as First Minister of the Crown, to give your consideration to the following reasons which we beg to urge in opposition to the proposed measure :—

"1. That it appears to us that it is absolutely necessary that a great Botanical Garden like that at Kew, which is confessedly far the most important in the world, should be in close connection with as perfect an Herbarium and Botanical Library as possible, and that these conditions are now fulfilled as far as circumstances and the present state of science will admit.

"2. That such a combination of living and dead specimens is requisite for the complete study of plants, as regards their technical, physiological, and economic characters; and that the removal of the Herbarium would be a retrograde step in a scientific point of view.

"3. That the records of the Colonial and India Offices will show of what immense importance the establishment at Kew has been to the welfare of the entire British Empire, and that weighty questions are constantly submitted to the Director which require immediate attention, and which could not, in many cases, be satisfactorily answered without reference to the Library or Herbarium.

"4. That every facility for the investigation of the intimate structure and general habits of plants, and the study of them in every point of view which can reasonably be considered within the scope of pure Botany, is afforded by the Herbarium and Museum of Botany in connection with the Garden, and that it would be easy to point out important labours in that direction which have been instituted at Kew, while the systematic treatment has always regarded the more minute characters as well as those which are superficial.

"5. It has been remarked, indeed, that important works, such as the 'Hortus Kewensis,' have been prepared without the aid of an Herbarium at Kew. We would, however, remark that the statement is not correct, as there was an Herbarium, which was dispersed before Sir W. Hooker became Director; and the conditions of Natural Science are at the present time so completely altered that it is impossible to institute any fair comparison, the number of known species being enormously increased since the date of the publication in question.

"6. That the Museums of Structural and Economic Botany, which owe their existence and importance to the late Sir W. Hooker, are often found of great value in the decision of critical points in the study of species, and that the severance of them from the Herbarium and Library would be a serious loss.

"7. That in the principal Botanic Gardens on the Continent, where effective work is done, there is in every case a large herbarium connected with them.

"8. That, in the interest of Botanical Science, we think it highly desirable that, besides the collections now existing at Kew, an Herbarium, or collection of dried plants, as complete as possible, should be maintained in connection with the Natural History Museum which it is proposed to place at South Kensington, and that the two Herbaria should be in intimate relation with each other.

"9. That from the delicate and perishable nature of its contents, and the necessity of referring to numerous specimens, an Herbarium cannot be made use of by many persons at the same time; and while it is desirable that students should have ready means of access at the National Museum in London to collections which may enable them to identify the plants of any particular country, it is still more essential that the authors of important works in Botanical Science should be enabled, as at present, to pursue their labours at Kew without interruption from casual visitors.

"10. That an Herbarium is the least costly of all collections of Natural History, and that which requires the least amount of space for its proper maintenance, in proportion to the number of objects which it contains.

"11. That the arrangements of the Herbarium at Kew are so perfect, and the facilities for study so great, that it is resorted to from all parts of the world; and it would therefore be unwise to make a change which in the result is almost certain to be detrimental, and which, we are assured, would be especially distasteful to the leading foreign botanists.

"M. J. Berkeley, F.L.S., Botanical Director to the Royal

Horticultural Society; Charles C. Babington, F.R.S., Professor of Botany, Cambridge; M. A. Lawson, F.L.S., Professor of Botany, Oxford; J. H. Balfour, M.D., F.R.S., Professor of Botany, Edinburgh; Alexander Dixon, M.D., Professor of Botany, Glasgow; G. Dickie, M.D., F.L.S., Professor of Botany, Aberdeen; E. Perceval Wright, M.D., F.L.S., Professor of Botany, Dublin; Robert Bentley, F.L.S., Professor of Botany, King's College and Pharmaceutical Society of Great Britain; W. T. Thiselton Dyer, B.Sc., F.L.S., Professor of Botany, Royal Horticultural Society, London; R. O. Cunningham, M.D., F.L.S., Professor of Botany and Zoology, Belfast; W. R. McNab, M.D., Professor of Botany, Royal College of Science, Dublin; George Henslow, F.L.S., Lecturer at St. Bartholomew's Hospital and Royal Agricultural College, Cirencester; John Ball, F.R.S.; Maxwell T. Masters, M.D., F.R.S.; James Bateman, F.R.S.; R. Trevor Clarke, F.R.H.S.; W. Wilson Saunders, F.R.S.; Geo. F. Wilson, F.R.S.; Robert Hogg, LL.D., F.L.S., Pomological Director to the Royal Horticultural Society; W. Sowerby, F.L.S.; D. Moore, Ph.D., F.L.S.; Andrew Murray, F.L.S.; William Munro, Major-General, C.B., F.L.S.; M. Pakenham Edgeworth, F.L.S.; John Miers, F.R.S., V.P.L.S.; Frederick Currey, F.R.S., Sec. L.S.; Daniel Hanbury, F.R.S., F.L.S.; C. E. Broome, F.L.S.; Leonard Blomefield, F.L.S.; J. T. Boswell Syme, LL.D., F.L.S.; Hugh Cleghorn, M.D., F.L.S.; Clements Markham, C.B., F.L.S.; R. C. A. Prior, M.D., F.L.S.; Edward J. Waring, M.D., F.L.S.; George C. M. Birdwood, M.D.; Walter Elliot, K.C.S.I., F.L.S.; J. Forbes Watson, M.D., F.L.S.; Richard Strachey, Major-General, C.S.I., F.R.S.; E. W. Cooke, R.A. F.R.S.; Robert Braithwaite, M.D.; William Mitten, A.L.S.; W. Allport Leighton, F.L.S.; William Phillips; John Goucher, F.L.S.; J. Leicester Warren; Worthington G. Smith, F.L.S.; M. C. Cooke; James M. Crombie, F.L.S.; Alfred W. Bennett, F.L.S.; V. G. More, F.L.S.; Thomas Moore, F.L.S., Floricultural Director to the Royal Horticultural Society; Thomas Thomson, M.D., F.R.S., late Superintendent Royal Botanic Garden, Calcutta; Charles Darwin, F.R.S.; George Bentham, F.R.S.

SCIENTIFIC SERIALS

THE *Journal of Botany* for November, 1872, commences with a paper by Prof. Thiselton-Dyer, on an intricate point of vegetable histology, "Tyloses," or the cellular filling-up of vessels, with a plate. Critical botany is represented by two articles, on *Dasylirion* and *Beaucarnea*, by Mr. J. G. Baker, and notes on some Scandinavian plants, by Dr. Trimen; and geographical botany also by two—"The Influence of Insect Agency on the Distribution of Plants," by Mr. A. W. Bennett, and notes respecting some Birmingham plants, by Mr. Jas. Bagnall. Among the extracts is a very interesting one on some southern plants observed in the environs of Paris in 1871, being an account of the species added to the flora of the neighbourhood of Paris by the German invasion, amounting to 190. In the December number Dr. Trimer records and draws a recent addition to the British flora, *Psamma baltica;* and the whole of the remaining original articles relate to cryptogamic botany—the Rev. Jas. Crombie discourses on lichens, the Rev. P. O'Meara on Diatoms, Mr. J. G. Baker, on a new *Asplenium* from Cape Colony, and H. Boswell, on the mosses of Oxfordshire. A large portion of the number for January, 1873, is occupied by a lengthy and interesting biography, accompanied by a portrait of the African traveller, F. Welwitsch. The remaining original articles include a contribution to the subject of the "Influence of Insect Agency on the Distribution of Plants," by Dr. Buchanan White, a valuable and suggestive paper by Prof. M'Nab, and a description by Mr. J. G. Baker of some new ferns from Lord Howe's Island. The short "Notes and Queries" are not the least interesting part of these three numbers.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 9.—"Further Remarks on the Sense of Sight in Birds," by Robert James Lee, M.A., M.D. He thinks it would be premature to enter upon general deductions until the data we possess are more numerous, and the anatomical details are generally allowed to be correct. Since his last communication he has received much assistance and valuable information from Mr. Hulke, who has directed considerable attention to the structure of the ciliary muscle in birds. In order to show the different degrees of development of the ciliary muscle, he drew up a short table containing those specimens which have been examined with most attention. For the present he considers the ciliary muscle as a simple structure for the production of one effect, whatever minute differences may exist in the internal arrangement of its fibres. According to the table the axis of vision in the Eagle Owl is 3·7; Vulture, 3·1; Buzzard, 4; *Rhea americana*, 3; Flamingo, 9; Penguin, 6; Andean Goose, 4; Vieillot's Pheasant, 6; Wood Francolin, 4 6; Canada Goose, 5; Hawk-headed Parrot, 4; Spotted Dove, 7; Grouse, 4; Partridge, 4. A second table is a continuation of that commenced in his last communication, and is intended to furnish certain data which are necessary for the determination of the visual powers in various species of birds.

"On the Union of Ammonia Nitrate with Ammonia." By Edward Divers, M.D.

Ammonia nitrate deliquesces in ammonia gas at ordinary temperatures and pressures, forming a solution of the salt in liquefied ammonia. To prepare the product, it is only requisite to pass dry ammonia gas into a flask containing the dry nitrate; but the condensation proceeds more rapidly if the flask is surrounded with ice. The liquid obtained varies in composition according to the temperature and pressure. The liquid boils when heated, and, when nearly saturated with nitrate, deposits crystals of it when cooled—just like an aqueous solution. It can also, like an aqueous solution, be heated above its boiling-point without boiling, and become supersaturated with the salt without crystallising. When poured out into an open vessel, it becomes almost instantly gelatinous in appearance—may, indeed, become so as it falls in a stream from the flask containing it. This effect is due to evaporation of ammonia and solidification of nitrate at the surface of the liquid; on breaking the crust of nitrate, the compound flows out as liquid as ever. It is not caustic to the dry skin. During its decomposition cold is manifested, and during its formation heat is evolved, but not to a great extent, because the heat given out by the liquefaction of the ammonia is nearly all used up in the liquefaction of the nitrate. Its specific gravity can be calculated from its composition, by taking for the purpose 1524·5 as the specific gravity of the nitrate, and 671 as that of the ammonia. In its rate of expansion by heat, the liquid resembles others that exist as such at ordinary temperatures, rather than those that, like ammonia itself, are only retained as such by great pressure. Its expansivity increases with the quantity of ammonia present. Its action upon a great number of substances, principally inorganic, has been tried, and found to be for the most part like that of ammonia (in the absence of water) and ammonia nitrate conjoined. The nitrate appears to undergo double decomposition with most salts, and the ammonia to unite with nearly all of them, including those of magnesium, aluminium, iron, and manganese. It is a good electrolyte, ammonia and hydrogen appearing at the negative electrode, and nitrogen and ammonia nitrate at the positive electrode.

Anthropological Institute, Jan. 7.—Sir John Lubbock, Bart., F.R.S., in the chair. A paper by the late J. W. Jackson was read on the Atlantean Race of Western Europe. The chief aim of the author was to controvert the largely accepted opinion that the dark Atlantean race was of Turanian origin.—A paper by Dr. John Shortt on the Kojahs of Southern India. The true Kojahs or Eunuchs are chiefly seen about the houses of wealthy Mussulman nobles, by whom they are placed at the head of their harems. Sometimes they hold important charges with a considerable amount of control. The ladies of the harem look upon them as their confidential advisers in all matters relating to their personal concerns. The second class of Eunuchs are called Higras or natural Eunuchs, who dress like and ape the manners of women, and are for the most part utterly worthless characters. The paper entered into minute details respecting the physical characters and habits of that strange class of men.—A joint paper by M. H. Gerber and Capt Butler on the Primordial Inhabitants of Brazil, was also read. It contained valuable and full statistical information as to the populations of the provinces; the occupations of the inhabitants, their industry and productions; the mineral wealth of the country, agriculture, manufactures, and colonisation.

Geologists' Association, Jan. 3, 1873.—The Rev. J. Wiltshire, F.R.S., president, in the chair. "On the Cambrian Rocks of Ramsey Island, St. David's;" Henry Hicks. In an exposed coast section which occurs at the north end of Ramsey Island, the three important groups of strata known under the names Lingula Flags, Tremadoc, and Arenig groups are seen resting on one another in the order of their succession, and are probably better exhibited than at any other place in Wales. The two first groups are those now usually recognised as forming the upper part of the Cambrian, and the latter as the lowest group of the Silurian system. This section is therefore at considerable importance bearing on classification, as it shows clearly the relation of the groups to each other. The Lingula Flags occur as hard siliceous sandstones with grey flaky slate, and dip under the others at an angle of about 60°. They contain the usual *Lingulella Davisii*, in great abundance; also a trilobite of the genus Nesuretus, Sophyton, a supposed land-plant, and numerous worm tracks. The beds are frequently ripple-marked, and give indications of having been shore or shallow water accumulations. The Tremadoc group rests quite comfortably on the Lingula Flags, and at first the beds are much like those of the latter in their lithological characters, but afterwards they gradually assume a darker and more flaggy appearance. Fossils are very plentiful in these beds, and numerous new forms come in. Amongst these may be mentioned the Lamellibranchs, Starfishes, and Encrinites. The tribolites belong to the genera Niobe and Nesuretus. A gentle and gradual depression of the sea-bottom was evidently taking place during the deposition of this group. Resting upon the last-mentioned is the Arenig group, a series of black, iron-stained slates and flags, and with a fauna wholly distinct from that of the Tremadoc group. The Graptolites come in here for the first time, as well as the genera Æglina, Trinucleus, and Ogygia. In many respects the fauna resemble that of the Quebec group of Canada. For the deposition of these beds a deep and decided depression of the sea-bottom must have taken place, and if the succession here is broken, this must have been sudden. It is probable, however, that a fault has passed along the strike of the beds, and that this has removed the series which should have intervened to connect them more closely, lithologically and palæontologically. As far as can be made out by the section, the boundary line between Cambrian and Silurian should certainly be placed above the Tremadoc group as exhibited at St. David's (the upper part of the Tremadoc group of North Wales will doubtless have to be included in the Arenig group) and below the Arenig group.

LEEDS

Naturalists' Field Club and Scientific Association, Dec. 10.—A paper was read by Mr. W. D. Roebuck upon the habitations constructed by hymenopterous insects, with a few remarks upon so-called parasitism, as observable among the British bees. This subject furnishes some noteworthy evidence bearing upon the question of "protective resemblance." When the bee infested by a parasite is social in its economy, and the nest is consequently never entirely deserted, the parasite assumes the colouring of its host, and is thus enabled to deceive and elude the sentries. On the other hand, if the bee attacked is of solitary habits, the female is consequently and necessarily absent when collecting her pollen and honey. This temporary absence is taken advantage of by her parasite, which does not therefore need any protection; and we accordingly find that in every case the solitary bee and her parasite are most strikingly dissimilar in appearance.

EDINBURGH

Botanical Society.—Nov. 14, 1872. The President, Prof. Wyville Thomson, delivered an address, giving biographical sketches of several of the deceased members. He then gave an address on "Fermentation and Putrefaction," which appeared in NATURE, vol. vii. p. 61. Mr. Adam Smith, Melbourne, sent a notice regarding the native bread fungus of Australia. It grows in large tubers, clusters of which are found connected together by small fibrous roots. The largest in a cluster is fully as big as a man's head, the others of smaller sizes. When cut they present the appearance of rice pudding, but although esteemed as a great delicacy by the Aborigines, they are too tasteless and insipid to become valuable for food.—Mr. John Sim noticed the occurrence of *Bupleurum rotundifolium* as a weed in a cottage garden near Perth.—Mr. Sadler exhibited specimens of a species of Lupinus, resembling *L. luteus*, which he found growing in a turnip-field near Blackshields, about 16 miles from Edinburgh, the seeds having probably been introduced with guano.

December 12.—Alexander Buchan, M.A., Vice-President, in the chair.—Mr. James M'Nab, Curator of the Royal Botanic Garden, took the chair as president, in room of Professor Wyville Thomson. "On the Organisation of Equisetums and Calamites," by William Ramsay M'Nab, M.D., Professor of Botany, Royal College of Science, Dublin. The general conclusions arrived at by the author were:—1. The stem of Equisetum differs but little in construction from that of Calamites. 2. In both Equisetums and Calamites the fibro-vascular bundles are but poorly developed. 3. The mass of tissue (woody wedges of Williamson) forming the most important part of the stem, consists of the small fibro-vascular bundles with the addition of a large quantity of thickened parenchyma and prosenchyma (sclerenchyma Mettenius). 4. The sclerenchyma (Mettenius) is part of the cortical tissues, and not a particle of the fibro-vascular bundles. 5. There is no evidence of any growth having taken place in the fibro-vascular bundles comparable to that observed in the dicotyledons. 6. If the stems of Calamites increased in diameter, it was by large additions to the cortical tissues and not to those of the fibro-vascular bundles. The President, Mr. James M'Nab, read a communication on the Disfigurement of Hedge-row Trees by telegraph wires. He thought the cropping of trees for telegraph purposes should be entrusted to some experienced gardener or forester, and not left to the mercy of men to cut and clear away as if paid by contract on the mile of clearance done.—"Notice of the occurrence in England of *Psamma baltica*, R. et Sch." By Philip Maclagan, M.D. The addition of *Psamma baltica* to the British Flora is due to Mr. William Richardson, of Alnwick. Returning one evening in August 1871 from the Holy Island towards Belford, and finding the sand wet, he betook himself to the "bents," not to botanize but to get firmer footing. He had not proceeded far when he met with the stranger growing side by side with *Psamma arenaria*. Afterwards he found it growing in patches at intervals along the coast for upwards of three miles.—Dr. John Kirk, Zanzibar, presented to the University Herbarium a collection of dried plants from the highest zone of vegetation in the Kilimanjaro, below the line of perpetual snow that crowns the summit. The Kilimanjaro is about 20,000 ft. high, in the country of Jagga, East Africa.

BOSTON, U.A.S.

American Academy of Arts and Sciences, Nov. 27, 1872.—Dr. Henry J. Bowditch alluded to a case of aortic aneurism, in which he had with the assistance of Dr. J. C. Warren, and Dr. J. J. Putnam, used electricity for the treatment of this usually fatal disease. The patient, an adult man, had a pulsation distinctly felt in the second right intercostal space, which last, with the parts adjacent, was slightly prominent, but not effaced. The respiratory murmur was free throughout both lungs, save in this part, and there it was bronchial to the extent of two or three inches; dull percussion in the same.

Two operations were made, viz. on November 12 and 17, 1872. Three needles coated with vulcanite were used at each operation. They were introduced about an inch from the first, and from an inch and a quarter to an inch and a half at the second operation. They evidently were introduced into a freely moving current at the first—as seen by the widely moving needle ends—but into a more solid mass at the second. The positive pole of the battery *alone* was applied to them, the negative resting on the right breast on a level with the tumour. The number of cells used (Stone's battery) was gradually raised from two up to sixteen at the first, and to twenty-eight at the second. The operations lasted 14½ and 14 minutes. A little faintness and pulselessness were noticed at the termination of each. They soon passed away. The result of the two operations has been a great solidity of the tumour, with considerable swelling of the parts adjacent, which swelling is now (November 26) subsiding. No superficial redness or sloughing of the skin occurred. No air appeared in the tumour, as noticed often in Europe where needles attached to both poles are usually introduced (viz. *Ciniselli Annali di Medicina*, November, 1870, Frazer's *Edin. Med. and Surg. Journal*, August 1867). The patient has suffered not at all from the operations. It is impossible as yet to say what influence they will have towards his radical cure, but he is now more comfortable than before the first operation.

December 10.—Professor E. C. Pickering exhibited a new form of theodolite magnetometer, which may be constructed at small expense from a common surveyor's transit. A mirror and magnet like that of a Thomson's galvanometer is attached to the cap of the telescope, and a right-angled prism and cross-hairs are placed in front of its eye-piece. The telescope is turned until the image of these cross-hairs is brought to coincide with those already in the eye-piece, when the axis of collimation will be exactly at right angles to the magnetic meridian. The remainder of the evening was devoted to a discussion of the great fire of November 9, by which sixty acres of the most valuable part of the city of Boston were destroyed. Numerous specimens of the effects of the fire were exhibited, among others a fused mass originally leather, but converted by the heat into a substance resembling resin. A strong wind with a velocity of twenty to twenty-five miles per hour was induced by the ascent of the heated air, although the velocity before the fire was but seven miles. This wind converted a narrow street into a sort of gigantic blow-pipe, and the flames were thus carried across Franklin Street, where it is over 100 ft. in width. The progress of the flames against the wind was noted, and explained by the radiant heat, which was so great that some of the engines were unable to get near enough to play on the fire. Buildings to windward might thus be set on fire, while those to leeward would be comparatively protected by the smoke. The carrying power of the air was remarkably great. Flakes of granite were carried across the water to South Boston, and fell in quantities on the side-walks and roofs, and papers were borne in some cases to a distance of over twenty miles. The light was so strong that it was easy to read by it in the higher parts of Belmont, over fifty miles distant; and the fire was seen at sea to a distance of ninety miles.

RIGA.

Society of Naturalists, March 6 (18 N.S.)—M. Frederking communicated a third section of his history of chemistry, in which he referred to the development of the electro-chemical hypothesis, and the discovery of isomorphism, and to that of the vegetable alkaloids.

April 3 (15 N.S.)—M. L. Taube presented a report on a work by M. Fischer, on the disease of bees, called "foul brood," which is ascribed by the author to the dying and subsequent putrescence of a portion of the larvæ. M. Fischer believes that the fluid given by the worker-bees to the larvæ is secreted by the salivary glands, and that the mortality amongst the larvæ is caused by a deficiency of this secretion brought on by a scarcity of food. He considers that this is proved by the fact that "foul-broodedness" in a hive is caused by the removal of its own workers and the substitution of healthy workers from another hive.

April 10 (22 N.S.)—M. Schroeder referred to the comet which was expected by some people to come in contact with the earth in August.—Colonel von Götschel read a paper on diseases of cage-birds, in which he especially recommended prophylactic measures.

April 24 (May 6 N.S.)—M. C. Berg criticised Sir William Thomson's opinion as to the origin of the first organisms from germs conveyed by meteorites.—M. Teich communicated a contribution to the Natural History of *Cucullia præcana*.

May 1 (13 N.S.)—A discussion took place on the means to be adopted for the protection of small birds, in which MM. Gögginger, Nauck, Westermann, and Burchardt, took part.

May 15 (27 N.S.)—M. Schroeder presented a table of the rainfall at various stations during the summer of 1871, and called attention to the very small amount recorded at Riga.

May 22 (June 3 N.S.)—Dr. Nauck communicated some observations on the torpidity of *Myoxus nitela*.—M. Westermann exhibited a pane of glass in which a circular hole of two inches diameter had been made by a hailstone on May 10. (22 N.S.) Dr. Nauck exhibited plaster-casts of hailstones from the same fall, and proposed a theory of the formation of hail by the production of a whirlwind caused by warm, moist winds meeting cold winds under angles of 90°, when the aqueous vapour is condensed, causing an inflow of air from above and below, and consequently an increase of precipitation, during which the water, striving to retain its fluid form, may easily fall several degrees below its freezing point, and its congelation into masses of ice may be accounted for by the fall into it of small grains.—M. J. H. Kawall gave an account of the publications of the Society of Naturalists of Charkow, including the titles of all the papers.

July 20 (August 1 N.S.)—The society assembled in the court of the Polytechnicum to hear an address in honour of Dr. G. Schweinfurth on his return from his African travels.

August 21 (September 2 N.S.)—Dr. Schweinfurth described several types of the inhabitants of Central Africa, belonging to the Ujam-Ujam, Bongo, Djur, Dinka, Mittu, and Akka branches of the Negro, noticing especially their modes of adorning themselves, and a few peculiar habits.—Baron F. Hoejningen-Huene communicated a continuation of his Phenological observations, containing notes on weather and other natural phenomena during the months of July and August, 1871.

PHILADELPHIA

Academy of Natural Sciences, July 2.—"On a new Genus of Extinct Turtles." Prof. Leidy stated that he had determined that the fossil-turtle he had named *Bæna undata* belonged to a different genus. Besides other well-marked distinctive characters, like the genus *Platemys*, it possessed an additional pair of plates to the usual number found in the sternum of the emydoids. These plates are intercalated between the hyo- and hypo-sternals. In *Platemys Bullockis* they are quadrate. In the new genus they are triangular, and the sutures defining them cross the plastron like a prostrated letter X, from which character it was proposed to name the genus Christernon.

July 9.—Prof. Leidy directed attention to a bottle containing numerous specimens of a minute crustacean from Salt Lake, Utah, caught on the 22nd of June by Mr. C. Carrington, a member of Prof. Hayden's exploring party now in the field. They were received from Prof. Hayden with the remark "that Salt Lake has been supposed, like the Dead Sea, to be devoid of life, but its saltest water contains the most of these little creatures." The crustacean is the *Artemia salina*, which has long been known in Europe, and has been previously found in other localities of this country. The animal has always been viewed with especial interest, in its order, from the fact that it lives and thrives best in a concentrated solution of salt, which would destroy most marine animals. It has not, I believe, been noticed in the ocean, but is found in salt lakes, and salt vats, in which, by evaporation, the brine has become more concentrated than sea water. Artemia is furnished with eleven pairs of limbs, which serve both for progression and respiration. The limbs are four-jointed, and the joints have leaf-like expansions fringed with long feather-like bristles. The narrow abdomen, or tail-like prolongation of the body is six-jointed, and traversed by the intestine. The last joint ends in a pair of processes, furnished each with a bunch of bristles like those of the limbs. The head exhibits a median, quadrate, black eye-spot, and in addition is provided with a pair of pedunculate, globular compound eyes. A short narrow pair of inarticulate antennæ project in advance of the eyes. The head of the male is furnished with a pair of singular organs for seizing the female. These claspers are large double-jointed hooks. In the female they are replaced by a pair of comparatively small horn-like processes. The first abdominal segment bears the ovarian sac in the female, and two cylindroid appendages in the male. The female of the Salt Lake Artemia ranges from four to seven lines in length; the male from three to four lines in length. The colour is translucent-white and ochreous-yellow, with three black eye-spots, and a longitudinal line varying in hue with the contents of the intestine. The ovarian sac appears orange-coloured from the eggs within. The antennæ end in three or four minute setæ, and are considerably longer in the male than the female. The first joint of the claspers is provided on its inner side just below the middle with a spheroidal knob. The last joint forms a rectangular hook, the angle having an elbow-like prominence. When the clasper is thrown forward, the outer border of the hook is convex; the anterior border straight, slightly or deeply concave, and the inner or posterior border is sigmoid. The antennæ are longer than in the female, and longer than the first joint of the claspers; and in the female are longer than their homologues. The ovarian sac is inverted flask-shaped, and has a pair of lateral conical or mamillary, finely tuberculated processes. The caudal setæ are longer than in the male, and are eight to each process. This description is taken from alcoholic specimens. They exhibit considerable variation in size, and to some extent in detail. Prof. Verrill has described what he views as two species of Artemia distinct from the well-known *A. salina*. One he names *A. gracilis*, from near Newhaven, Conn.; the other *A. Monico*, from Lake Mono, Cal. That from Salt Lake differs from either of them as much as they do from *A. salina*, and with the same propriety may be regarded as a distinct species.

I am disposed to view them all as varieties merely of *A. salina*. Prof. Leidy stated that from time to time he had observed specimens of teeth from various cretaceous formations which were identical in character with those of *Lamna elegans* and *L. cuspidata* of tertiary deposits, except that they were devoid of the lateral denticles. He had now in his possession well-preserved specimens of such teeth, unabraded, but exhibiting no trace of the existence of lateral denticles. There were teeth of the *L. elegans* variety found with the skeleton of *Hadrosaurus Foulkii* in New Jersey, and others from the cretaceous of Mississippi and Kansas. There were also teeth of the *L. cuspidata* variety from the cretaceous of Kansas, and one in a block of chalk from Sussex, England. The absence of the lateral denticles in all the cretaceous specimens he thought could hardly be accidental, and suspected that these teeth represented the *oxyrrhina* ancestors, of the tertiary *Lamna elegans* and *L. cuspidata*, which lived during the cretaceous era.

PARIS

Academy of Sciences, Dec. 30, 1872.—M. Faye, president, in the chair. The president read the second portion of his paper on the solar spots. He argued in favour of their cyclonic nature, and said that the pores were simply minute spots. He pointed out that Wilson, in 1783, had suggested that the spots were "eddies and whirlpools," and that Sir J. Herschel had made use of a similar phrase, but that the knowledge only recently obtained was required before these suggestions could be accepted.—M. Jamin read a note on concealed magnetism (*magnétisme dissimulé*). The author found that when a current used to magnetise a horse-shoe bar of iron attained a certain power, the bar appeared to return to its natural state; but that, with either stronger or weaker currents, magnetism was produced. This neutral state he calls "concealed magnetism," and supposes it to be due to a particular distribution of the magnetic force.—A note from Mr. A. Cayley on the condition under which a family of surfaces forms part of an orthogonal system, was next read.—M. Janssen read the second part of his report on the eclipse of December 31. It was referred to the astronomical section.—M. F. P. Le Roux read a paper on peri-polar induction. The author applies the above name to a new form of electro-magnetic phenomena, in which the different points of the body acted on remain at the same distance from the active pole.—A paper on the dimensions of the pores of membranes by M. Guerout was presented by M. Becquerel.—M. Delafont sent a memoir on the first elements of the theory of conjugate points and right poles, which was submitted to the examination of M. Serret.—MM. Le Clère and Du Plantys sent a note on *Phylloxera* which were sent to that commission; and a second memoir on fermentation from M. Sacc was referred to a special commission.—General Doutrelaine sent a note relating to the questions of priority concerning the prolongation of the French meridian; M. Baillaud the elements and ephemerides of 127; and Mr. N. Lockyer an abstract of his late paper on spectrum analysis, communicated to the Royal Society.—MM. Troost and Hautefeuille sent a note on certain reactions of the chlorides of boron and silicon. These bodies decompose porcelain at a high temperature.—M. P. Pichard read a note on the estimation of manganese in iron ores, cast-iron, and steel, by a calorimetric process; and M. A. Houzeau, one on the volumetric estimation of minute quantities of antimony and arsenic.—M. Sorin read a note on the presence of methylamine in methylic nitrate and in methylic alcohol.—M. L. Colin's note on the passage of the blood pigment through the vascular sides in *melanemia palustris* was presented by M. Larrey, which was followed by a note on the distribution of the tympanic cord, by M. J. L. Prevost.—M. A. Béchamp read a note on the alcoholic and acetic fermentation of the liver, and on the physiological alcohol of human urine. The author has obtained from two litres of urine from a man of 50, enough alcohol to estimate.—M. A. Bernard presents a memoir on the "degeneration" of nerves after section, by M. L. Ranvier.—M. L. Posaoz sent a note on the estimation of sugar by cupric solutions. He stated that these liquids may be preserved from their usual faults by the passage of a stream of carbonic anhydride, or by the addition of alkaline bicarbonates.—M. J. Chautard sent a note on the absorption spectrum of delorophyll; and M. Sacc a note entitled, "Studies on Marmots," relating principally to the composition of the urine of these animals.—M. Decharme sent a paper on the ascending motion of liquids in very narrow vessels (bands of porous paper) compared with their ascent in capillary tubes.—M. Boileau sent a note on the preservation of potable water. The author kept eighty bottles of water fresh and free from bad odour during the siege of Paris, by leaving them simply covered with caps of paper.—M. Belgrand made some observations on this note.—M. Dausse sent a note on the best position for flood gauges in rivers.

DIARY

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 8.30.—Note on an Erroneous Extension of Jacobi's Theorem: J. Todhunter.—On a New Formula for a Microscopic Object-Glass: F. H. Wenham.—Additional Note to the Paper On a Supposed Alteration in the Amount of Astronomical Aberration of Light produced by the Passage of the Light through a considerable Thickness of Refracting Medium: Sir G. B. Airy.
ROYAL INSTITUTION, at 3.—On Oxidation: Dr. Debus.
ZOOLOGICAL SOCIETY, at 4.
SOCIETY OF ANTIQUARIES, at 8.30.—Election of Fellows.—Opening of Exhibition of Bronze Implements and Weapons.
LINNEAN SOCIETY, at 8.—On the Recent Synonyms of Brazilian Ferns: J. G. Baker.
CHEMICAL SOCIETY, at 8.—On Ethylamyl: Mr. Grimshaw.—On the Heptanes from Petroleum: C. Schorlemmer.—On the Vanadates of Thallium: T. Carnelley.—On the Formation of Sulphide of Sodium by the Action of Sulphuretted Hydrogen upon Sodium Chloride: C. T. Kinggeth.
NUMISMATIC SOCIETY, at 7.
ROYAL SOCIETY CLUB, at 6.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 8.—On the Old and New Laboratories at the Royal Institution: Dr. W. Spottiswoode.
GRESHAM LECTURES, at 7.—On Contagion and Infection: Dr. E. S. Thompson.
MEDICAL AND MICROSCOPICAL SOCIETY, at 8.—President's Introductory Address: Jabez Hogg.

SATURDAY, JANUARY 18.

ROYAL INSTITUTION, at 3.—On Comparative Politics: Dr. E. A. Freeman.
GRESHAM LECTURES, at 7.—On Antiseptics and Disinfectants: Dr. E. S. Thompson.

MONDAY, JANUARY 20.

LONDON INSTITUTION, at 4.—On Air, Earth, Fire, and Water: Prof. Armstrong.
SOCIETY OF BRITISH ARCHITECTS, at 8.
MEDICAL SOCIETY, at 8.
ASIATIC SOCIETY, at 8.
VICTORIA INSTITUTE, at 8.

TUESDAY, JANUARY 21.

SOCIETY OF CIVIL ENGINEERS, at 8.
STATISTICAL SOCIETY, at 7.45.
ANTHROPOLOGICAL SOCIETY, at 8.—Annual General Meeting.
ZOOLOGICAL SOCIETY, at 8.30.

WEDNESDAY, JANUARY 22.

SOCIETY OF ARTS, at 8
GEOLOGICAL SOCIETY at 8.—On the Glaciation of Ireland: J. F. Campbell.—Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders: D. Mackintosh.—On the Origin of Clay-ironstone: J. Lucas.
ROYAL SOCIETY OF LITERATURE, at 8.30.
ARCHÆOLOGICAL ASSOCIATION, at 8.
LONDON INSTITUTION, at 7.—Conversazione. The Song of Roland: Victor Pleiginer.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 8.30.
ROYAL SOCIETY CLUB, at 6.
ROYAL INSTITUTION at 8.—On Oxidation: Dr. Debus.
SOCIETY OF ANTIQUARIES, at 8.30.—Implements of the Bronze Period: John Evans.

CONTENTS